

Linguistic Features to Consider When Applying Persona of the Real Person to the Text-based Agent

Youjin Hwang
youjin.h@snu.ac.kr
Seoul National University
Seoul, Korea

Donghoon Shin
ssshyhy@snu.ac.kr
Seoul National University
Seoul, Korea

Seokwoo Song
seokwoo.song@samsung.com
Samsung Research
Seoul, Korea

Joonhwan Lee
joonhwan@snu.ac.kr
Seoul National University
Seoul, Korea

ABSTRACT

As artificial intelligence (AI) technologies advance, the possibility of developing virtual agents capable of mimicking human beings is increasing. Furthermore, AI techniques applicable to mimicking certain features of a specific person (e.g., facial expression, voice, motion) are becoming more sophisticated. Although the HCI community has explored how to design or develop AI agents mimicking a real person, limited studies on mimicking someone's text-based behavior shown in the instant messaging exist. This study investigates the features that make users perceive text-based agents as people they know in reality. On top of the previous efforts of designing human-like virtual agents, our work suggests design guidelines for applying the persona of the real person (PRP) to text-based agents.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; User studies.

KEYWORDS

chatbot, chat analysis, personality, authorship attribution

ACM Reference Format:

Youjin Hwang, Seokwoo Song, Donghoon Shin, and Joonhwan Lee. 2020. Linguistic Features to Consider When Applying Persona of the Real Person to the Text-based Agent. In *22nd International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI '20 Extended Abstracts)*, October 5–8, 2020, Oldenburg, Germany. ACM, New York, NY, USA, 4 pages. <https://doi.org/10.1145/3406324.3410723>

1 INTRODUCTION

Applying the agreeable persona to the conversational agents makes them convincing social actors compared to arbitrary personalities [14]. To create agreeable personas, many researchers have investigated users' responses to human-like robots [8]. These have

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

MobileHCI '20 Extended Abstracts, October 5–8, 2020, Oldenburg, Germany

© 2020 Copyright held by the owner/author(s).

ACM ISBN 978-1-4503-8052-2/20/10.

<https://doi.org/10.1145/3406324.3410723>

demonstrated that human-like features of agents may considerably influence users' perceptions of their intelligence, sociability, likability, credibility, and submissiveness among other traits [11]. This is because agents that resemble humans provide people with familiarity that may ease social acceptance, since human-like features were found to improve perceptions and increase rapport [5]. For these, applying human-like personas to agents is a key consideration when creating a persona for a specific agent. Among many strategies, mimicking a specific person's persona has recently been attempted and becoming more feasible, as mimicking techniques based on artificial intelligence (AI) rapidly advance.

However, few human-computer interaction (HCI) works have studied what features affect persona perception of a text-based agent with the persona mimicking person in the real world. To be more specific, there is a lack of studies investigating what makes users feel as if they are interacting with someone they know while they are interacting with a text-based virtual agent. Therefore, defining these features is necessary to understand and predict the behavior of users toward agents with PRP.

In this paper, we investigate the linguistic features that affect perceptions of the text-based agents with PRP. We conduct a modified Wizard-of-Oz experiment to define the major features determining the personas of text-based agents with PRP. In addition, we conducted a survey to evaluate these features and defined which features should be considered in priority when designing PRP. The contributions of our study are as follows: (1) we defined linguistic features that affect persona perception of PRP (2) we suggest design guidelines for applying PRP to text-based agents.

2 RELATED WORK

2.1 Opportunities for Applying Persona of a Real Person (PRP)

As AI technologies advance, opportunities for applying PRP to virtual agents are increasing. For example, a Google patent raised the new possibility of creating robot personalities based on the voices and behaviors of dead celebrities or loved ones. This idea is becoming a reality as industry members attempt to design and develop systems with PRP. One of these is Phoenix [2], which mimics a dead person's appearance and voice features to develop a replica robot of a loved one. Another example, Didimo [3], provides users a life-like digital version of themselves in their virtual communications.

This offers them the opportunity to incorporate human attributes that are at the core of human communication: visual appearance and animation, behavior, emotion, and voice. In particular, deep learning technologies (e.g., Deepfake) have bolstered mimicking voice/video technologies by making them more applicable.

In the HCI community, persona studies aimed at defining what makes an agent human-like have long been a research interest. These studies have focused on general human-like features not those of a specific person in the real world. However, as applying PRP is becoming more feasible with emerging technologies, there is an increased need to define the features affecting perceptions of personas of agents with PRP. Particularly, the need for defining linguistic features to create the sophisticated design of a text-based agent is needed.

2.2 Linguistic Features Affecting Persona Perception

The textual interface (including text-to-speech) is limited in its ability to display physical gestures and read users' physical expressions. It is therefore necessary to understand how text-based agents can be perceived as convincing social actors through written interactions. A written text conveys a great deal of information about the writer, including his/her personality and identity traits that can be inferred from the text [10, 12, 13]. A previous study identifying the features correlated with a writer's personality defined lexical, syntactic, and turn-taking features, including frequent words, character, punctuation, emoticons, response time, imitation rate, and so on [10].

Some of the features identified in the study overlap with our findings. This approach, however, lacks user-centered insight about "text-based features that reinforce perceptions of the personas of agents with PRP." Therefore, we redefined the linguistic features based on the (1) scope of PRP from (2) user-centered perspectives. We referred to Bloom et al.'s language model [4] consisting of three intersecting components: content, form, and use. Content refers to semantics, form includes morphology and syntax, and use includes message context and pragmatics. Through this study, we provide detailed guidelines for applying PRP to text-based agents.

3 METHODOLOGY

To explore a user's linguistic factors and evaluate its effectiveness, we conducted (1) empirical study defining the features affecting persona perception and (2) survey evaluating these features.

3.1 Empirical Study

The study was conducted with the modified user-driven Wizard-of-Oz method [9] to explore the linguistic factors that affect perceptions of the personas of agents with PRP. On top of conventional Wizard-of-Oz that makes the user believe that it is actually working, we added a user-centered approach by assigning the role of the wizard performing the action mainly to the participants.

In this study, we recruited 4 teams, each consisting of two participants who communicated with each other via a chatting application more than three times a day. In total, four teams consisting of eight participants participated (Table 1). During the session, they were told that they were chatting with the system with the persona of

Table 1: Information of the participants in the empirical study

Team	ID	Age	Relation	Daily chat
1	P1	53	Mom	> 5
	P2	26	Daughter	> 5
2	P3	33	Sister	> 3
	P4	29	Sister	> 3
3	P5	31	Friend	> 3
	P6	31	Friend	> 3
4	P7	36	Husband	> 10
	P8	31	Wife	> 10

another participant. Each participant used the chat interface [1] in a separate room. During the interaction, they were asked to use think-aloud technique to answer the main question: What linguistic elements make you feel as if you are having a conversation with the other participant on the team? All the session was voice-recorded and transcribed by authors.

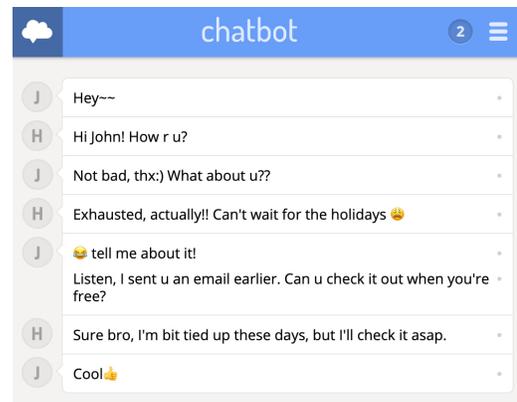


Figure 1: Screenshot of tlk.io that we used as chat-interface in the empirical study

Along with the think-aloud data that we collected from the session, we used inductive thematic analysis to identify themes from participant responses. Two researchers independently analyzed the results. This analysis showed a strong inter-coder agreement between the two researchers (Cohen's Kappa coefficient (κ) = 0.79.) In the end, we categorized the themes into the three intersecting components of language (content, form, and use), referring to Bloom et al.'s study [4]. This process was conducted by two professionals in linguistics (Cohen's Kappa coefficient (κ) = 0.90). The list of the factors found from the empirical study is included in Table 2.

3.2 Survey

Based on the factors found from the empirical study, we conducted a survey to evaluate what the participants thought about the factors that characterize a specific person in the text-based chatting and the example texts expressing the features in their chatting application.

Table 2: Examples of linguistic features we examined in our study. Texts were translated in English

Feature	Example
Wake-up word	Hey, What's up
Sentence completion	"I've done my homework" vs "Done"
Punctuation	!, ?, ~
Word transformation	Mumpy
Back-channeling	Okay, Uh-huh
Split sentence	"Let's meet there" vs "Let's" + "meet" + "there"
Emoji	:-), XD
Slang	Y'all, Cheesy
Interjection	Wow , Aha!
Hedging	Certainly, Possibly
Abbreviation	lol, BTW
Sentence structure	"Let's go to coffee shop" vs "Coffee shop go!"

Through this survey, we aimed to guide the persona designers in terms of features that should be prioritized. To do so, we asked the participants to score each feature using a 7-point Likert scale. The survey was implemented to 82 people (Age of 10s: 27, 20s: 16, 30s: 38 and 50s: 1.)

4 RESULTS

We compared the scores of individual features and three major language components.

4.1 Linguistic Features

We ranked 16 linguistic features scored via the survey (Table 3). The highest-ranked feature was wake-up words in the text-based conversation. These included words participants called each other among other words. Wake-up words were followed by emojis, which are considered to be a determinant of PRP in text-based agents. Nowadays, chatting applications provide various kinds of emojis, offering people a means of expressing themselves. Response time was also highly ranked.

4.2 Language Component

In the empirical study, two professionals in linguistics categorized the linguistic features into major language components (form, content, and use). We also statistically analyzed the difference between these components affecting persona perception of PRP in the text-based agent. We compared the means of scores using one-way ANOVA (Table 4). There was a significant difference between these

Table 3: Mean (M) and standard deviation (SD) of linguistic features affecting persona perception of PRP

Rank	Feature	Language	M	SD
1	Wake-up word	Content	5.56	1.30
2	Emoji	Content	5.40	1.23
3	Response time	Use	5.34	1.35
4	Sentence completion	Form	5.19	1.40
5	Slang	Content	5.08	1.75
6	Punctuation	Content	4.92	1.51
7	Interjection	Content	4.91	1.64
8	Word transformation	Content	4.88	1.46
9	Delivery	Use	4.84	1.46
10	Hedging	Content	4.72	1.52
11	Back-channeling	Content	4.64	1.46
12	Abbreviation	Content	4.63	1.55
13	Emotion	Use	4.49	1.63
14	Euphemism	Use	4.40	1.46
15	Split sentence	Form	4.29	1.63
16	Sentence structure	Form	4.11	1.17

Table 4: Mean and standard deviation (SD) of language components

	Form	Content	Use
Mean	4.53	4.91	4.79
SD	0.568	1.51	0.463

Table 5: Post-hoc comparison of mean values of language components with Tukey HSD

	Difference	Adj. P value
Form-Content	-0.4417	0.0003
Use-Content	-0.2028	0.1177
Use-Form	0.2388	0.1579

components ($F(2,1320) = 8.036, p < .0001$). Content showed the highest mean value followed by use and form. Post-hoc comparison using the Tukey HSD indicated that the difference between Form and content were significant ($M = -0.4417, p < .0005$) but others were not (Table 5).

5 DISCUSSION

Our study differs from previous persona studies in that we found linguistic features that make users perceive the persona of an agent as a PRP. Some of such features are expected to be effective in recognizing the persona of a specific person among a group of diverse individuals.

We included features that were shown to be important in previous persona studies in the HCI community. When it comes to text-based conversational agents, there have been many studies on linguistic markers to design human-like agents that can engage in natural conversation. However, we discovered the possibility of mimicking the text-based chat styles of a specific person by studying how some linguistic markers actually show the persona of a specific person in the real world.

Among the highest-ranked feature found, wake-up words used at the start of conversations could affect perceptions of the personas of text-based agents with PRP. It could be that they contribute to the first impression between the agent and the user. This feature could be extracted easily from one's conversation data, but it should be designed carefully since it could hinder natural conversation when repeated too much [7]. Other 15 features should also be considered when applying PRP to text-based agents. Another thing we gained from the empirical study is that the importance of each feature differs depending on the kind of PRP (i.e., a specific person's characteristic.) Persona designers should consider the differentiated weight of each feature depending on the PRP type.

PRP has great potential in that it can apply the personas of people who have social relationships with users in the real world. This is because a social connection is the main goal of conversation in interpersonal interaction [7]. Our study could guide persona designers in terms of how to apply PRP to text-based agents by investigating linguistic features.

Based on this preliminary study, we propose the following future research topics: (1) To what extent should we implement the features we have specified (2) How could the features, if they are implemented with PRP, affect user engagement, acceptance, etc. People may have adverse affective responses to highly human-like robots. For example, *Uncanny Valley* hypothesis suggests that a robot's imperfect human-likeness can evoke eerie feelings in human perceivers [6]. Moreover, it is necessary to study how users accept agents that resemble people they know, particularly text-based agents that only use linguistic features to model personas.

6 LIMITATION

Our study is limited in that participant data used for the analysis were collected in Korean. However, since our work is based on the general language model [4], we forecast that our work could contribute to call for the follow-up studies on applying to the text-based agent on other languages.

ACKNOWLEDGMENTS

This research was supported by the National Research Foundation of Korea (NRF) Grant funded by the Korean National Police Agency and the Ministry of Science and ICT for Police field customized research and development project. (NRF-2018M3E2A1081492).

REFERENCES

- [1] 2011. *Tlk.io*. <https://tlk.io>
- [2] 2014. *Phoenix*. <https://fenixbegravning.se>
- [3] 2016. *Didimo*. <https://mydidimo.com>
- [4] Lois Bloom and Margaret Lahey. 1978. Language development and language disorders. (1978).
- [5] Elizabeth Broadbent, Vinayak Kumar, Xingyan Li, John Sollers 3rd, Rebecca Q Stafford, Bruce A MacDonald, and Daniel M Wegner. 2013. Robots with Display Screens: A Robot with a More Humanlike Face Display Is Perceived To Have More Mind and a Better Personality. *PLOS ONE* 8, 8 (August 2013), 1–9. <https://doi.org/10.1371/journal.pone.0072>
- [6] Tyler J. Burleigh, Jordan R. Schoenherr, and Guy L. Lacroix. 2013. Does the uncanny valley exist? An empirical test of the relationship between eeriness and the human likeness of digitally created faces. *Computers in Human Behavior* 29, 3 (2013), 759 – 771. <https://doi.org/10.1016/j.chb.2012.11.021>
- [7] Leigh Clark, Nadia Pantidi, Orla Cooney, Philip Doyle, Diego Garaialde, Justin Edwards, Brendan Spillane, Emer Gilmartin, Christine Murad, Cosmin Munteanu, Vincent Wade, and Benjamin R. Cowan. 2019. What Makes a Good Conversation? Challenges in Designing Truly Conversational Agents. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland UK) (CHI '19). Association for Computing Machinery, New York, NY, USA, 1–12. <https://doi.org/10.1145/3290605.3300705>
- [8] Julia Fink. 2012. Anthropomorphism and Human Likeness in the Design of Robots and Human-Robot Interaction. In *Social Robotics*, Shuzhi Sam Ge, Oussama Khatib, John-John Cabibihan, Reid Simmons, and Mary-Anne Williams (Eds.). Springer Berlin Heidelberg, Berlin, Heidelberg, 199–208.
- [9] Sang-Su Lee, Jeonghun Chae, Hyunjeong Kim, Youn-kyung Lim, and Kun-pyo Lee. 2013. Towards More Natural Digital Content Manipulation via User Free-hand Gestural Interaction in a Living Room. In *Proceedings of the 2013 ACM International Joint Conference on Pervasive and Ubiquitous Computing* (Zurich, Switzerland) (UbiComp '13). Association for Computing Machinery, New York, NY, USA, 617–626. <https://doi.org/10.1145/2493432.2493480>
- [10] François Mairesse, Marilyn A. Walker, Matthias R. Mehl, and Roger K. Moore. 2007. Using Linguistic Cues for the Automatic Recognition of Personality in Conversation and Text. *J. Artif. Int. Res.* 30, 1 (Nov. 2007), 457–500.
- [11] Elizabeth Phillips, Xuan Zhao, Daniel Ullman, and Bertram F. Malle. 2018. What is Human-like? Decomposing Robots' Human-like Appearance Using the Anthropomorphic RoBOT (ABOT) Database. In *Proceedings of the 2018 ACM/IEEE International Conference on Human-Robot Interaction* (Chicago, IL, USA) (HRI '18). Association for Computing Machinery, New York, NY, USA, 105–113. <https://doi.org/10.1145/3171221.3171268>
- [12] Giorgio Roffo, Cinzia Giorgetta, Roberta Ferrario, and Marco Cristani. 2014. Just the way you chat: Linking personality, style and recognizability in chats. In *International Workshop on Human Behavior Understanding*. Springer, 30–41.
- [13] Giorgio Roffo, Cinzia Giorgetta, Roberta Ferrario, Walter Riviera, and Marco Cristani. 2014. Statistical analysis of personality and identity in chats using a keylogging platform. In *Proceedings of the 16th International Conference on Multimodal Interaction*. 224–231.
- [14] Tuva Lunde Smestad and Frode Volden. 2018. Chatbot Personalities Matters. In *International Conference on Internet Science*. Springer, 170–181.