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

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

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

Additional Key Words and Phrases: chatbot, chat analysis, personality, authorship attribution

1 INTRODUCTION

Applying the agreeable persona to the conversational agents makes them convincing social actors compared to the arbitrary personalities [12]. To create agreeable personas, considerable research has investigated users' responses to human-like robots [8]. These studies have demonstrated that the 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 a sense of familiarity that may ease social acceptance, since human-like features have been found to improve perceptions and increase rapport [5]. For these reasons, applying human-like personas to agents is a key consideration when creating a persona for a specific agent. Among the many strategies, mimicking a specific person's persona has recently being attempted. This idea is 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 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

Table 1. Information of the participants in the empirical study

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

with someone they know while they are interacting with a 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 affects persona perception of PRP (2) we suggest design guidelines for applying PRP to text-based agents.

2 RELATED WORK

2.1 Opportunities for applying 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 upon 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 lifelike 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, need for defining linguistic features to create sophisticated design of 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. 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]. 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
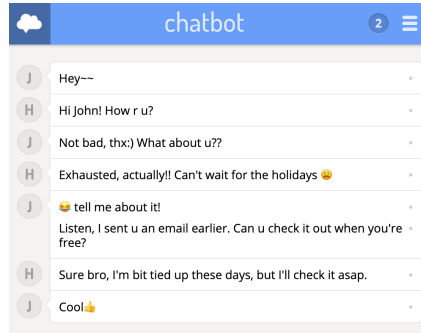
Fig. 1. Screenshot of tlk.io that we used as chat-interface in the empirical study.

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 two studies including the empirical study (Study 1) to define the features affecting persona perception of PRP and the survey (Study 2) to evaluate 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. We added user-centered approach to the conventional Wizard-of-Oz study. Conventional Wizard-of-Oz is used to quickly prototype the interactive system in the early design stages by making the user believe that it is actually working. However, in the modified user-driven Wizard-of-Oz method, the role of the wizard performing the action is mainly played by the researcher.

In this study, we recruited 4 teams, each team 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 session, they were told that they were chatting with the system with the persona of another participant. Each participant used the chat interface [1] in a separate room. During the interaction, they were asked to use the think-aloud technique to answer the main question: What linguistic elements make you feel as if you are having a conversation with him/her (the other participant on the team.) All the session was voice-recorded and transcribed by authors.

With the think aloud data which 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 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. 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 & 50s: 1).

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

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

4 RESULTS

The scores of individual features and the scores of the three major language components (content, form, and use) were compared.

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

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

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

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 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 specific person by studying how some linguistic markers actually show the persona of a specific person in the real world.

Regarding 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. If the same wake-up word

is repeated too much, it could hinder natural conversation [7]. The other 15 features should also be included in a checklist 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., 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 social connection is the main goal of conversation in human–human 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 we collected participant data in Korean and translated into English for the analysis. 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 PRP to the text-based agent.

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