

## THE EFFECT OF EMPATHY ON HUMAN-AGENT INTERACTION

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Received December 2019; accepted March 2020

**ABSTRACT.** *Technology development and information communication have led to an increase of human-agent communication and provided an opportunity to overcome the existing limitation human-human communication. Psychological counseling studies suggest conventional face-to-face counseling method can replace the role of a counselor by applying agent technology. The present study has been established to identify the effects of empathy in human-agent interaction. In order to do so, we designed and conducted a pilot study of a prototype of counseling conversation based on psychological counseling theory. We have found that empathic agents resulted in lower score on counselor's assessment and lower level of empathy perceived by the subjects. The simple empathy used in this study may have given the participants a sense of imitating a clumsy human being and have caused a higher level of displeasure and discomfort compared to the agents without empathy response. This study is meaningful in that it provides basic data for developing and improving an artificial intelligence-based psychological counseling system by designing artificial intelligence counseling agents and varying levels of empathy.*

**Keywords:** Artificial intelligence, Empathy, Chatbot, Human-agent interaction, Human-agent communication

**1. Introduction.** Along with the technology development of smart home and artificial intelligence, conversational agents are applied in various ways and quantities. Chatbot, a conversational agent which uses text to communicate, has been used first and are now applied in various fields such as e-commerce, mental health care, and aviation [1]. Likewise, technology development of chatbot and information communication have led to an increase of human-agent communication and provided an opportunity to overcome the existing limitation human-human communication. In psychological counseling research, it has been found that the traditional method of face-to-face counseling can replace the role of counselor by applying agent technology [2].

Artificial intelligence counselor can provide customized counseling service to individual users [3] and the performance can be maintained since it experiences neither fatigue nor emotional exhaustion [4,5]. Thus, artificial intelligence counselor cannot be developed by just replacing human counselors with artificial intelligence systems since human counselors empathize with the client's emotions. As one of the major determinants of counseling outcome, counselor empathizes with the client by providing appropriate emotional response according to client's emotional state. Client empathy is a key element in building relationship with client [6]. Empathy is about feeling similar emotions to client with defined purposes and methods; distinguished from feeling compassion [7]. During counseling, the counselor encourages clients to speak openly through empathic listening, which includes reaction strategies such as comprehension, emotional concentration and co-communication in empathetic manner.

Numerous studies in recent years have been carried out with great interest in empathy. Zeng et al. collected users' movements and voice data for empathy in agent interaction to perform research on automatic emotion recognition [8]. In Riek et al.'s study, a chimpanzee head-shaped robot was used to imitate mouth and head movements of humans [9]. Users experienced higher satisfaction through the interaction of the robot. In the field of robot interaction, research on empathy has been carried out in a way to infer or emulate the emotional states of the users. Cramer et al. used iCat robots to define the effects of empathy on user trust [10]. In order to enhance user satisfaction of using conversational agent, it is necessary to design chatbot and its system according to the context of conversation [11].

However, in previous studies, not enough research has been conducted on the context of user-agent direct communication and in designing empathic dialogue with agents. Unlike previous studies where agents and robots are designed to only interact in particular situations, in this study, we performed interaction through user-agent direct communication to define the effects of empathy in human-agent interaction. Thus, we designed a psychological counseling dialogue prototype based on the psychological counseling theory and conducted a pilot study.

## 2. Counseling Agent Prototype Design.

**2.1. Counseling process.** Egan defined counseling as a process of answering four key questions on a problem, while Hackney and Cormier defined it as a gradual process of moving toward the end of problem solving [12,13]. Ivey et al. argued that counseling is divided into five dimensions and is a process of problem solving where clients gain insight into behavior, emotion and thought [14]. Furthermore, Kottler classified counseling into five stages and defined it as a process of moving forward, stage by stage [15].

Each counseling stage consists of skills and perspectives which counselors should be aware of. A satisfactory result can be obtained as if the aspects of each stage are properly implemented. Among the theories of counseling process, the five-stage model proposed by Kottler is relatively clear in definition and its classification between the stages. Hence, we considered Kottler's five-stage model in designing counseling processes of our prototype (Figure 1).

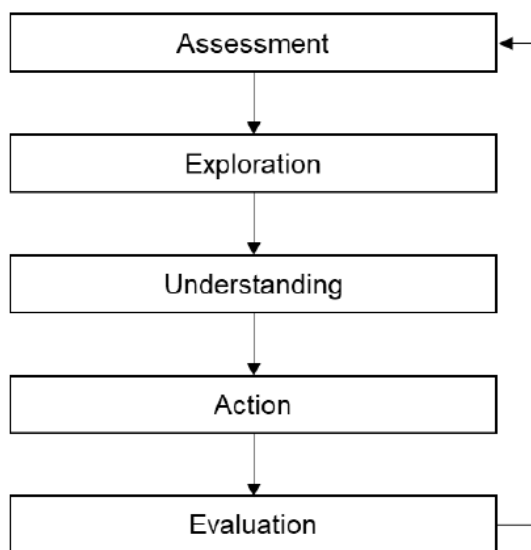


FIGURE 1. Kottler's five-stage model

**2.2. Rule-based chatbot agent.** A chatbot refers to a software agent designed to interact with users through text-based conversation interface [16]. There are two ways in chatbot implementation: rule-based model and learning-based model [17]. A rule-based model, where the responses are designed in advance, starts the communication process by first classifying users' input messages. The most appropriate response among the pre-designed is then selected as the output. In rule-based model, there is an advantage of less error since the results are derived according to pre-defined scenarios. However, the process of designing scenarios costs time and effort, and is not a simple procedure. The learning-based model first learns artificial intelligence model itself based on big data, and the most appropriate answer is then predicted based on user input [18]. Through learning-based model, we can have free conversation with chatbots. However, due to free conversation, the vast subject of communication is not easy to be controlled well. Furthermore, errors may occur that do not appropriately respond to user questions and requirements.

Unlike casual conversation, psychological counseling has a set goal, agreed with the client, to reach. The counseling theory sets purpose of psychological counseling. Thus, there is a high possibility of achieving effective result when step-by-step counseling has been conducted by a professional counselor. Therefore, in this study, we decided to implement a rule-based chatbot to minimize error in the user requirements and to maintain purpose of counseling.

**2.3. Prototype architecture.** This study is an early-stage study for implementing a psychological counseling agent and therefore, it is not easy to implement all the stages counseling. There are time and technical limitations in designing all the possible countermeasures of problems that clients go through. Consequently, the counseling topic was limited to the state of depression that the university students had. University students are well-known for their high level of depression and due to depression, they experience high risk of interpersonal difficulties, suicide, self-harm, etc. [19,20]. Depression is one of the most common types of mental disorders that, if left untreated, can result in physical, cognitive and social disorders [21,22].

Applying all five stages of counseling to a rule-based designed prototype requires a large number of scenarios. Thus, we designed a prototype system with three-stage counseling process (assessment, exploration and evaluation) reviewed by three consulting experts.

We designed based on empathic comprehension response and empathic emotional concentration response [23]. Among the sub-strategies of empathic comprehension response, we used simple consent (e.g., "You may not want to") and information request (e.g., "I will ask you a question to support you"). In case of empathic emotional concentration response, we applied sub-strategies of inference empathy (e.g., "I see.") and condolence (e.g., "It must have been hard."). By applying empathic strategy, we were able to empathize with client perspectives, and encourage them to deepen their inner expressions. For comparative research, we designed two separate agents according to presence and absence of empathic response.

Thus, we established the following three constraints in consideration of the limitations.

- 1) Counseling topic is limited to state of depression.
- 2) Designs include only three of five stages of counseling: Assessment, Exploration and Evaluation.
- 3) Two types of prototypes are designed according to presence or absence of empathic response.

### 3. Method.

**3.1. Participants.** The participants of this study were university and graduate students attending the research institute where our researchers belong to. We announced recruitment notices to bulletin boards and online communities, and among the applicants who

expressed willingness to participate in the experiment were recruited to participate. A total of 28 participants (Male: 14, Female: 14) were recruited, in age range of 22 to 29 years ( $M = 25.04$ ,  $SD = 2.05$ ). The number of male and female participants was the same (Male: 7, Female: 7) for each agent. The criteria for recruiting the participants were as follows: 1) capable of using smartphone; 2) when confirming the recruitment announcement, the participant agrees to the purpose of this study and to the fact that one has participated voluntarily; 3) there should be no problem with participant communicating with researchers.

The study has been approved by the Bioethics Committee of the institution (IRB No. 7001988-201810-HR-403-03) before the experiment has been conducted. The handout to the subjects provided the possibility of participation and abandonment of the experiment, side effects and treatment methods, and compensation for participating in the experiment. According to the guidelines of personal information, the collected data were to be protected by privacy. After the completion of the experiment, the researchers provided ₩20,000 worth of compensation. Participants who were judged not to be suitable for the experiment also stopped the experiment and were provided the same compensation.

**3.2. Apparatus.** Intelligent chatbot platform ‘Danbee’ was used for designing prototype of counseling agent. ‘Danbee’ is an artificial intelligence chatbot implementation platform which uses a rule-based model. Furthermore, it can be linked to general messenger. In this study, ‘Danbee’ was linked to ‘Kakaotalk’ messenger, a mobile messenger application commonly used in South Korea. For this reason, the participants were easily accessible to the application. Psychological counseling was conducted by using smartphone interface and LG’s smartphone G5.

**3.3. Procedure.** Participants were informed of the chatbot input method and practiced the input method using the training chatbot. Additional training chatbot was designed separate from the main chatbot. The practice session was conducted on unrelated subjects to main experiment, such as preferred food and travel experience. About 10 minutes of practice were given to participants to ensure that they have fully practiced the input method.

During the experiment, the participants were interviewed for about 25 minutes by the counseling agent. Participants were informed in advance that the counseling would proceed to the exploration stage and that the process would be stopped before providing the solution. After the counseling was completed, the participants have conducted Counselor Rating Form-Short (CRF-S) and Empathic Understanding Subscale (EUS) questionnaires to evaluate level of empathy and counseling.

**4. Result.** In this study, we used two agents: an agent in which empathy response was designed in advance and an agent without the response. To evaluate each agent, CRF-S and EUS questionnaires were given to participants when finished having conversation with the agent. CRF-S questionnaire was first developed by Barak & LaCrosse with 36 questions and then it was shortened by Corrigan and Schmidt to 12 questions [24,25]. The questionnaire consists of three factors: professionalism, trust and favorability. It is rated by using a 7-point Likert scale and the total score is ranged from 12 to 84 points; the higher the score, the more positive evaluation made on the counselor. EUS, which consists of 16 questions, is a measure of evaluating empathy level of a counselor. It is rated by using a 6-point Likert scale and the total score is ranged from 16 to 96; the higher the score, the higher level of empathy among counselors perceived by the subjects.

In total of 28 participants, six were not suitable for the experiment and had outlying data and were excluded. The analysis of results was performed on 22 subjects (Male: 12, Female: 10). In total, 11 subjects (Male: 6, Female: 5) participated in each experimental task of empathy agent and non-empathy agent; thus, we performed analysis based on the

TABLE 1. Independent group t-test results on empathy and non-empathy agent

Factors	Group	N	Mean	Standard deviation	t-test		
					t	df	p-value
CRF-S	Empathy	11	49.3636	6.29719	-3.194	20	0.005
	Non-Empathy	11	59.2727	8.13746			
EUS	Empathy	11	48.6364	8.02836	-2.502	20	0.021
	Non-Empathy	11	56.3636	6.36039			

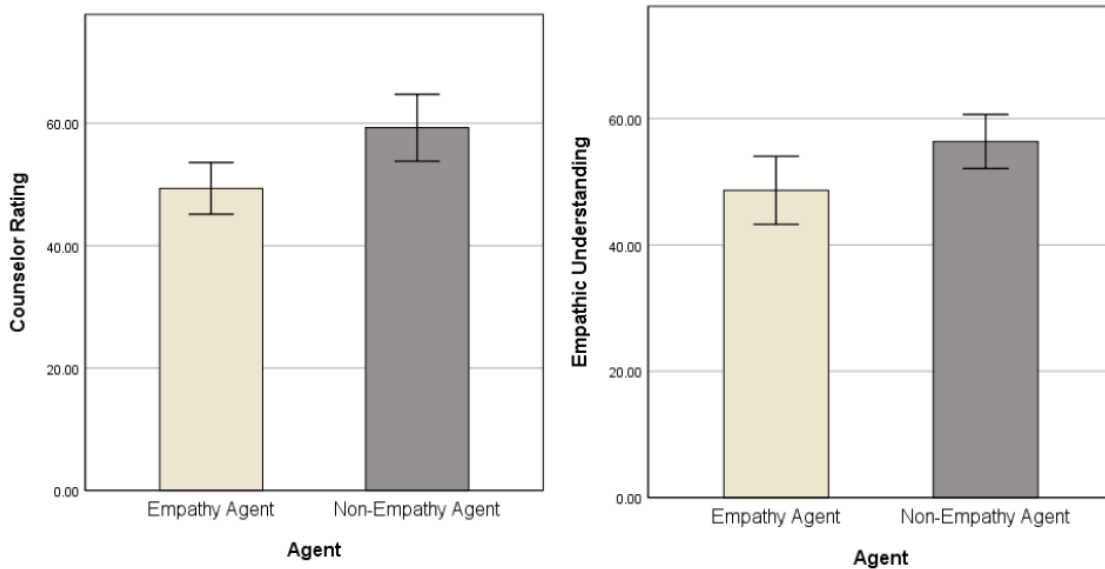


FIGURE 2. Evaluation score graph by empathy and non-empathy agent

subject data for each agent. Two groups were analyzed using independent t-test and the results are shown in Table 1.

In counselor rating results, the empathy agents were found to have a lower level of counselor compared to non-empathy agents. Furthermore, the empathy level among counselors perceived by the subjects was found to be low, as well. As a result, the participants showed that the agent with no empathy was favorable in counseling process in comparison with the empathy agent (Figure 2).

**5. Conclusion.** In this study, we designed a text-based psychological counseling agent to perform a user assessment based on the presence and absence of empathic conversations. In previous studies, empathic responses have a very important effect in human-human communication. However, we have found that empathic agents resulted in lower score on counselor’s assessment and lower level of empathy perceived by the subjects. We concluded that number of factors may have affected the result of this study.

First, we designed human-agent conversation in advance and therefore, presented a conversation with low level of empathy. Thus, the conversation is less realistic than a human-human conversation and the empathy response was designed by simply repeating the answer. As a result, due to the diversity of empathic response and of the low level of empathy, the participants in the experiment may not have received enough empathy from the agent.

Second, we failed to consider the context of the conversation. The agents designed in this study are based on the rule-based model and empathy conversation was designed in advance by predicting dialogue scenarios. It is not possible to predict and design all possible empathic responses to reflect all kinds of conversation context that may occur in

the process of participant conducting conversation experiment with the agent. Therefore, the simple empathy in which conversation context was not considered, may have failed to convey empathy to the subjects.

Third, uncanny valley in human-agent interaction. ‘Uncanny valley’ refers to the phenomenon in which the more awkwardly a robot looks like a human being, the level of displeasure people experiences increases. If a robot’s appearance is very different from that of humans, no change is found in affinity. However, as the robot starts to look unnatural as it starts to look like humans, people starts feeling displeasure and discomfort. Therefore, the simple empathy used in this study may have given the participants a sense of imitating a clumsy human being and have caused a higher level of displeasure and discomfort compared to the agents without empathy response.

This study is meaningful in that it provides basic data for developing and improving an artificial intelligence-based psychological counseling system by designing artificial intelligence counseling agents and varying levels of empathy. However, since only partial counseling stage has been carried out, there has been some inadequacy in counseling effect. It is expected that the implementation phase should be added at the end in order to complete the counseling process. In further studies, 7 to 12 counseling sessions [26], which are known to be suitable for analyzing the performance of counseling, are to be prepared to verify the effectiveness of the client’s depression. In the future, these researchers will follow up on these complementary purposes.

**Acknowledgment.** This work is financially supported by Korea Ministry of Land, Infrastructure and Transport (MOLIT) as [Innovative Talent Education Program for Smart City]. This work was supported by Institute of Information & Communications Technology Planning & Evaluation (IITP) grant funded by the Korea government (MSIT) [2016-0-00562(R0124-16-0002), Emotional Intelligence Technology to Infer Human Emotion and Carry on Dialogue Accordingly].

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