A Hot Bot: Testing Effect of Temperature on Feelings of Closeness When Interacting With a Chatbot

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Abstract
This study examined the effect of touching a warm or cold surface while interacting with a chatbot to see if temperature contributes to feelings of closeness with the artificial conversational agent. Our two-group experiment (N= 44) found no differences between hot and cold conditions in people's liking of the chatbot, but found a main effect of existing favorable attitudes toward chatbots.

Author Keywords
Temperature; touch; chatbot; conversational agent; haptic

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Introduction
In the past 20 years, there has been an ever-growing body of literature of human-robot interaction that includes audio, visual, and more recently, haptic interaction. Touch is a simple way to interact with computers. When we touch something, we feel some haptic sensations including pressure, tactile impression,

How People Treat Chatbots

- Can communicate through text or voice [6,8,10]
- Utilize electronics like Amazon Echo's Alexa, iPhone's Siri, or Window's Cortana [5]
- Used for various methods of human communication (body gestures, speech, emotions) [2,5]
- Can express and perceive emotions, communicate with high-level dialogue, and develop a distinct personality [8,13]

and temperature. The haptic research, however, has primarily focused on tactile feedback -- such as the role of vibrations for providing proper user experience to users [6]. Temperature has not played a prominent role in human-robot interactions. Studies that were done on temperature have mostly been with physical robots.

Temperature has been researched to be important in human-to-human interactions, even as far as being considered a main component of first impressions, the way we evaluate each other, and the way we behave around each other in regards to the cold-warm spectrum. This evaluation involves who we trust, help, and befriend. The colder we feel, the "colder" we act towards someone. In contrast, the warmer we feel, the "warmer" we act towards someone [12]. This "warm" feeling has been researched to improve trust [4], the chances of giving a reward versus keeping the reward [12], and even our ability to socialize and befriend those around us [14]. While temperature has been studied in HRI, there were no studies found that looked at temperature interacting with chatbots. Because of the lack of literature, our team chose to focus on how the tactile element of temperature affects people's perception of a chatbot while they interact with it.

Touch in Human-Robot Interaction

The interaction between humans and robots have become more widespread over the last two decades. Because of this, there has been an ever-growing body of literature in human-robot interaction. Haptic feedback is one major component of recent research studies [1, 14]. Some general studies include experiments revolving around a dinosaur robot [12], a robot that is used for hugging [7], and interacting with a robot's hand [6].

Touch has also shown to be important in developing human to robot relationships [3,7]. Nakanishi found that haptic sensation was essential to social touch through the use of a robot hand [6]. Wullenkord [12] found physical contact with the robot reduced negative emotions. Both studies reveal that participants benefitted from interacting with the robot.

Temperature in Human-Robot Interaction:

As mentioned previously, few studies have been conducted in temperature research. It has been less prominent due to a lack of commercial communication technology that incorporates temperature. However, a select few studies have implemented temperature through a robot medium [1,9,11,12]. Nakanishi et al. [6] demonstrated that warmth in a robot's hand could improve connectivity with the room facilitator. Park and Lee [8] discovered that participants who interacted with the warm temperature level had a greater degree of perceived friendship when compared with the other temperature levels. Cooney, Nishio, and Ishiguro's [1] study also used a robot medium. Although temperature has played an important role in face-to-face communication, it has not been studied in depth through computer mediated communication. This is the reason why our hypothesis is focused on temperature:

Hypothesis: People will feel closer with a chatbot when exposed to warm temperature than cold temperature.

Methods

44 college students between the ages of 18-32 participated in the experiment, 31 of them were male. Participants were paid $10. After signing a consent form, participants first interacted with the "chatbot" by

answering 24 simple questions through speech with no stimulus. These questions included "What are you most passionate about?" and "Who do you admire most in your life?" During this part of the experiment, another researcher was controlling the "chatbot" with a pre-determined list of questions using the Wizard of Oz method. Following that, they answered questions about their feelings of closeness toward the chatbot on a 7-point scale. They then put both hands on a hot or cold stimulus and further interacted with the chatbot, followed by another survey about their feelings about the chatbot.

Results

We conducted a univariate analysis of variance to see the effect of the hot and cold manipulation on perceived closeness with the chatbot. Existing attitudes toward chatbots and gender were included as control variables. There was no effect of temperature (F (1, 32) = .16, p = .69) or gender (F (1, 32) = 3.41, p = .07) but a significant effect of existing attitudes (F (1, 32) = 10.83, p = .002). Participants in the cold condition (M = 5.56, SD = .33) did not feel significantly closer to the bot than participants in the hot condition (M = 4.60, SD = .23). These results suggest that pre-existing attitudes toward bots override effects of temperature; the temperature manipulation may not have been long or strong enough to replicate previous studies' positive effects of warm temperature.

To gain more insight into these results we analyzed participants' open-ended responses related to their thoughts on the study. Thirteen participants felt that the conversation was too "deep and personal" which made them feel uncomfortable because they knew they were talking with a bot. There was also a discrepancy in that some participants thought the conversation was very natural and others said it felt like an interrogation or interview. Several participants mentioned that placing their hand on a cold or hot surface felt unnatural.

Discussion

It was clear that there were many elements of the experiment that were stronger than the temperature manipulation. Even though all participants had to answer the same questions audibly with the chatbot, they reacted differently to the questions. Some responded positively while others were weirded out. Future studies may want to take this into consideration and look at what factors make people feel friendlier toward chatbots. A follow-up study could be done to vary the experiment, i.e., allowing the participants to experience both the hot and cold stimulus. Previous studies of physical robots found positive effect of temperature but we did not. This could mean that the embodiment is important, but also raises questions on whether or not those studies would replicate once voice interaction is introduced to the experiment.

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