Emotional Contagion from Chatbots to Humans

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ABSTRACT
Chatbots can be seen performing roles such as therapy and customer service. In roles like those, the effects of the chatbot towards the user are important. There is a lack of research in how the perceived emotion or mood of a chatbot can affect the user interacting with it. The phenomenon of emotional contagion suggests that humans can spread their emotions towards other humans because humans naturally mimic the behavior of others. In this study, we will determine if this phenomenon occurs from chatbots to humans as well. To carry out this study, we relied on a Wizard-of-Oz (WoZ) approach to test a chatbot individually among a group of participants. We believed that the perceived emotion of the chatbot will spread to the person interacting with it. Our results showed that this may be the case. Humans mimicked the behavior of chatbots similar to how they do so with other humans.

Author Keywords
Chatbots, HCI, Emotional Contagion

ACM Classification Keywords
H.5.m Information interfaces and presentation (e,g., HCI): Miscellaneous

INTRODUCTION
Chat robots (chatbots) are becoming increasingly common in our world. Our personal smartphones now come with such robots built-in. Service industries and help centers are adopting such robots to help carry out conversational work. Humans are also being expected to work with or alongside robots with some conversational ability to perform tasks. For example, helper chatbots are common in workplace communication platforms such as Slack.

Despite the proliferation of chatbots, there is not much understanding in the side-effects of conversing with such robots. This can be problematic in many scenarios. If a chatbot was intended for therapy, there could be issues if the chatbot triggers unintended emotions such as anger or grief. For this project, we will determine if the phenomenon of emotional contagion exists within the context of human-chatbot interaction. The chatbots we will focus on will be those using text rather than speech. Our hypothesis is that emotional contagion can occur from chatbots to humans interacting with them. This topic is important and interesting because there is no clear understanding in whether or not this human-to-human phenomenon can be unintentionally occurring from chatbots to humans. While there has been similar research done for more conventional robots, there is still research to be done with chatbots. It is unsure if chatbots can transmit emotion to humans like humans can. Emotional contagion is believed to occur in part to cues humans can transmit to humans. Chatbots lack the ability to use such cues.

Emotional Contagion
Emotional contagion is the phenomenon where one person's emotions can be spread to another person. More specifically, it is "the tendency to automatically mimic and synchronize expressions, vocalizations, postures, and movements with those of another person's and, consequently, to converge emotionally [1]." This effect can be caused by either primitive emotional contagion or emotional comparison. In the case of primitive emotional contagion, a person quickly and subconsciously mimics the speech pattern or movements of the other person. With emotional comparison, a person consciously compares their feelings to other persons and adapts to that situation. In both these cases, there is a reliance on traits and abilities that chatbots do not have. For example, chatbots have no physical behavior that humans can see and mimic. The speech pattern of a chatbot is also very dissimilar to that of a conversing human. While humans can read emotions or behaviors such as friendliness [5] into the words of chatbots, it is not clear if humans will respond emotionally in the same manner because the social cues and context are not the same as with another human being.

RELATED WORK
Some prior research indicates that there is potential for emotional contagion to exist between humans and chatbots. There was some research on developing models for evaluating contagion from physical robots such as those in the front-line service industry [3]. In some of those studies, contagion has appeared to be prevalent from those types of physical robots. When humans mimic the physical behavior of those robots, they can pick up on the emotion of those behaviors just like they could from humans [4] [6]. Another study has shown that contagion can occur from non-social

targets with no human behaviors. Humans can perceive and adopt the emotion from objects such as artwork [2]. Seeing that physical human traits are not required for contagion can be promising for the existence of contagion from chatbots.

A project from Breazeal suggested that humans and robots could have emotional and affective interactions [11]. For these types of interactions to occur, the human would have to be able to perceive and act with the robot's emotions in mind. Another work by Gennaro follows this by suggesting that chatbots can "elicit social and emotional responses [13]." This may have implications on the possibility of emotional contagion occurring.

A chatbot, GremoBot, was shown to have the capability to influence human emotion within a group setting. GremoBot was designed to regulate group emotions in an online communication platform. However, it did not rely on exploiting emotional contagion. Instead, it had used visualization to show the group if their mood was positive or negative. This allowed the group to respond to that and adjust themselves accordingly.

Another study suggested that service scripts have an influence and effect on the perception of humans towards chatbots [10]. This has implications for our work, as we will be manipulating robot mood within our robot's script.

METHOD

We relied on a Wizard of Oz (WoZ) approach to simulate a chatbot for our experiment. In our experiment, our objective was to determine if emotional contagion can occur from our chatbot to the human. We split the participants into two groups, one for a happy chatbot and the other for an angry chatbot.

Wizard-of-Oz (WoZ)

WoZ is used as an experimental technique for robot design. The purpose of this technique is to test a robot without having to build it. There are many benefits to this. Implementing or building a robot can be time consuming and expensive. In an iterative design process, the drawbacks can accumulate quickly. Another issue is with the current state of technology. The type of robot being designed may not be feasible yet with current tools, but the designers may still want to test the robot. With WoZ, the robot will not have to be built. Instead, the robot is faked, or imitated. The participant interacts with the robot as if it was a real robot. They will not know that it is fake and manipulated by the researchers.

In our experiment, we implemented the WoZ approach with Slack. Our participants were asked to join our Slack channel to perform our provided task. They messaged SlackBot, our customer service chatbot controlled by us. To make Slackbot appear realistic, we created a script for each group. This script had a line for parts of the task like greeting and receiving a request. The script was also designed to handle edge cases with a generic error message. We believed a chatbot that was too flexible in user inputs would be unrealistic, so we designed our script around that.

Elements of our script included:

- Greeting
- Request Received
- Order Details Received
- Refund Request Complete
- Communication Error
- Service Breakdown
- End (Goodbye)

If the participant gave an input that did not follow the task, we can use the communication error line. If communication breaks down altogether due to an event such as the user testing the chatbot, we can use the service breakdown line to conclude the session.

Both happy and sad groups had their own unique lines for each part of the script.

Participants

We recruited 2 participants for this experiment, one for each group. Both participants were male and recently graduated with undergraduate degrees. They had both interacted with chatbots in the past to some degree and have a better than average self-reported understanding of technology.

Task

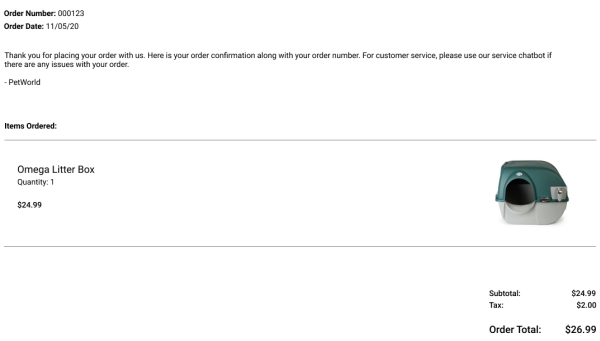

Figure 1: Task scenario and order invoice provided

We will placed the participants in a scenario where they must communicate with the chatbot to perform a task. The task was to start the return process for an order they have ordered. Task details were provided like shown in Fig. 1. Order details such as order number, date, and product ordered were shown. This order invoice is intended to be similar to actual order invoices.

The chatbot was a customer-service oriented bot that would help facilitate the return process. This robot could have two emotions – happy or angry. Each participant was randomly assigned to a robot with one of the two emotions. The return process will be facilitated by communicating with

ServiceBot over Slack. A researcher was on the other side of pretending to be a service robot.

Measuring Tools

To observe the effects of emotional contagion, we relied on using the Self-Assessment Manikin (SAM) scale. This scale allows users to self-report valence, arousal, and dominance in a pictographic scale. The SAM scale can show us the emotion and intensity of it that they experience at that moment. We asked the participants to complete the SAM scale in a post-survey and then compare the results between groups.

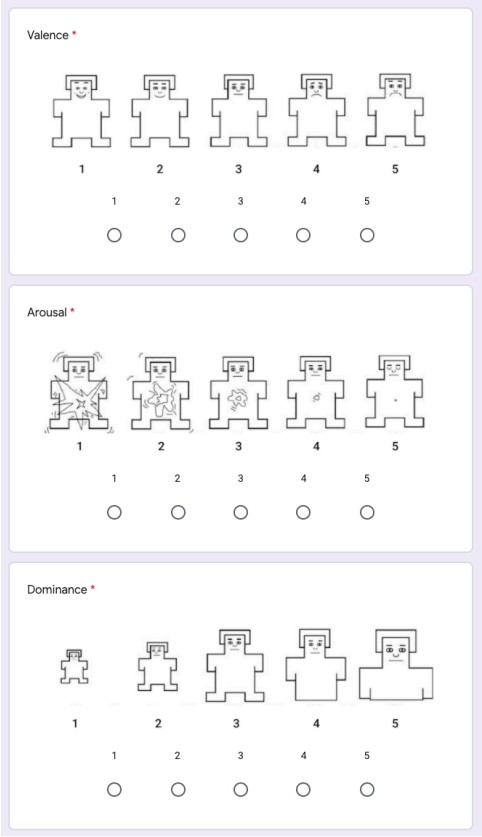

Figure 2: 5-point SAM scale used post-survey

We predicted that the post-survey scale will show participants adapting to the emotion expressed by the chatbot. This would validate our hypothesis of emotional contagion occurring in the context of human-chatbot interaction.

Another tool we used was a sentiment analyzer implemented by Soper. This tool measures sentiment from provided text. We inputted the text from the participant into the analyzer. The expectation was for the user's input to mimic the chatbot's perceived mood. This would indicate that emotional contagion was possibly occurring.

RESULTS

The results from our small study were mostly as expected. The sentiment detected from the participants text input was aligned with their perception of the chatbot's text.

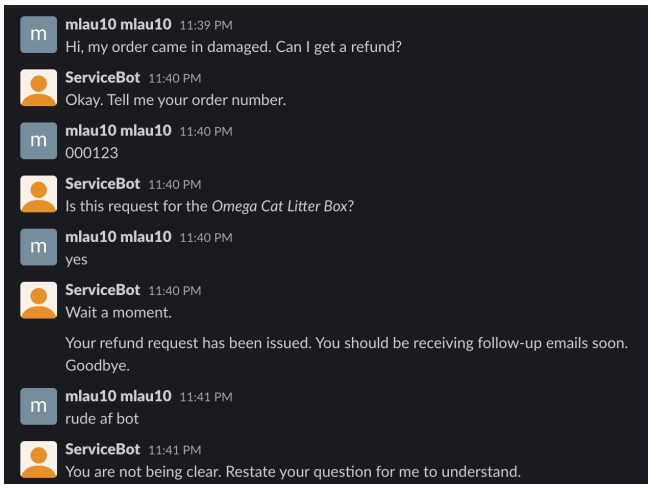

Figure 3: Participant interacting with Angry chatbot

In our group for the angry chatbot, the participant reported that the chatbot appeared to be slightly unhappy, although not angry like we had intended. The sentiment analysis tool detected a negative and/or serious sentiment from this participant's text input. Reading the text, we found the participant had told the bot it was being rude. This indicated that the bot may have been making an impression on the participant, and the participant was mimicking the rude behavior back by making a rude statement of their own. The behavior can be seen in Fig. 3.

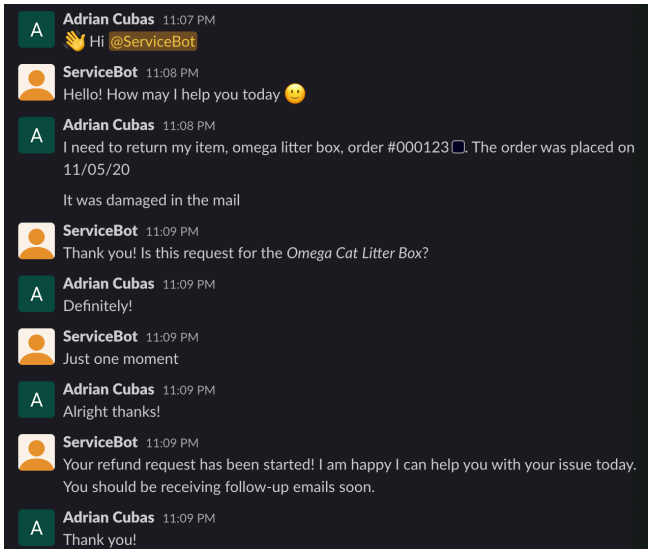

Figure 4: Participant interacting with Happy chatbot

The participant in the happy chatbot group showed another example of mimicry. From observing the chat logs, it appeared that they had adopted the happy tone of the chatbot almost immediately. Certain speech patterns such as exclamation points were used by the participant after they had seen the chatbot use them. This participant noted that the chatbot was quite happy. The sentiment analysis reflected this in the text inputted from this participant.

There was a similarity between the mood of the chatbot and the sentiment found in the input from the participants. Along with that, it had also appeared that they were mimicking the chatbot's text style to some degree. This helps validate our hypothesis that emotional contagion is occurring between the chatbot and human.

Our SAM scale results were inconclusive. Both participants had reported the same values across all three questions in the scale. We believe that this can partially be due to the short duration of the task. Both participants had completed their product return task in under 3 minutes. We believe that extending this task to at least 10 minutes may lead to a stronger effect on the participants.

Our post-interview with the participants confirmed that our WoZ deception was successful. Neither had suspected they were communicating with a human rather than a chatbot.

LIMITATIONS

A limiting factor that may have restricted the effects of the chatbot interaction may be the length of the task. The product return task was completed in very short time. The interaction was usually under 10 exchanges between the chatbot and participant.

Another potential task could be for a therapy-focused chatbot where we can ensure a set amount of time for communication. Incorporating other types of chatbots can help further prove or disprove emotional contagion across chatbots.

Our experiment sample size was also far too small. It would be an exaggeration to say this experiment gave a definite answer to our original question on emotional contagion within our context. The amount of groups could also be expanded. We had only used two emotions – happy and angry. Perhaps emotional contagion may be more or less apparent if we tested sad chatbots.

CONCLUSION

Our small sample size makes it difficult to definitely prove or disprove the effects of emotional contagion from chatbots to humans. However, the results we do have indicate that this may very well be occurring. The participants were mimicking the chatbots they were interacting with to some degree. One participant had mimicked the behavior they had perceived as being rude. The other participant had mimicked the diction or style of their chatbot.

Mimicry is a major component of emotional contagion that was not well-studied between humans and chatbots. Our study shows that this behavior can occur. Along with that behavior, the emotions appear to have transferred from the chatbot towards the humans as well.

These initial results suggest that chatbot designers should be mindful of emotional contagion occurring when humans interact with their chatbots. It could be potentially dangerous in some cases if humans mimicked unintended behaviors from their chatbot.

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