Nurturing the Companion ChatBot

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Abstract

Although recent technical progress of artificial intelligence is impressive, the affective effect of intelligent agents has not been investigated sufficiently. My research focuses on this problem. I start with the audio analysis using brain imaging method and my work concentrates on music emotion. Then I move to text data, and select to study ChatBot. We observe an interesting phenomenon that not only the affective response from ChatBot influences user's experience, but also the manner that user interacts with ChatBot affects the development of the ChatBot's intelligence. So this work proposes an ethical issue that it is necessary to regularize the user's behavior. We validate this argument by designing a novel paradigm, which enables the users to nurture companion ChatBots via developmental artificial intelligence techniques. With only twenty days nurturing, the users build affective bonding with the ChatBots and the ChatBots show significant progress in communication skills.

Introduction

Over the last few years, advances in many artificial intelligence applications, such as ChatBot that enables computer to converse naturally with human beings, have drawn worldwide attention. The rapid developments of both learning algorithm and computer hardware have led to powerful techniques for ChatBot. However, the life span of most commercial ChatBots is relatively short. The ChatBot named Tay, designed by Microsoft for human engagement experiment, has to been taken offline within twenty-four hours because of the abuse from some users (Neff and Nagy 2016). Observing this phenomenon, we propose a hypothesis that the development of artificial intelligence is not only determined by the technical progress, but also influenced by the manner that users interact with the intelligent agents, such as ChatBot. Based on this hypothesis, we design a novel framework that enables the user to nurture a private ChatBot for companion, which aims to provide companionship by daily chatting.

ChatBot Design

We utilize the typical deep learning based dialogue generation techniques (Li et al. 2016) with two Long Short-Term Memories (LSTMs). Stochastic gradient descent is used to train the sequence-to-sequence learning model (Sutskever, Vinyals, and Le 2014).

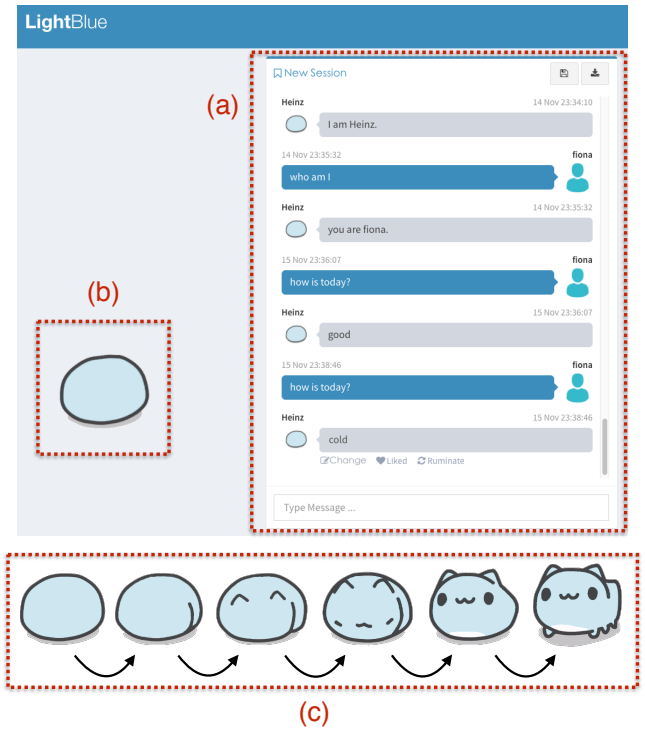

Figure 1: The interface of "LightBlue". (a) Dialog: User shares knowledge and experience with the ChatBot via conversation. (b) Cartoon image: The ChatBot shows its degree of growth. (c) Growth scheme: The image changes progressively according to growth level of the ChatBot.

The nurture system is designed for nonprofessional users. As showing in Figure 1, the ChatBot named "LightBlue" is in a neat and cute style. Only three buttons, "Change", "Like", and "Ruminate", are provided for the nurturing. When user wants to correct the output of ChatBot, they can type in the desired sentences. After clicking "Change" button, the system keeps learning until ChatBot outputs the desired sentences. When the ChatBot generates excellent sen-

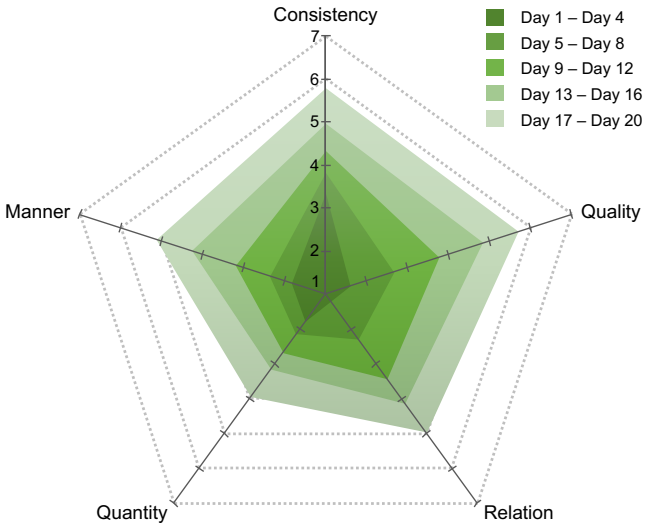

Figure 2: Evaluation results after nurturing.

tences, the user can increase the learning rate for these sentences by clicking "Like" button. By "Ruminate", ChatBot goes through and learns from the whole conversation history.

Paradigm Design

Subjects Overall, there are 101 subjects (22 females) in our study. The subjects range in age from 18 to 23, with a mean age of 21.52 years (SD = 2.28). All subjects are undergraduate students. None of the subjects has any prior knowledge of our study.

Procedure The nurturing period contains 20 days. The goal of nurturing is to give the ChatBot basic communication skills and personality. The ChatBots learn from the subjects by mimicking their words. The performance of the ChatBot in the nurturing period is evaluated by a group of linguistic experts as the subject's course project score.

Results

A group of linguistic experts from City University of Hong Kong are instructed to provide their evaluation for the ChatBots' performance each four days through conversation on daily topics, including weather, outdoor activity, and health. Using a seven-grade Likert scale (Likert 1932), which range from "1 = Strongly disagree" to "7 = Strongly agree", they grade the ChatBots on the following seven evaluation attributes:

- Consistency: ChatBot has consistent personality and avoids self-contradictory behavior.
- Relation: Response is relevant to topic of discussion (Grice 1989).
- Quantity: ChatBot is only as informative as required and not more or less (Grice 1989).
- Manner: ChatBot avoids ambiguity or obscurity, is direct and straightforward (Grice 1989).
- Quality: ChatBot tells the truth that can be proved by adequate evidence (Grice 1989).

Figure 2 shows the evaluation results averaged across all subjects. In the nurturing procedure, the general intelligence of ChatBots is progressively increased. Specifically, ChatBots show high Consistency over the whole nurturing period, which indicates personal nurturing significantly helps the ChatBot to build a consistent personality. For Relation, although the ChatBots show weak capability to focus on the right topic at the beginning stage, a significant rise is found from day 5 to the end. This suggests that by personal nurturing, the ChatBots could learn to identify conversation topics in short days without very large-scale data. By contrast, a much slower rise is found for Quantity, which indicates it is relatively difficult for the ChatBots to know exactly how much information to output. Considering that the progress on Quantity from day 17 to day 20 is better than before, we expect the ChatBots' performance on Quantity would be further improved with a longer nurturing period. For Manner and Quality, the performance shows fast yet steady growth over the nurturing period.

Besides the subjective evaluation, we perform objective evaluation based on the statistical data for both the 20-day compulsory nurturing period and the 12 days after it. We find that after the first 20 days, the frequency of use per day keeps on a level comparable with the level of beginning and middle stage. Without external requirement, users intend to keep nurturing and chatting with their personal ChatBots. This result suggests the users' affective bonding with their ChatBots is built.

Conclusion and Future Work

We conclude that the nurturing of companion ChatBot builds affective bonding between the user and ChatBot. With healthy human-computer interaction, the ChatBot show great progress of both intelligence and communication skills. In the future, we would like to explore the affective effect of the interaction using sound and image, and perform experiment with a longer period.

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