"I Almost Fell in Love with a Machine": Speaking with Computers Affects Self-disclosure

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ABSTRACT

Listening and speaking are tied to human experiences of closeness and trust. As voice interfaces gain mainstream popularity, we ask: is our relationship with technology that speaks with us fundamentally different from technology we use to read and type? In particular, will we disclose more about ourselves to computers that speak to us and listen to our answers? We examine this question through a controlled experiment where a conversational agent asked participants closeness-generating questions common in social psychology through either text-based, voice-based, or mixed interfaces. We found that people skipped fewer invasive questions when listening and speaking compared to other conditions; the effect was slightly larger when the computer had a male voice; and people skipped more frequently as questions became more invasive. This research has implications for the future design of conversational agents and introduces important new factors in concerns for user privacy.

KEYWORDS

Voice User Interface; Closeness Generating; Self-disclosure;

INTRODUCTION

People project some human characteristics on computers, but we know little about whether and how people experience becoming close to or trusting a computer. This question is particularly salient as conversational and voice based interfaces become more embedded in everyday life. For most of the history of human evolution, listening to and speaking to another person has meant that they are physically close by, therefore more likely to be part of the in-group [9]. Feeling close to other people is deeply rooted in our experience as social beings. But, do humans experience similar closeness and trust when interacting with speaking machines?

To investigate this question we rely on research in social psychology that has found that the experience of closeness with another person can be temporarily triggered through a set of increasingly invasive personal questions [3]. We examine what happens when people are asked those questions by a computer, how often they answer the questions, and whether the mode of the interface (speech vs. text) affects self disclosure. This study has implications for the design of conversational assistant applications and in examining privacy concerns for users interacting with them.

RELATED WORK

The Media Equation Theory posits that people apply social rules, which widely exist in real life social settings, to their interactions with computers. In a controlled experiment, people were asked to rate the performance of a computer after completing a task with it. People who completed the review on the original computer rated it higher than those who completed the review on another computer. Thus, those who were asked to rate the computer by itself acted politely and gave it a higher score [9]. In a series of further experiments people were shown to treat computers as social actors in a number of ways including attributing humor and gender characteristics to them [9]. Relying on the media equation model, we explore how the closeness generating procedure affects the relationship between a person and a computer.

The Closeness Generating Procedure

Closeness has been defined as "including other in the self - an inter-connectedness of self and other" [1, 2]. Researchers in social psychology have developed and validated a procedure for temporarily generating feelings of closeness between two strangers [3]. After subjects are grouped into pairs, they are instructed to interact by using three sets of slips. The slips use questions as a format and involve tasks that require intimate personal self-disclosure. The intensity of invasiveness gradually increases within each set as well as over the three sets. At the end, participants take a post-interaction questionnaire based on the Inclusion of Other in the Self (IOS) [2] scale and the Subjective Closeness Index (SCI), [4] which are used to measure level of closeness.
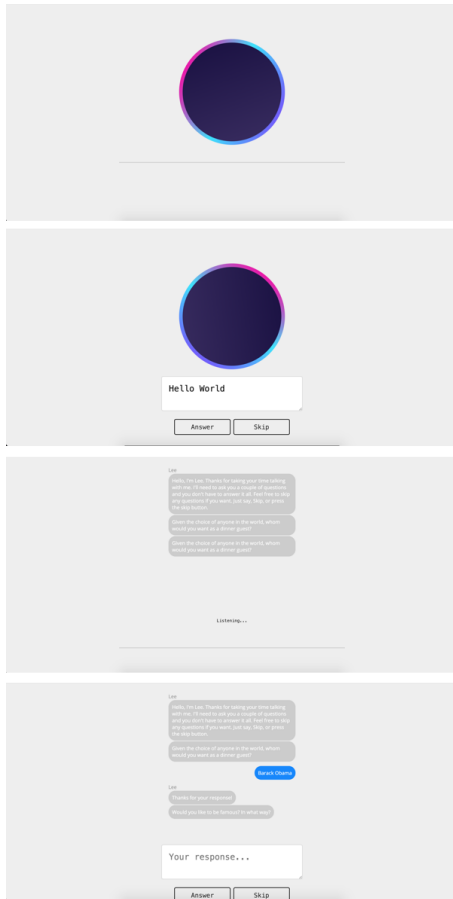
Figure 1: (From top to bottom) 1.1 Interface using synthesized voice as output, human speech as input. 1.2 Interface using synthesized voice as output, text as input. 1.3 Interface using text as output, human speech as input. 1.4 Interface using text as input and output

Self-disclosure occurs as a prerequisite to affinity and as a precursor to intimacy, it plays a key role in generating feelings of closeness between individuals [5]. Moreover, human-computer interaction scholars (e.g. [6, 10]) found that people self-disclose more after receiving self-disclosure from a life-like, virtual agent. In this paper, we also investigate participants' degree of self-disclosure.

The Affordances of Speech Interfaces

The proliferation of voice interfaces is in part due to the ease of the interaction but can also be attributed to the unique role of voice in human physiology and cognition. Voices effectively indicate social presence [9]; hearing a voice implies that another human is nearby and attempting to communicate [7]. Given the expansive set of socially relevant cues conveyed by human voice, voice affords a complex development of social relationships. For instance, a controlled experiment found that peoples' responses were significantly more socially appropriate and cautious when the treatment was a computer with a voice input, compared to other input modes like mouse clicking, typing on a keyboard or hand-writing [9]. Building on this research we examine the differences in disclosure when interacting through listening and speaking with reading and typing.

Human voice characteristics signal gender. Compared to male sounding voices, female sounding voices tend to display wider pitch range, more expressiveness, and a greater frequency of sentences ending with rising pitch [8]. According to prior literature, behavioral differences have been shown when people are exposed to gendered voices. Specifically, gender stereotypes are reaffirmed and verified among people when interacting with computers possessing a prerecorded male or female voice. Computing systems with female voices are rated as more informative when discussing love and relationships. Meanwhile, those with male voices were rated as more informative when discussing technology [9]. Hence, we compare a male and a female voice in our experimental treatments to examine any gender differences in closeness and disclosure.

RESEARCH METHOD

We conducted a controlled experiment where participants interacted individually with a conversational agent on a computer. We recruited 30 subjects via convenience sampling. Their ages range from 18 to 34 and 56% were female. Participants were randomly assigned to one of 6 conditions where we manipulated their interaction mode with the conversational agent (Table 1). We named the conversational agent, Lee, allowing participants to refer to it during the procedure. Participants completed three batches of questions, where each batch consists of answering seven questions adapted from the closeness-generating procedure [3]. The questions became increasingly invasive in each batch. Participants were able to skip any questions they wanted to without any penalty. After, participants completed a short questionnaire on the same computer. We also conducted short

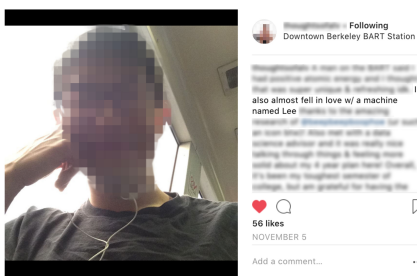|		Output		
		Reading	Listening (Female Voice)	Listening (Male Voice)
Input	Typing	I	II	III
	Speaking	IV	V	VI

Table 1: Experimental Conditions

Figure 2: Participant and their private Instagram post explaining that they "almost fell in love with a machine named Lee," our conversational agent. Permission to use photo granted by subject

Variable	β	SE	Listening
Speaking	0.01	0.07	0.18
Listening (female)	0	0.07	0
Listening (male)	0.09	0.07	1.2
Listening (female):Speaking	-0.10	0.1	-0.9
Listening (male):Speaking	-0.21 .	0.1	-1.8
Intercept	0.15 *	0.05	2.72

Table 2: Results of linear regression on skip rate. The baseline was Reading and Typing, variables include Speaking and Listening (either to a male or female voice).

* $:p < 0.05$, . $:p < 0.1$, N=30, Adj. R^2 is 0.09

post-experiment interviews with participants allowing us to detect possible problems affecting validity and to understand participants' experiences.

We measure disclosure based on the person's actions during the study. We measured: How many questions in each set did the person respond to vs. skip? How long (i.e., the number of words) were the answers in each condition? What differences exist in the language and sentiment of the responses for each treatment? Following prior research, we also measure closeness as a combination of Self report by the Inclusion of Other in the Self (IOS) [2] scale and the Subjective Closeness Index (SCI) [4].

We use a linear regression to analyze the effect of the interface modality on answer rates. Additionally, participants' responses to Lee's questions were manually synthesized as well as analyzed with a text categorization tool. Although the closeness generating questions were designed for temporary feelings of closeness, We did not expect that any subject would develop a personal attachment to Lee [3]. However, one of the researchers came across a subject's private Instagram post, expressing how they almost fell in love with Lee (Figure 2).

RESULTS

Participants interacted with and perceived Lee, our conversational agent, as a social actor across conditions [9]. Participants gave similar types of responses to the closeness-generating questions across all conditions. Common topics included positive emotion, family, children, friends, home, and domestic work; the content of the answers align with the personal and intimate nature of the questions. On average participants skipped 3 out of 21 questions (SD=2.75) or around 14.29%.

The content of participants' responses were honest and conversational. Most participants disclosed personal information related to their family life and values some even shared potentially sensitive information. When asked about their greatest accomplishment, one subject responded: *"Recovering from my mental illness"*. Emotional words such as *love* and *sorry* were frequently used across all conditions. In addition, subjects displayed interesting communication patterns, such as repeating an answer for emphasis: *"trust. . . yeah trust."* Another participant began their answer to a question with *"let's. . . ,"* treating the computer as a social actor.

People Self-disclosed More When Listening and Speaking

Although the types of answers were consistent across conditions, the levels of self disclosure varied.

Participants gave the longest answers and skipped the fewest questions in the {listen-male, speak} condition. To analyze the effect of the different interface modalities we performed a linear regression analysis to predict the effect of modality on skip rate (Table 2). Due to our small sample size none of the coefficients were statistically significant, however they suggest trends that we will explore further in future work. In particular, participants skipped fewer questions than the baseline (reading-typing)
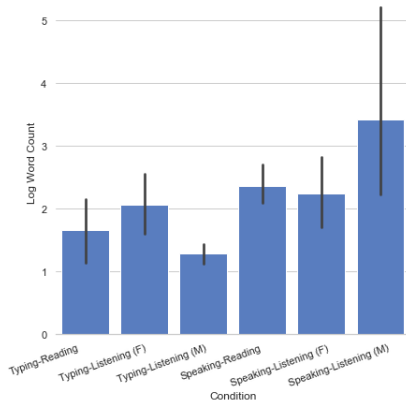
Figure 3: The difference in logarithmic word count among different experimental conditions
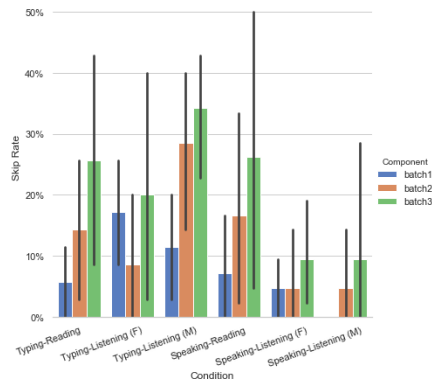

Figure 4: The difference in skip rate among different experimental conditions

when they both listened to the questions and spoke their answers. This suggests that it is not the act of speaking or listening by itself that result in fewer skips, but the combination of both listening and speaking. The two, combined, likely triggers a social actor mechanism that results in more disclosure.

Figure 3 shows the average logarithmic word counts of participant's responses. Responses in the listening-speaking conditions and reading-speaking condition are higher than that of the other two. Figure 4, shows the skip rate across different batches of questions. Our results replicate prior findings that people tend to skip more as questions become more invasive [3]. However, the skip rate increased less for the listening-speaking interface with both voice genders than for other modes.

Input modality affected language of response. Participants used symbols such as hashtags (e.g., #livingthedream) and emoticon keyboard shortcuts under the typing as input treatments. When voice was used as the input modality, subjects responded more eloquently. Participants used conversation fillers such as *"ah, good question"* and reacted to questions as if they were speaking to an actual social actor, responding with *"Interesting, huh... I'll give you a really shallow answer I would say"* and *"Damn dude! What kind of questions are these?"* Also, when voice was an input, subjects more frequently used the self-reference *I* than when they were using text as an input.

Participants revealed mixed attitudes towards feelings of closeness and disclosure. In the post-experiment questionnaire, Subjects in each condition were asked to rate Lee. In descending order, under the Subjective Closeness Index (SCI), interface modes are ordered listening-typing, reading-speaking, reading-typing, listening-speaking. Meanwhile, the Inclusion of Self (IOS) ranked closeness in the order of listening-typing, reading-typing, listening-speaking, reading-speaking.

The Gender of Voice User Interfaces Affects Self-disclosure

Both female and male participants tended to have a lower skip rates when listening to a male voice. The logarithm response length of the male voice interface is slightly higher than the female voice. The voice interface with a female voice more frequently generated responses that pertained to children, while the male voice had responses that had topics about friends and domestic work. The gender of the voice also elicited different interaction behaviors. When Lee had a female voice, subjects were more likely to ask Lee to repeat the question.

Effect of Gender on Sensitive Questions. Six out of 21 questions in the closeness generating procedure are marked as sensitive. This includes questions that ask for intimate details *(e.g. How do you feel about your relationship with your mother?)* or may elicit vulnerable emotions (*e.g. What is your most terrible memory?*). The male voice increases the word count of responses to sensitive questions while the female voice reduces the skip rate of the questions. Overall, subjects disclosed more information to Lee as a female voice than to all other outputs.
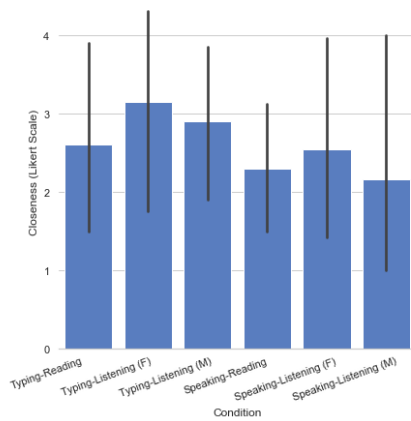
Figure 5: The difference in closeness index among different experimental conditions
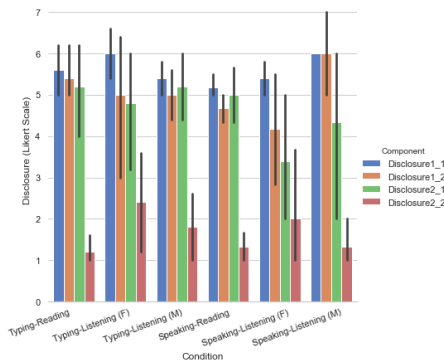

Figure 6: The difference in self-disclosure index among different experimental conditions

DISCUSSION

Due to the small sample size of our pilot study, we were not able to make conclusions with statistical significance. However, the trends we found suggest the following hypotheses for further experimentation.

- H1: Interface modes that use voice cause a higher degree of self-disclosure.
- H2: Different voice genders cause different degrees of self-disclosure.

Future work will study these questions with the same methodology but larger sample size (x10). We will also conduct more thorough analysis of the nature of responses in each condition.

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