

The Impact of Different Embodied Agent-Feedback on Users' Behavior

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Abstract. This study investigated whether emotional expressions of an ECA influence the participants' nonverbal and verbal behavior. 70 participants took part in a small talk (10 min.) situation with the ECA MAX who was presented with two different types of feedback: emotional feedback (EMO), which provided a feedback about the emotional state of MAX (including smiles and compliments) and envelope feedback (ENV), which provided a feedback about the comprehension of the participants' contributions. In general we found that participants showed frequent behavior known from human-human-communication, such as proactive greetings or waving goodbye. Additionally, with regard to some behaviors, the agent's behavior had an impact: Participants in EMO significantly gave more compliments and exhibited more phrases of politeness ("Thank you!") than in ENV.

Keywords: evaluation study, nonverbal behavior, emotional feedback, envelope feedback, social effects of ECAs, behavioral data.

That the behavior of ECAs has an impact on humans has been shown in numerous studies, for a review see [1]. However, most evaluation studies concentrate on subjective measurements such as *self-reported acceptance* and *self-reported social effects* or objective measurements like *efficiency* and *performance*, but there is a lack of studies which use *nonverbal behavior* for objective measurements [1]. In the present study (based on [2], for previous results see [3]) we were interested in whether behavior emerges that is usually observed when interacting with fellow humans and whether this behavior is affected by the ECA's behavior. With regard to the latter aspect our research questions were: What are the effects of different types of feedback on (1) the participant's nonverbal behavior (smiling and laughing) and (2) the qualitative verbal behavior (e.g. greeting, bidding farewell, etc.)?

The study was conducted with the ECA MAX [4]. MAX can express himself multimodal, and is able to respond to natural language input (via a "Wizard of Oz"

procedure [5]). To test our research questions, we tested versions of MAX with and without envelope feedback (including vocal backchannels (e.g. “Ja” (yes), “mhm”) and nonverbal signals (head tilt, nod, frown)), as well as with and without emotional feedback (MAX consistently showed a smile in the beginning and the end of the conversation and gave a compliment (“Your clothes are cool!")). As independent variables we thus varied the existence of emotional and envelope feedback in a 2 x 2 between subjects design. As dependent variables we (1) counted the number of smiles and laughs, did a qualitative analysis of the conversations with regard to (2) politeness, (3) how leave-taking was processed, (4) whether or not the participants proactively began the conversation and (5) what kind of conversation style the participant chose. Seventy persons, ranging from 17 to 48 years age ($m=24.09$; $sd=5.717$), participated in the study. Participants on average laughed 8.76 times ($sd=7.696$), the of smiling were on average 15.44 ($sd=7.600$). 54% of the participants said “Thanks” and 26% said “You’re welcome” to MAX at least once and 59% made or returned a compliment to MAX. By means of a MANOVA we identified a main effect for emotional feedback: Participants who had experienced emotional feedback were more polite and significantly thanked MAX more ($F(1;69)= 15.523$; $p= .000$; $\text{partial } \eta^2= .190$; mean values: EMO= 1.374 ($sd=1,060$), ENV= 0.861 ($sd=1,046$)) and more often made or returned a compliment to him ($F(1;69)= 9,580$; $p= .003$; $\text{partial } \eta^2= .127$; mean values: EMO= 1.317 ($sd=1,207$), ENV= 0.861 ($sd=1,094$)). 24.3% said good bye to MAX, in addition to this 15.7% waved to MAX. Most of the participants (63%) behaved proactively (greet MAX first and/or asked him a question), whereas 27% waited for MAX to speak up first. After the greeting phase 60% chose to chat with MAX, whereas 21.4% instructed Max to give an explanation. The rest did not make a choice and quietly waited for what would happen next.

We found that participants displayed several behaviors that are common in face-to-face interactions among humans. The combination of human-like appearance and non-verbal behavior of MAX seems to have an affordance character: two third of the participants started the conversation with MAX proactively by greeting him. Participants chose to have a chat with MAX rather than getting an explanation about specific topics. With regard to the different kinds of feedback we demonstrated that participants in EMO significantly gave more compliments and thanked the agent more often than participants in ENV. These results tie in nicely with previous results for emotional feedback (participants experienced more feelings of interest [3]) and supports the assumption that emotional feedback leads to larger social effects in the user. In conclusion, we demonstrated that objective measurements like observing participants’ nonverbal behavior or analyzing qualitative verbal behavior can give some new insights into ECA evaluation and provide more evidence for validity and reliability of subjective measures.

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