

Understanding the Social Relationship Between Humans and Virtual Humans

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Abstract. Our review surveys a range of human-human relationship models and research that might provide insights to understanding the social relationship between humans and virtual humans. This involves investigating several social constructs (expectations, communication, trust, etc.) that are identified as key variables that influence the relationship between people and how these variables should be implemented in the design for an effective and useful virtual human. This theoretical analysis contributes to the foundational theory of human computer interaction involving virtual humans.

Keywords: Embodied conversational agent; virtual agent; animated character; avatar; social interaction.

1 Introduction

Interest in virtual humans or embodied conversational agents (ECAs) is growing in the realm of human computer interaction. Many believe that interfaces based on virtual humans have great potential to be beneficial. Anthropomorphizing an interface means adding human-like characteristics such as speech, gestures, and facial expressions. These components can be very effective and efficient at conveying information and communicating emotion. The human face, especially, is powerful in transmitting a great deal of information efficiently [9]. For example, a virtual human with a confused face might be better (e.g., faster) at letting a user know that the virtual human does not understand the user's command than simply displaying "I don't understand" on the screen. The text requires the user to read, which might be disruptive to the main task the user is involved in [7].

Virtual humans can work as an assistant, such as a travel agent or investment advisor, and help with tasks that require managing vast amounts of information [7]. Personified interfaces are also known to be engaging and appropriate for entertainment tasks [15]. In clinical settings, virtual humans can be useful as well (for a review, see [11]). Some studies noted that exposure to a virtual audience might be helpful in diminishing the fear of public speaking [1]. Virtual humans have also been adopted in the development of virtual classroom scenarios for the assessment and treatment of Attention Deficit Hyperactivity Disorder (ADHD) [21].

Interest in understanding the social dimension of the interaction between users and virtual humans is growing in the research field. Some research suggests that there is a striking similarity between how humans interact with one another and how a human and a virtual human interact. For example, a study by Nass, Steuer, and Tauber [19] claimed that individuals' interactions with computers are fundamentally social. Their evidence suggests that users can be induced to elicit social behaviors (e.g., direct requests for evaluations elicit more positive responses, other-praise is perceived as more valid than self-praise) even though users assume machines do not possess emotions, feelings, or "selves".

In order to examine the social dimension of the interaction between users and virtual humans, we survey a range of human-human relationship models and research that might provide insights to understanding the social relationship between humans and virtual humans.

2 Social Interaction with Virtual Humans

An understanding of the nature of human relationships might provide insights to the social aspects of the interaction people can have with virtual humans. People build and maintain relationships through a combination of verbal and nonverbal behaviors within the context of face-to-face conversation. The relationship is formed based on a dyadic interaction where a change in the behavior and the cognitive and emotional state of a person produces a change in the state of the other person [14]. However, in the human-virtual human relationship, this change will mostly occur in the human's state because the virtual human typically takes an assistant or advisory role.

Because relationships are often defined in terms of what people do together, it is important to survey the types of tasks people might do with a virtual human. A virtual human can help with tasks ranging from one-time tasks to tasks that require a larger amount of time or that are done on multiple occasions (see Table 1).

Table 1. Different types of tasks a virtual human might assist (human interacting with virtual human) or people might do together (human interacting with human) distinguished by the length of the interaction

	Short Term Interaction	Long Term Interaction
Human Interacting With Virtual Human	<ul style="list-style-type: none"> • Providing information or facts (e.g., displaying information from a kiosk booth) • Providing recommendations for a simple task (e.g., which items to pack for a trip to a foreign country) • Helping carry out a simple procedure (e.g., editing a document) 	<ul style="list-style-type: none"> • Assisting a user through a month-long health behavior change program [4] • Teaching a user some skill that requires several or many sessions
Human Interacting With Human	<ul style="list-style-type: none"> • Service encounter 	<ul style="list-style-type: none"> • Tasks that form a service relationship (i.e., customer – service provider) • Tasks that form an advisor-advisee relationship (e.g., graduate student – advisor)

2.1 Service Relationship (Buyer-Seller Relationship)

A good deal of research about social relationships has been done at both ends of the time spectrum. Tasks done in a shorter time frame with a virtual human can be influenced by studies of service interactions defined as a service *encounter* where there are no apparent expectations of future interactions. This is differentiated from a service *relationship*, where a customer expects to interact with the service provider again in the future. Interestingly, a marriage metaphor has been used to make contributions to the understanding of the service relationship [8]. This enabled us to explore how relationships develop and change, the importance of social/relational elements (e.g., trust, commitment), and cooperative problem solving.

One such important variable in the marriage metaphor is expectation. Expectation relates to behaviors that contribute to the outcome (e.g., a partner behaving in a cooperative and collaborative manner) and the outcomes themselves [3]. Partners might improve interaction by either altering expectations on desired outcomes or by altering expectations on how they would interact. With virtual humans, users' expectations are certainly different from when they interact with traditional windows and icons. Users expect more social behavior and more flexibility, yet at the same time, they are well aware of the capabilities and the limitations of virtual humans. Xiao [25] claimed that expectations or perceptions of users on virtual humans are subject to enormous individual differences. For this reason, Xiao further emphasizes the importance of flexibility in virtual human design. We think that providing sufficient training or practice with the virtual human might provide the opportunity and time for users to adjust their expectations of what they can achieve through the interaction and how to best interact with virtual humans.

In a service relationship, communication behaviors influence problem-solving efficacy. This includes *nondefensive listening*, paying attention to what a partner is saying while not interrupting; *active listening*, summarizing partner's viewpoint; *disclosure*, sharing of ideas and information, direct stating of point of view; and *editing*, interacting politely and not overacting to negative events [6]. One partner's communication behavior will influence the other partner's. For example, a failure to edit negative emotions will result in the expression of reciprocal negativity from the other partner [8]. In another example, a unilateral disclosure of information or ideas can elicit reciprocal disclosure from the other's partner. The nature of the tasks determines the nature of communication between users and virtual humans. The design of a communication method should be a deliberate one. When a task requires disclosure of a user's view on a certain event, it is probably a good idea to provide virtual human's (i.e., designer's) view first and ask one in return.

Expectations, communications, and appraisals (how one might evaluate the other) all influence the longer-term outcomes of the relationship such as satisfaction, trust, and commitment. Most marketing studies mentioned that service providers should put emphasis on these variables to extend their relationship with their customers [17]. Designers who are specifically developing virtual humans for a long-term relationship should be mindful of these factors.

2.2 Advisor-Advisee Relationship

Another long-term relationship that has been studied rigorously is the advisor-advisee relationship. Advice-giving situations are interactions where advisors attempt to help the advisees find a solution for their problems [18] and to reduce uncertainty [24]. Finding a solution or making a decision is social because information or advice is provided by others.

Research on advice taking has shown that decisions to follow a recommendation are not based on an advisee's assessment of the recommended options alone [13] but also on other factors such as characteristics of the advisee, the advisor, and the situation. For example, advisees are more influenced by advisors with a higher level of trust [24], confidence [23], and a reputation for accuracy [26].

Trust is the expectation that the advisor is both competent and reliable [2]. Trust cannot emerge without social uncertainty (i.e., there must be some risk of getting advice that is not good for the advisee); trust can also reduce uncertainty by limiting the range of behavior expected from another [16]. Bickmore and Cassell [5] implemented a model of social dialogue between humans and virtual humans and demonstrated how it has an effect on trust.

Confidence is the strength with which a person believes that an opinion or decision is the best possible [20]. Higher confidence can act as a cue to expertise and can influence the advisee to accept the advice. With virtual humans, a confident voice, facial expression, and tone of language might increase the acceptance of the virtual human's recommendations.

Another factor in this relationship is the emotional bond or rapport. Building rapport is crucial in maintaining a collaborative relationship. Studies showed a significant emotional bond between therapist and client [12], between supervisor and trainee [10], and between graduate advisor and student [22]. It might be interesting to examine if rapport between humans and virtual humans varies as a function of the length of the relationship, display of affect by the agent, and the type of task.

There are factors in a human-virtual human relationship that are likely to have a different weighting relative to a human-human relationship. For example, the human-human advisor-advisee relationship can have monetary interdependency. The advisor might receive profits from advisee's decision or suffer loss of reputation or even job security [24]. The decision making process is affected by this monetary factor which does not exist in a human-virtual human advisory relationship. In another example, studies showed that advisors (e.g., travel agents, friends) conducted a more balanced information search than the advisee; however, when presenting information to their advisee, travel agents provided more information supporting their recommendation than conflicting with it [13]. Assuming virtual humans provide objective and balanced information to the users, this might favor virtual humans over humans in some advisor-advisee relationships.

3 Conclusion

Our review surveyed a range of human-human relationship models and research that might provide insights to understanding the social relationship between humans and virtual humans. We specifically considered two long-term relationship models: the

service and advisor-advisee relationship model. We delved into various social constructs (expectations, communication, trust, etc.) that are identified as key variables that influence the relationship between people and how these variables should be implemented in the design for an effective and useful virtual human. This theoretical study contributes to the foundational theory of human computer interaction involving virtual humans.

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