Friendship Relations with Embodied Conversational Agents: Integrating Social Psychology in ECA Design

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Research Motivation and Research

The motivation for this research stems from the interest of he Parlevink Research Group of the University of Twente in the area of Embodied Conversational Agent (ECA) technology. In this field of Human Computer Interaction (HCI) and Artificial Intelligence (AI), the design of ECAs, or 'virtual humans', and the communication between those agents and human users is the object of research. A lot of effort is put into research to make ECAs more lifelike and believable and to make communication with ECAs more effective, efficient, and more fun. In order to do so, the idea was to make the agent more actively concerned with the relationship with the user. As a 'lay psychologist', we all know that people that you like (or your friends) are able to help you better, teach you better, and generally are more fun to interact with, than people that you don't like. However, 'liking' is person dependent. Not everybody likes the same person, and one person is not liked by everyone.

These observations sparked our interest in the application, effects, and design of a 'virtual friend'. An agent that observes it's user, and adapts it's personality, appearance and behavior according to the (implicit) likes and dislikes of the user, in order to 'become friends' with the user and create an affective interpersonal relationship. This agent might have additional benefits over a 'normal' Embodied Conversational Agent in areas such as computer assisted teaching and entertainment.

The above being the basis of our research, we were looking for a sound foundation on which to build research on a 'virtual friend'. This led us to the field of psychology. There is extensive knowledge about human interpersonal relationships in the field of personality and social psychology. However, psychology suffers from the fact that every person has 'judgement of character' and insight into 'human nature', which makes everybody a self proclaimed 'lay psychologist'. Hence, research and application of sound psychology research in other areas (such as computer science) is often found unnecessary. But lay psychology and folk wisdom is often proven wrong by psychology research. For example, folk wisdom dictates that,in human interpersonal relationships, 'opposites attract'. If a researcher would try to increase Human-ECA attraction by designing an ECA that is exactly the opposite of the human in terms of personality characteristics, it would be likely that the ECA would not be effective, because it has been shown hat attraction is greater when personality characteristics are similar. Thus, ECA design decisions need to be based on sound psychology research and not on 'folk wisdom' or otherwise.

Furthermore, recent computer science history already shows that application of rigid psychology in computer science is very useful: the application of cognitive psychology in computer science in the last two decades has resulted in improvements in problem-solving skills and task related behavior of computer users, thus improving Human-Computer Interaction effectiveness. Because communication with an ECA is social in nature, improving Human-ECA interaction should be accomplished by applying findings from social psychology. Consequently, a main aspect of our research is the application of (social) psychology in ECA design.

Research Questions

The object of the research is to extend the knowledge in the field of Embodied Conversational Agent (ECA) technology in Human-Computer Interaction, concerning human-ECA relationships and

human-ECA friendship, in order to make Human-Computer Interaction more effective. The research questions guiding this research are:

1. What is known about friendship in psychology research? In answering this question, we explored the psychology behind friendship, including:
    (a) What are the psychological mechanisms behind the formation of friendship?
    (b) What are variables and issues affecting friendship?
    (c) What are the effects of friendship on interaction?
2. How can we apply findings from research question 1 to Human-Computer Interaction? In answering this question, we took findings from psychology and translated them to a human-ECA situation. Sub questions were:
    (a) Is it possible to apply social psychology to human-ECA relationships, and if so, how?
    (b) How can we translate the knowledge about friendship in social psychology to useful insights in human-ECA friendship?
3. How does the answer to research question 2 affect the creation of ECAs? In this research question we applied he translation of human psychology to the design phase, design issues, and architecture of ECAs. Research sub questions were:
    (a) Given the translation of psychology, how can the design phase of an ECA be adapted to accommodate ‘friendlier’ ECA creation?
    (b) What are important issues in the design of ‘friendly’ ECAs and how can they be addressed?
    (c) Given what is known about human-ECA relations,how can the architecture of an ECA be adapted in order to create ‘friendlier’ ECAs?

Approach and Results

Because of the novelty of the object of research and limited time, this research has an exploratory and theoretical character, and focus has not yet been on a possible implementation. Research question 1 has been answered by means of literature research in the psychology literature, specifically research in social psychology of interpersonal relationships and attraction, and has resulted in a description of relevant theory. The answer on research question 2 has been based on the findings from research question 1 and translated to the human-ECA situation. Obviously, the CASA studies play a role here. We have looked at anthropomorphic characteristics of ECAs (gender, attitudes, emotion, personality, ethnicity) and what role they play in developing a friendship relation. Answering research question 3 has been done by presenting a way to create ‘friendlier’ ECAs that incorporates the findings of research question 2.

Among the issues we had to look at are the possible implementation of a reinforcement theory. From that perspective, the way to create a relationship between a human and an agent is to provide the human with rewards. These rewards can be numerous: fun, information, or other positive reinforcements. Hypothetically, if we use positive reinforcement, the human will become attracted to the agent. Social exchange theory dictates that the rewards of a relationship must outweigh the costs. Hypothetically, the same general principle can be applied to human-ECA relationships: rewards for the human ned to higher than costs for the human. Examples of rewards for humans are fun interactions or positive reinforcements, examples of costs are irritation or negative reinforcements. Equity theory dictates that the perceived input/outcome ratios of the parties involved should be equal. Hypothetically, this should be true for the human-ECA situation too. This means that the ECA should not be the only one to contribute towards a relationship, but the ECA should also ‘expect’ contributions from the user and ‘gain’ something out of the relationship. Communicating reciprocity of liking by an ECA could be an application of this theory.

In order to have a friendship relation with a human, the ECA needs to obey also the rules of human-friendship relations that deal with time. The relationship needs to be initiated and maintained, and in

each stage the ECA needs to conform to the rules that govern these stages of friendship, including a stage of decline.

Further considerations about the tranlation of mechanisms involved in friendship formation to the human-ECA situation include examining the influence of certain human characteristics. For example, when users are younger (or males) they may base the relationship with the ECA more on commonality, whereas oleder users (or females) may deem the relational features of a friendship as more important. Sexual attraction, social class and age simililarity, and ethnicity also influence attraction and friendship.

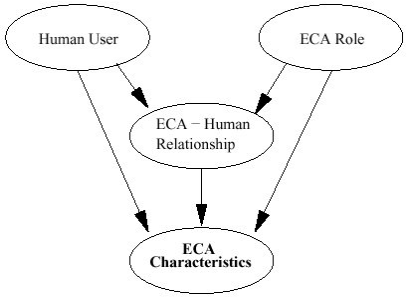

Figure 1: Interrelation of ECA design space characteristics

Research question 3 has resulted in a (modest) proposal for the design phase, a description of the relevant design issues, and an overview of an ECA architecture. The most straightforward way to incorporate the factors affecting friendship is to take the user characteristics, domain role and intended interpersonal role into consideration in the design process of he ECA, and incorporate them in the decision about the characteristics and competences of the ECA (Figure 1). In order to do so, a high abstraction level ECA design tool is needed, a *design method for the character of an ECA*. This design method has to facilitate consideration of the interrelation of user characteristics, ECA characteristics and -roles in order to increase friendliness. We propose a design process that is based on general scenario-based design, its specialization designed by, among others, Churchill et al., with focus on the earlier mentioned friendship aspects of ECA design.

There are several reasons why scenario-based design is practical as the design process of ECA characters. First, scenario-based design has already been used successfully in developing ECAs, so its validity is already shown. Furtermore, this application of scenarion-based design in ECA design showed that the method is useful for putting pieces of different research in ECA technology together. Most importantly, the design method is based on designing explicitly with social interaction in mind, and can be used to focus on the 'soft' side of the ECA design, the personality, roles, and competences. After the character of the ECA is designed on the action and interaction level, the design of the ECA on the representational and algorithmic level needs to begin.

Another way to increase friendship likelihood is to align the characteristics of the user and the ECA during interaction in order to facilitate friendship and attraction by *adapting the character* of the ECA to the perceived characteristics of the user (see Figure 2). The *ECA characteristics updating* part of the ECA changes the ECA characteristics according to some adaptation strategy. This strategy should be directed at finding the optimal set of characteristics for friendship, given the user model. Because the general tendency of humans is to like people that are similar to them, a plausible strategy could focus on adopting user characteristics (personality, attitudes) that are similar to those of the user. Eca's characteristics influences the actions and interactions of the ECA.

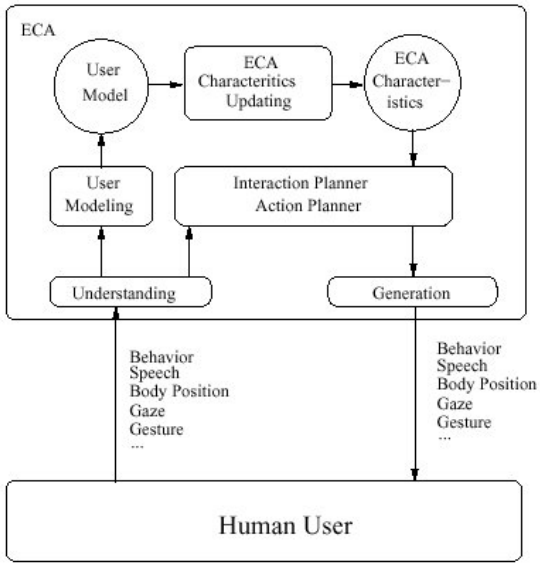

Figure 2: Example architecture for adaptation of ECA characteristics to the user model

Not all characteristics can be adapted. Certain issues in the environment of the ECA limit the adaptable characteristics. For example, if the personality of a sales-ECA would be adapted to be completely similar to the personality of a user, problems will arise when an extremely introvert user uses the agent. Constraints like this need to

be considered in the design phase of the agent, and integrated in the adaptation strategy of the ECA

Conclusions

Because of the theoretical research perspective, neither the design method proposed nor the adaptive architecture could be applied or tested. In order to test the scenario-based character design method ECA characters should be developed using his method. Depending on the experiences of the design process, the proposed method should be further refined and adapted. Research in adaptive ECA architectures should be continued by implementing an ECA architecture that adapts to the user, based on the technique proposed in our research.

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