Abstract

The objective of our research is to facilitate social conversation between persons affected with Alzheimer’s Disease (AD) and their caregivers via a future intervention for caregivers. In the intervention, a computer system will enable caregivers to practice spoken conversation with high-fidelity Virtual Patients simulating the verbal and non-verbal behavior of persons with AD (VP-AD). It is hoped that the skills acquired by the caregiver will improve the quality of life of persons with AD and reduce caregiver stress. In this paper, we describe a pilot study intended to evaluate the efficacy of active participation in conversation with a lower fidelity VP-AD in comparison to passive observation of the same VP-AD in conversation. The study found, after 15 minutes or less of practice, a significant increase in use of recommended caregiver communication skills by participants in the active condition.

Introduction

About 5.3 million people in the U.S. have Alzheimer's Disease (AD) (Alzheimer’s Association 2009). Many communication problems are associated with AD (Santro Pietro and Ostuni 2003, Bayles and Tomoeda 2007). It has been suggested that if caregivers can learn communication techniques to overcome these problems so that social conversation with persons with AD is enhanced, it may make a significant difference in the quality of life of persons with AD and thereby reduce caregiver stress (Dijkstra et al. 2004). For the most part, communication training courses for caregivers of persons with dementia have used non-technological modes of active instruction such as role playing with human trainers (Ripich et al. 1998, Burgio et al. 2001) and individualized one-on-one coaching (McCallion et al. 1999, Bourgeois et al. 2004). Irvine et al. (2003) describe an interactive multimedia computer program that enables a user to observe videos of conversations in which nurse aids demonstrate use of recommended communication techniques in conversation with actual patients. In addition, the program provides the user with interactive quizzes on the demonstrated techniques. Our goal is to develop a system that enables formal and family caregivers to practice spoken conversation with high-fidelity Virtual Patients simulating the verbal and non-verbal behavior of individuals with AD (VP-AD). By high-fidelity we include not only physical attributes such as appearance and voice but also the ability to participate in realistic spoken dialogue. In other words, development of a high-fidelity simulation will require spoken natural language dialogue capabilities and dynamic simulation of verbal and non-verbal behavior characteristic of persons with AD.

On the way to developing that system, we have developed a prototype system featuring a lower fidelity VP-AD. It is lower fidelity in the sense that the animation of the VP is cartoonish, the voices (produced by a text-to-speech synthesizer) do not sound natural, the dialogue follows a branching script, and the user is restricted to communicating with the VP-AD through a menu interface. Nevertheless, developed in consultation with an expert, the script is based upon conversational patterns found in actual dialogue with persons with AD and recommended communication techniques. This paper describes a pilot study we performed to compare the efficacy of active participation in conversation with the VP-AD in comparison to passively observing the VP-AD participating in conversation. The study found that active participation increases use of recommended communication techniques and suggests that it is more effective than passive participation.

Alzheimer’s Caregiver Communication Prototype

A screen shot of the system used in the active condition of the study is shown in Figure 1. The parrot labeled Buddy on the left of the screen provides hints on request and positive or negative feedback after each pair of
Caregiver-Patient turns of dialogue. To the right of Buddy, the person labeled Caregiver embodies the user’s point of view in the conversation. The person on the far right of the screen labeled Patient embodies the VP-AD. The text box labeled Buddy History records Buddy’s comments, and the text box labeled History records the dialogue between the Caregiver and Patient. For example the dialogue history in Figure 1 shows that the user chose to open the conversation with a greeting including the name of the patient (“Hello Ada!”), to which the Patient replied “Hello”. The Caregiver’s choices of what to say next appear on the menu between the Caregiver and Patient. The menu in Figure 1 shows that the Caregiver now has three options for continuing the dialogue.

After making a menu selection, the user may (1) ask Buddy for feedback by pressing the Get Hint button or (2) press the Talk button under the Caregiver to hear her say what the user has selected. In the latter case, the Caregiver’s spoken output is then recorded in the dialogue history box. To allow the user to control the pacing of the dialogue, he must next press the Talk button under the Patient to hear the Patient’s response (which is also recorded in the dialogue history box). The Patient’s response depends upon whether the user selected the correct choice or not. In the event the choice was incorrect, the Patient responds in an undesirable manner, and the menu is repeated so that the user can try another selection. The dialogue with the Patient moves forward only after the user selects the correct choice.

Three levels of hinting are provided for each menu choice on request. The first time the user requests a hint on a particular correct choice, the hint provides positive feedback and a very brief explanation of why it is a preferable choice. The second and third time a hint is requested for a choice, the system provides progressively more detailed explanations of why the choice is preferable. If a user requests a hint on an incorrect choice, Buddy provides a brief hint encouraging the user to try an alternative approach to communicating with the Patient. In addition to providing hints on request, after the Patient’s turn Buddy provides feedback on the correctness or lack of effectiveness of the Caregiver’s last choice. For example, the Buddy History in Figure 1 shows the feedback given on the user’s choice for opening the conversation.

The system is designed so that a user can select different conversational scenarios, each one lasting a few minutes. Each scenario consists of an autobiographical vignette from the Patient’s life. In the scenario used for the study, if all of the user’s choices are correct the dialogue consists of eighteen turns.

For the passive condition of the study described in the next section, an alternate version of the system was implemented. Using the same script as the active version, the passive version is identical in operation except that the menu of choices for the Caregiver’s turn is not displayed and the Get Hint button is disabled. The choice for each of the Caregiver’s turns is hard-coded. The user still controls the pacing of the dialogue using the Talk buttons under the Patient and Caregiver. Although proactive hinting is disabled in the passive condition, after each pair of Caregiver-Patient turns Buddy gives the same feedback on the Caregiver’s choice that is given in the Active condition.

To give the user in the passive condition a chance to observe both correct and incorrect choices and the accompanying feedback from Buddy, the dialogue is divided into four segments. Each segment begins with a Caregiver choice that is incorrect in the current context followed by the Patient’s undesirable response. After Buddy’s feedback on the exchange, the segment is repeated beginning with the correct choice in the current context.

The prototype system used in the study was constructed by adding the hinting functionality to the software described in (Green et al. 2004), implementing a different script, and making some modifications to the user interface.

The caregiver communication skills taught through the dialogue are illustrated in the following exchanges between the caregiver (C) and Ada (A), a person with Alzheimer’s.

1. **Begin a conversation with a greeting and use the patient’s name to get her attention:**
   C: Hello Ada!

2. **Show empathy for the patient:**
   C: Hey there. You doing ok?
   A: Not too good.
   C: I am sorry.

3. **Balance negative answers with positive:**
   A: Is it time for a snack?
   C: No, I’m sorry. It will be soon though.

4. **Use yes-no questions:**
   C: Does this picture look like your bird?

5. **Rephrase a question if it is not understood:**
   C: Does this picture look like your bird?
   A: Like mine did you say?
   C: This bird looks like yours?

6. **Use newsmarks:**
   C: And what was his name?
   A: Budgy!
   C: Budgy!

A newsmark, illustrated by C’s emphatic repetition of the name in example 6, conveys to A the noteworthiness of A’s preceding turn and thereby helps sustain the conversation (Ramanathan 1997).
Study

The study used a between-subjects design. The sixteen participants were undergraduate university computer science students at least eighteen years of age who volunteered and received no compensation. Participants were randomly assigned to the active or passive condition. The study was conducted in a laboratory with three to five students at a time. The procedure was the same for students in both conditions. When each group of students arrived, they were asked to read the informed consent form and to sign it. Then each student who agreed to participate was assigned to a separate desktop computer with headphones and given one page of written instructions. The purpose of the headphones was so that the student would not be distracted by spoken output from the other computers. The instructions covered taking a pre-test and post-test and briefly described the user interface controls for the simulated conversation. After reading the instructions, students took the on-line pre-test. Next, each student used the (active or passive version of the) system. The instructions said to use the system as long as desired for up to 15 minutes. After finishing, the student completed the on-line post-test.

The pre-test and post-test each contained three multiple choice questions designed to assess acquisition of three communication skills demonstrated in the scenario (e.g., see Figure 2). For each question, the student was asked to select the most appropriate thing to say in a certain situation. Different situations and dialogue were used in pre-test and post-test, and the test situations and dialogue differed from the scenario used for training. For test questions on situations involving several turns of dialogue before the user’s turn, the preceding turns were displayed in text on the screen and output as speech by the system.

The gain in mean communication skill test scores from pre-test to post-test was .88 (SD .835, p=.045) for the active condition (N=8) and .38 (SD .518) for the passive condition (N=8). Using a one-tailed independent t-test, the difference between active and passive groups was weakly significant (p=.086).

In addition to objective assessment of communication skill acquisition, the post-test included four subjective questions with responses on a five-point Likert scale: none (1), some (2), average (3), more than average (4), and much more than average (5). The results for the active and passive conditions combined (N=16) are as follows: the students rated their previous experience with a person with AD (question 1) at 1.88 (SD1.088); rated the realism of the VP-AD (question 2) at 2.25 (SD 1.238); rated the extent to which the interface controls interfered with the simulation (question 3) at 1.56 (SD .727); and rated how much using the program had improved their ability to have a social conversation with someone with AD or a similar condition (question 4) at 3.13 (SD 1.204).

Related Work

For a summary of published communication training interventions for family caregivers of persons with AD, see (Byrne and Orange 2005). (Levy-Storms 2008) critiques experimental research on training formal caregivers (certified nursing assistants) in therapeutic communication with persons with dementia in long-term care institutional settings.

As far as we know, there has been no other work on creating conversational VPs for improving caregiver communication with persons with AD. The menu mode of interaction with the VP-AD in our current prototype is similar to that used in systems designed to counsel healthcare clients on exercise (Bickmore et al. 2004) and coping skills (Marsella et al. 2000). As in FitTrack (Bickmore et al. 2004), the social function of language is important in conversation with the VP-AD. Virtual characters with spoken dialogue capabilities have been developed for training or testing doctors on patient interviewing (Kenny et al. 2007, Johnsen et al. 2007, Hubal et al. 2007), as well as for training law enforcement personnel to interact with potentially mentally disturbed individuals (Hubal et al. 2003). Notably, Johnsen et al. (2007) found a significant correlation between medical students’ interaction with a virtual patient and interaction with trained actors.

Conclusion

The communication skill test results suggest that active participation in simulated dialogue is more effective for communication skill acquisition than passive observation. We feel hopeful, therefore, that as we increase the fidelity of interaction by allowing the user to engage in spoken language dialogue with the VP-AD and by providing more realistic simulation of behavior of a person with AD, efficacy will continue to improve.

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References


1. You have just entered Ada’s room. You notice a new framed photograph of Ada and her grandchildren at a birthday party. Ada is looking away from you.

   Now what do you say?
   a. Whose birthday is that?
   b. That's new!
   c. **Hello Ada!**
   d. None of the above.

2. Imagine you and Ada have been talking as follows.
   You: How are you today?
   Ada: Got a little cold.

   Now what do you say?
   a. Me too.
   b. **That's too bad.**
   c. It must be going around.
   d. None of the above.

3. Imagine you and Ada have been talking as follows.
   Ada: My daughter came to visit this morning.
   You: What's her name?
   Ada: What?

   Now what do you say?
   a. What's your daughter's name?
   b. **Your daughter's name is Cindy?**
   c. Can you tell me her name?
   d. None of the above.