Blissful Agents: Adjuncts to Group Medical Visits for Chronic Pain and Depression

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Abstract. In this paper we describe a conversational virtual agent that is designed to be used in conjunction with group medical visits to help treat individuals with chronic pain and depression using non-medical treatments including yoga, meditation, and self-massage. Results from two rounds of pilot testing indicate that patients like the virtual agent and find that it helps them manage their condition.

Keywords: relational agent, meditation, yoga, complementary and alternative medicine.

1 Introduction

Several virtual agents have now been developed to deliver one-on-one counseling for a variety of health conditions [1]. However, an increasingly popular mode of delivery for medical and behavioral interventions for chronic health conditions is the group medical visit, also known as a "shared medical appointment". Despite the advantages of group visits, patient adherence to medical advice in-between group visits remains a problem. Recommendations for diet, exercise, and other self-care tasks are rarely followed exactly, especially over the long term. Virtual agents may be able to bridge the time between group visits by reinforcing information delivered during visits, guiding patients through self-care procedures, motivating adherence to the overall intervention, and providing a virtual source of social support.

A number of virtual agents have been developed in recent years to counsel patients on health problems in general, and chronic disease self-care, in particular [1]. Several agents have been developed specifically to help individuals manage chronic health conditions. Monkaresi, et al, developed the "IDL coach", an embodied conversational agent (ECA) that helps individuals with diabetes manage prescribed exercise, nutrition, blood glucose monitoring, and medication adherence, although no evaluation studies are reported [2]. Bickmore, et al, developed an agent to help individuals with schizophrenia to manage their condition, to increase physical activity, and to continue to take prescribed antipsychotic medication; promising results from a quasi-experimental pilot evaluation have been reported [3]. ICT's SimCoach is an ECA that

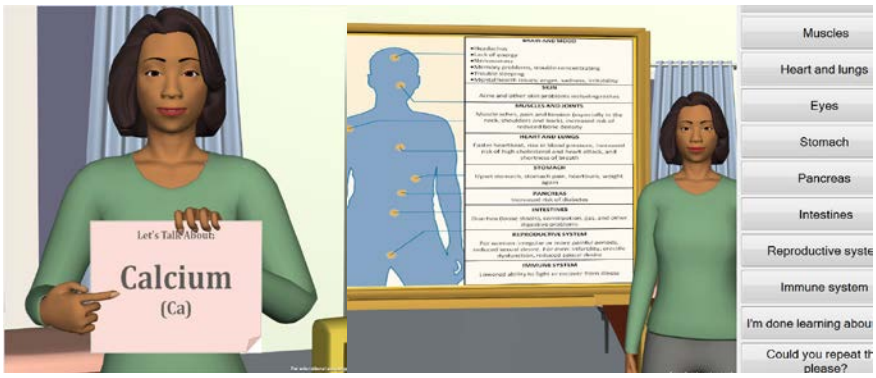

Fig. 1. Screen Shots of Gabby Agent and Chronic Pain Intervention

was designed to address depression and/or post-traumatic stress disorder (PTDS), although results from a large randomized controlled trial with 333 patients failed to find any clinically significant benefits of using SimCoach [4].

We developed a virtual agent that assists patients with chronic pain and depression. To evaluate this system, we conducted two pilot studies in which patients interact with the virtual agent at home, and use it to review the material covered in each visit in more detail, as well to practice self-care skills such as meditation and yoga.

2 Design of the Agent-based Intervention for Chronic Pain

The virtual agent used in our work is animated in a 3D game engine using custom animation software, running on a dedicated-use 8" touch screen tablet computer provided to patients. The agent is designed to appear as a racially ambiguous female in her mid-forties. The agent's nonverbal behavior is generated using BEAT [5], and includes hand gestures and eyebrow movements, as well as a range of iconic, emblematic, and deictic gestures. The agent speaks using synthetic speech, and user input is obtained via selection of utterances on the touch screen (Fig. 1)

The agent guides patients through nine weeks of new material in coordination with the group visits. Each week, following a group visit, the agent reviews the new educational material just learned (on nutrition, physical activity, pain, stress, sleep, and depression), walks patients through practice sessions (e.g. meditation and yoga), and allows them to review material covered in prior weeks.

3 Pilot Evaluation Study

We conducted two rounds of pilot testing of the virtual agent with chronic pain patients, in conjunction with medical group visits at BMC. The pilot studies allowed us to collect users' feedback on the initial system, as well as their suggestions to improve the system for the main randomized controlled trial.

Participants. Twenty patients aged 26-60 (mean 47), 75% female, were recruited. Patients were predominantly low-income minority adults (50% African-American, and 25% white), and 60% had incomes near or below the poverty level.
Measures. We assessed participants' satisfaction with and attitudes towards the agent at the end of the intervention, as well as health behavior change using six validated self-report questionnaires before and after the 9-week intervention.

Table 1. Self-Report Ratings of Agent in Pilot Studies

Question	Anchor 1	Anchor 7	Agent
How satisfied were you with talking to Gabby about reducing stress?	Not at all	Very satisfied	5.9
How satisfied were you with talking to Gabby about healthy eating?	Not at all	Very satisfied	5.6
How helpful was Gabby in reducing your stress?	Not at all	Very helpful	5.6
How helpful was Gabby in improving healthy eating?	Not at all	Very helpful	5.8
How easy was it to talk to Gabby?	Very difficult	Very easy	6.2
How much do you trust Gabby?	Not at all	Very much	6.2
How well did Gabby answer any questions that you had?	Not at all	Very well	5.7
Did you feel like Gabby provided support and encouragement to reach your goals?	Not at all	Very much	6.2
Would you like to interact with Gabby again?	Not at all	Very much	5.9
How much would you have preferred talking to a doctor or nurse than to Gabby?	Definitely prefer doctor/nurse	Definitely prefer Gabby	4.2

Results. Based on analysis of log files from the tablet computers, patients spent an average total of 90 minutes (range 0-294, SD 80.2) interacting with the virtual agent at home over the nine weeks of the intervention.

Ratings of the agent were very high, with overall satisfaction rated 5.9 on a 1-7 scale (Table 1). Quantitative data from validated health questionnaires was collected in person at baseline, and at nine weeks (Table 2). Although these are quasi-experimental results (no control group), patients did report significant improvements in depressive symptoms, social support, stress, patient activation, and medication misuse, over the nine weeks of the intervention.
Conclusion. We demonstrated that a home-based virtual agent can be effective for patients with chronic pain and depression, when used in conjunction with medical group visits, especially for patients who are low income, disadvantaged minorities. Our study indicates that even individuals who have little experience with technology find the virtual agent an acceptable and effective medium for receiving healthcare.

Acknowledgments. This work was funded by grant AD-1304-6218 from the Patient-Centered Outcomes Research Institute.

Table 2. Pre-post Changes in Health Conditions in Pilot Studies (mean (SD))

Measure	Baseline (N=20)	9-Weeks (N=13)	p-value
Pain Self-Efficacy Questionnaire (PSEQ) [6]. A 10-item questionnaire that assesses individuals' confidence in performing activities while they are in pain.	28 (12.9)	35 (12.2)	.10
Patient Health Questionnaire (PHQ-9) [7]. A standard 9-item questionnaire used for measuring depression	11 (5.2)	7 (3.9)	**.02**
Duke-UNC Functional Social Support (FSS) [8]. An 8-item questionnaire to measure the strength of one's social support	3 (1.4)	4 (0.76)	**.03**
Perceived Stress Scale (PSS-4) [9]. The most widely-used scale to measure a person's perceived stress	8 (2.9)	6 (3.4)	**.049**
Patient activation (PAM) [10]. Assesses patient empowerment and confidence to take care of themselves	41 (5.2)	44 (5.7)	**.001**
Current Opioid Misuse Measure (COMM) [11]. Medication misuse of pain patients on long-term opioid therapy	12 (8.3)	9 (5.4)	**.01**

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