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Poster

# Real-Time Tailoring of Depression Counseling by Conversational Agent

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## Abstract

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**Background:** Depression is the leading cause of disability in the world, with over 350 million people affected worldwide. To address this, many researchers have developed computer-based therapy systems to treat this condition. However, many of these systems have been shown to have significantly worse retention than face-to-face counseling, limiting their effectiveness. We believe this discrepancy is partially due to these systems' inability to respond to a user's emotional state in real time.

**Objective:** We have developed an affectively aware virtual agent for depression counseling: an animated computer character that responds to users' affective states in real time during virtual therapy sessions. The virtual agent guides users through a manualized cognitive behavioral therapy (CBT) intervention, while sensing users' affect from their facial expressions and changes in speech prosody. During this simulated face-to-face conversation, the agent provides real-time tailored responses in response to sensed user affect. The automatically generated responses corresponded to empathic statements that allowed participants to pause the interaction in order to calm and compose themselves and reflective statements that rephrased emotionally sensitive content elicited from participants to emulate empathic listening.

**Methods:** We conducted a quasi-experimental pilot study to assess acceptance of the system by individuals with mild to moderate depression. Ten individuals (5 male, 5 female, aged 18-28) participated in a single 30-minute CBT-based session with the affectively aware virtual agent. We measured depression (Patient Health Questionnaire-9, PHQ-9) and state anxiety before and after the session and self-reported attitudes towards the system on scale measures and via a semi-structured interview.

**Results:** Participants scored between 5 and 15 (mean=6.6, SD=2.7) on baseline depression measures (PHQ-9). No significant changes were found in pre-post tests for depression (pre-interaction mean=8.0, SD=4.62, post-interaction mean=6.4, SD=3.13) or anxiety (pre-interaction mean=23.3, SD=6.46, post-interaction mean=21.78, SD=7.61), although both trended towards improvement. Agent ratings were generally neutral across the board, with satisfaction (mean=4.5, SD=1.35), desire to continue using (mean=4.2, SD=1.6), trust (mean=3.9, SD=1.66), and likability (mean=4.4, SD=1.7) scoring around the mid-point. Thematic analysis of the semi-structured interviews indicated that 50% of participants reported that the agent evoked emotional responses in them during the interactions and that 70% of participants felt the agent understood their emotional state. Participants stated that this was caused by the agent presenting them with "information they did not realize" (Patient 5) and that the agent "... understood my emotions because I felt that it gave me the right responses" (Patient 8).

**Conclusions:** This study suggest that it is possible for a virtual agent to evoke and respond to a user's emotional state in real time during counseling sessions. Although we did not design this study to produce significant changes in depressive symptoms due to its size and duration, the majority of users expressed that they felt the agent understood their emotional state and responded appropriately.

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**KEYWORDS**

depression; virtual counseling; computer-mediated therapy

This poster was presented at the Connected Health Symposium 2016, October 20-21, Boston, MA, United States. The poster is displayed as an image in [Figure 1](#) and as a PDF in [Multimedia Appendix 1](#).

**Figure 1.** Poster.

**Real-time Tailoring of Depression Counseling by Conversational Agent**

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**Overview**


Depression is one of the leading causes of disability in the world effecting more than 350 million people. While other researchers have developed computer based therapy systems, most have been shown to be equally or less effective than traditional face-to-face therapy. This discrepancy is due, in part, to the inability of these systems to detect and react to a user's emotional state during therapy sessions.

To address this, we developed an affectively aware virtual therapist that detects and responds to a user's emotional state in real time during their interaction with the system.

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**What is a Virtual Agent?**

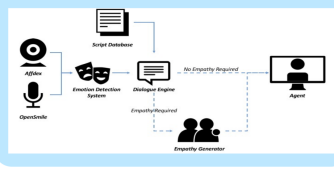
Our virtual agent, Tanya, is an animated computer character that emulates face-to-face conversations through both verbal and non-verbal behavior. While interacting with the system, the user's emotional state is captured via speech processing and webcam input.




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**Responding Intelligently to a User's Emotions**

Based on theories that explore the role of emotion in therapy we developed an empathy generator to automatically respond to a user's emotional state during a conversation. This generator automatically created empathic statements and reflective dialogue to both assess the accuracy of its detection software and to build user rapport.




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**Automated Empathic Responses**

After detecting negative affect during a interaction, the agent prompted users with the following:

**Agent:** You sounded pretty sad, do you need a minute before we go on?

**Button Prompts:**

- **Yah.**
- **I'm fine, let's continue.**

After eliciting emotional sensitive dialogue:

**User expresses:** "Feelings of hopelessness, pessimism", "Feelings of guilt, worthlessness, helplessness", "Decreased energy, fatigue, feeling slowed down"

**Agent:** So you have been feeling hopeless, helpless and exhausted recently?

**Pilot Study**

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**Task**

Participants interacted with the affectively aware virtual therapist to complete the first session of a cognitive behavioral therapy intervention

**Design**

Design Type: Quasi-experimental

**Measures:**

- PHQ-9
- State Anxiety
- Attitude towards agent questionnaire
- Semi-structured Interview

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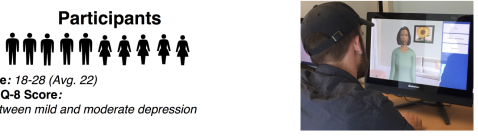
**Conversational Topics:**

- How to interact with the agent
- What is depression
- Reviewing the user's depressive symptoms
- The user's thoughts on therapy
- Introduction to cognitive behavioral therapy

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**Participants**

Age: 18-28 (Avg. 22)  
PHQ-8 Score:  
Between mild and moderate depression




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**Results**

**Quantitative Findings**

Pre/post testing conducted immediately before/ following the agent interaction found no significance differences in depression or anxiety, although both trended in a positive direction.

	Pre Interaction	Post Interaction
PHQ-8	8 (4.62)	6.4 (3.13)
State Anxiety	23.3 (6.46)	21.78 (7.61)

**Qualitative Findings**

Thematic analysis of the semi-structured interviews found that participants felt the virtual therapist evoked emotional responses in them during the interaction.

- [The agent] "... understood my emotions because I felt that it gave me the right responses" (Participant 8)
- [The agent] "... could decipher some of my attitudes" (Participant 10)
- [I felt emotional because the agent presented] "... information I did not realize" (Participant 5)

**Multimedia Appendix 1**

Poster.

[\[PDF File \(Adobe PDF File\), 10MB-Multimedia Appendix 1\]](#)

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