

An Affect-Aware Dialogue System for Counseling

Lazlo Ring

Abstract

Emotions play a key role in human-human communication. Because of our emotional understanding, we communicate empathic cues to others that act as foundations for building relationships and gaining trust. This is especially important in the healthcare domain, where empathy has been linked to improved doctor-patient relationships and stronger therapeutic bonds. However, as we move towards developing automated healthcare solutions, this rich channel of information can be lost.

To address this lack of emotional understanding by computational interfaces, researchers have developed techniques to detect and respond to the user's emotional state in real time. While research in emotion detection has achieved positive outcomes, the question of how automated systems could effectively use this information for empathic communication remains largely unanswered. Simple techniques such as mirroring back a user's emotions have been shown to be unsuccessful, and almost none of this work being done in the healthcare domain.

In this dissertation, I present a novel approach that allows computers to automatically adapt and respond to a user's emotional state. Informed by an analysis of empathic communication in the context of human-human counseling, I develop a theoretical framework that integrates empathy into automated healthcare systems. I demonstrate how this framework can be applied to develop an automated depression counseling system, and evaluate its efficacy in a series of evaluation studies. In a longitudinal evaluation study with 36 participants, I compare an affect-aware version of the system against a conventional counseling system. Results show that participants received improved therapeutic care and had higher levels of system engagement using the affect-aware version.

Acknowledgements

Throughout the PhD process, many people have helped me through their guidance and their encouragement. In this section I would like to acknowledge those who have stood out as being invaluable resources in helping me get to where I am today.

I'd like to thank my advisor, Timothy Bickmore, for guiding me to become a better researcher and for helping me to pursue my academic dreams. I would also like to thank Stephen Intille, Stacy Marsella and Paola Pedrelli for being on my PhD committee and for the invaluable feedback they have given me on my work.

I would like to thank the many labmates I have had throughout the years, who have assisted me throughout my endeavors. I would especially like to thank Daniel Schulman and Laura Pfeifer Vardoulakis for introducing me to the PhD program and by teaching me what I needed to know to survive. Also, I would like to give a special thanks to James Yin, Juan Fernandez, Liang Zhang, Reza Asadi, Ramesh Radhakrishna Manuvinakurike, Dina Utami and Ha Trinh for being not only great lab mates, but awesome friends throughout my academic journey.

Finally, I would like to thank all my friends and family members for supporting me over the years, without your help I would have never made it to where I am today. I would especially like to thank my parents for letting me pursue my dreams. Lastly, I would like to thank Thien An Nguyen who has been with me through my whole journey, inspiring me to work harder every day; I could have never done this without you.

Contents

Abstract	2
Acknowledgements	3
Contents	4
Chapter 1: Introduction	9
Dissertation Outline	12
Chapter 2: Related Work	13
Understanding and Classifying Emotion	13
Classifying emotions	13
Understanding and Treating Emotional Disorders	15
An Overview of Cognitive Behavioral Therapy	15
An overview of the therapy process	16
Understanding cognitive distortions	16
Understanding and utilizing thought records	16
An Overview of Emotion Focused Therapy	17
Fixing maladaptive emotion schemas	17
Buffering through affect regulation and coping skills	18
Phase 1: Bonding	18
Phase 2: Evoking and exploring	18
Phase 3: Emotion restructuring	19
Intelligent Cognitive Behavioral Therapy Systems	19
MoodGYM	20
Beating the Blues	21
Agent-Based Counseling	21
Longitudinal agent systems	22
Empathic Systems	22
What is Affective Computing?	22
Automated affect detection	23
Automated sympathy	24
Empathy	24
Empathic systems	25

Chapter 3: The Role of Empathy in Human-Human Counseling	26
The Structure of a Counseling Session	26
Addressing Problems between the Counselor and Patient	27
Session problems	28
Out-of-session problems	28
How a Counselor Adapts to a User's Affective State	28
Addressing emotional discrepancies	29
Reflective dialogue	30
Reacting to extreme emotions	31
Emotion and Counseling in Research	32
Automating the Empathic Process	33
Understanding the user's emotional state	33
Addressing emotional discrepancies	34
Simulating reflective dialogue	34
Reacting to extreme emotions	34
Chapter 4: Towards an Affectively Aware Counselor	36
The Feasibility of User Mood Classification by Human Judges:	36
Results	37
The Effects of Form of Request and Mood on Persuasion	37
Hypothesis	38
Measures	38
Experiment	39
Results	39
Discussion	41
Chapter 5: An Affectively Aware Dialogue Framework for Counseling	43
Overview of Framework	43
Reflective dialogue	44
Emotional discrepancies	44
Responding to extreme emotions/emotionally sensitive material	45
Example Implementation	45
Dialogue engine	46
Emotion detector	46

Empathy generator	47
Reflective statements	48
Emotional discrepancy	48
Responding to extreme emotions/emotionally-sensitive material	48
Responding to other emotions	48
Anger	49
Fear and Anxiety	50
Shame	50
Chapter 6: Evaluating the Feasibility of Deploying an Affect-Aware Virtual Agent for Counseling	52
Prototype System	52
Emotion detection	53
Pilot Study	54
Study design	54
Participants	54
Measures	55
Results	55
Quantitative results	55
Qualitative results	56
Behavioral results	57
Discussion	57
Detection limitations	57
Design limitations	58
Chapter 7: A Longitudinal Evaluation of an Affective-Aware Virtual Agent for Depression Counseling	59
System Changes	59
Scripting language improvements	59
Script structure	60
Improved agent design and conversational features	60
Changes to emotion detection	61
Semantic script analysis	61
Empathy changes	63
Study Design	64

Participants	64
Enrollment and conditions	64
Measures	65
Study Results	65
Baseline Measures	66
Usage Metrics	68
Depression Metrics	70
Pre-post analysis	70
Time series analysis	71
Working Alliance	73
Agent Ratings	74
Semi-Structured Interview Analysis	78
General system impressions	79
Changes in depressive symptoms over the course of the study	79
Emotional experiences with the system	80
Emotional intelligence of the system	81
Preference of real therapist or system	81
System engagement	82
Comments about system usage	83
Recommending the system to others	83
Affective Response Analysis	83
Analysis of user's choices	84
Homework and Thought Record Analysis	86
Power Analysis	89
Discussion	89
Differences in system usage	90
Differences in agent ratings	90
Changes in depressive symptoms	90
Acceptance of affective tailoring	91
Limitations	91
Future Work	92
Chapter 8: Conclusions	93

Future Work	94
Appendix A: Agent Dialogue from Longitudinal Evaluation Study	97
Appendix B: Questionnaires for Longitudinal Evaluation Study	185
PHQ-8	185
State Anxiety	187
Agent Satisfaction	190
Working Alliance	192
Appendix C: Interview Questions for Longitudinal Evaluation Study	194
For All Conditions:	194
For Character Conditions	194
Appendix D: Sample Therapy Transcript with Section Annotation	196
References	206

Chapter 1: Introduction

Emotional expression is a key component in human-human communication. Through our non-verbal expressions of emotion, we communicate our internal states in ways that are universally understood within a culture [39], and as some theorize, across all cultures [29]. Equally important, expressing understanding of these displays of emotion plays an important role in how we build and maintain our relationships [25] and develop trust in others [20]. This need for emotional understanding has been seen in a variety of disciplines ranging from customer service [76] to marketing [55]. Where it may be most prevalent however, is the healthcare domain. Studies have shown that emotional understanding plays a key role in improving communication between doctors and patients [93] and establishing healthy therapeutic relationships [47]. When interacting with today's computer systems, however, these rich channels of communication are lost.

This is especially worrisome given the rise of automated healthcare systems over the last two decades [61]. Today's automated healthcare systems provide care to patients by displaying interactive web pages for the user to read [106], or by mimicking face-to-face conversations through the use of complex dialogue systems built upon models of human discourse [4]. While the majority of these systems lack emotional understanding, incorporating this understanding could significantly increase the quality of care provided by these systems [74]. Results of a recent study have shown that even the simplest display of empathy in these systems can lead to significantly improved health outcomes for users [80].

One area that emotional understanding would be especially important for is automated mental health counseling. Recently, disorders like depression have been on the rise [71], affecting over

350 million people in the United States alone [54]. Classified as a disorder in which one feels extreme sadness or hopelessness for a long period of time [2], patients of depression are often prescribed therapy to treat their disorder. While effective, less than half of those diagnosed receive any forms of treatment [73] due to the cost, availability, and social stigma related to the therapy [86].

To address this, some researchers have developed automated counseling systems [106,107].

While effective, these systems are still greatly inferior to standard human care [21], with significantly higher dropout rates and lower efficacy. This is likely due to the affective nature of therapy, which is often designed around having patients express their emotions to provide mental and physical relief [37] or by having therapists help their patients to identify and understand their emotional states [42].

In order to rectify this lack of emotional intelligence in existing computer systems, researchers in affective computing have begun to develop methods to automatically detect and respond to a user's emotions in real time. While there have been great advances in accurately detecting a user's emotional state [30,69], the answer to how a system should respond to a user's emotional state is still largely unknown. Researchers such as Bursell have explored the development of complex computer systems that monitor a user's emotional state through suites of sensors, only to find that simple reactionary responses such as mirroring a user's behavior provide no significant improvements in user experience [13]. Similarly, attempts to use emotional cues to guide interactive tutoring systems have had little to no success, only showing slight improvements in acceptance rates with the empathic variants, and no significant differences in learning outcomes [28]. Furthermore, very little of this work has been done in the healthcare

domain, leaving even more questions about its potential efficacy in automated healthcare systems.

The goal of this dissertation is to investigate how to effectively integrate emotional understanding into automated health counseling systems. In this work, I explore the potential power of emotional understanding in such systems, and propose a general theoretical framework for automatically responding to a user's emotional state. To accomplish this, I set forth the following questions to answer:

1. How does a user's emotional state impact their reaction to dialogue given by a health counseling system?
2. Should a health counseling system adapt to real time changes in a user's emotional state?
3. How does emotional responsiveness impact system efficacy in longitudinal health behavior change interventions?

Through the work presented in this dissertation, I answer these questions and provide the following contributions to HCI and health informatics:

1. Demonstration that messages tailored to a user's emotional state have a significant impact on the efficacy of health behavior change systems.
2. A theoretical framework outlining how empathic feedback should be incorporated into health behavior change systems.
3. An empirical study demonstrating how this framework was successfully used to guide the development of a longitudinal health behavior change system and the resulting benefits patients received.

Dissertation Outline

In this dissertation I aim to answer my research questions through literature review and a series of empirical studies of computational artifacts along with a theoretical framework to guide their design. In Chapter 2 I review related work that explores the importance of emotional understanding, as well as previous work in designing intelligent counseling systems. Following this, I present an analysis of the role of empathy in human-human counseling in Chapter 3, based on traditional, face-to-face human counseling. I then answer the first of the proposed questions in Chapter 4 by presenting a study of the effects of affectively tailored dialogue in a month-long health behavior change intervention. Chapter 5 then presents the theoretical framework used to guide the design of an affectively-aware counseling agent. In Chapters 6 and 7, I present two empirical studies designed to evaluate this framework, in which I show its efficacy and answer questions two and three. Finally, I conclude the dissertation and discuss future directions of research.

Chapter 2: Related Work

Before developing an affectively-aware agent for counseling, we must first establish a working understanding of emotions and their role in human-to-human counseling. In this section, I explore the purpose of emotions, the way they are classified, and the problems that arise from their existence. Afterwards, I examine the way counselors integrate emotional understanding into their practices by reviewing the use of empathy in cognitive behavioral therapy and emotion focused therapy. Finally, I review prior attempts at developing affective aware systems and other automated health counseling systems to gain a further understanding of the issues currently present in this field.

Understanding and Classifying Emotion

Emotions are a crucial part of human existence that influence and motivate our every action. Due to this, emotions have been a fundamental part of psychotherapy since its creation, when Freud found that patients could be cured of their physical ailments through the discussion of emotionally traumatic events [37]. Over one hundred years later, researchers like Fredrickson, Hamilton, and Williams [36,44,103] are still exploring the relationship between emotion, cognition and physical well-being.

Classifying emotions

Before exploring the importance of emotions in human-to-human counseling, we must first understand how emotions are classified and differentiated from one another. Traditionally, emotions were classifiable into one of seven different types: anger, disgust, fear, happiness, sadness, surprise, and contempt [29]. These emotions were considered distinguishable from each other through unique sets of nonverbal behaviors, such as raising the corner of the lips when

expressing happiness (i.e. smiling), or lowering the corners when expressing sadness. However, researchers quickly found fundamental flaws in this model, such as evidence disproving cross cultural expressions of emotion [48] and examples demonstrating that context plays an important role in the recognition process [53].

To address this, dimensional models of emotion were developed which conceptualized the space of emotional expressivity across two or three different dimensions. One of the most prominent examples of this is Russel's circumplex model, which classifies emotions with a nine-by-nine scale [85]. In this model, a subject's valence (how positive or negative they feel) is represented by their position on the horizontal axis, while their arousal (how sleepy or excited they are) is represented by their position on the vertical axis (Figure 1).

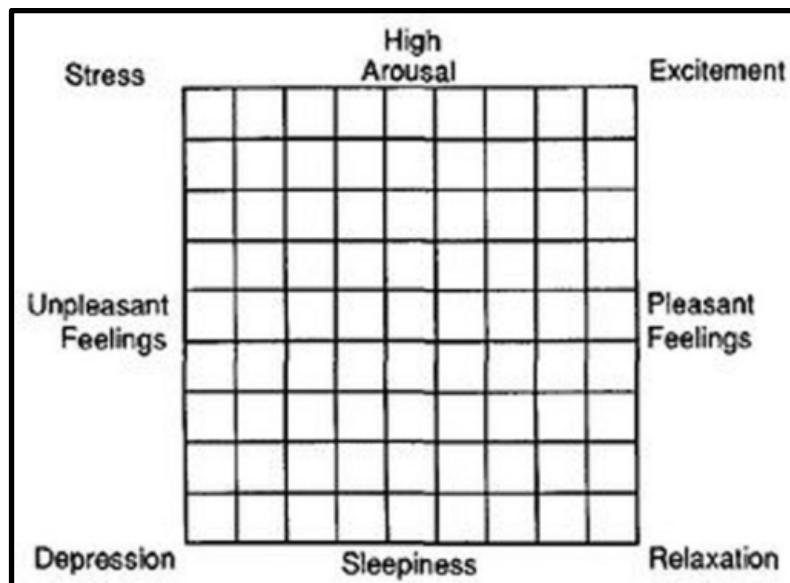


Figure 1: Affect Grid

This is not to say that these dimensional models are without flaws. In Chapter 4 we explore the difficulties human judges have in labeling emotions further, in a study that demonstrates the problems unique to both of these models.

Understanding and Treating Emotional Disorders

Utilizing these models, we can begin to explore how emotional disorders manifest themselves, and how they are treated. Caused primarily by negative emotional reactions due to misattributed thoughts, many of these disorders result in patients getting stuck in a cycle of negative thoughts and self-doubt. These misattributed thoughts, referred to as cognitive distortions[14], are the primary focus of many therapeutic frameworks in which the therapist tries to help patients identify inaccurate thought patterns to help them regain a positive view towards life. This is probably best exemplified by Cognitive Behavioral Therapy, which focuses on the connection between a patient's thoughts, feelings, and behaviors.

An Overview of Cognitive Behavioral Therapy

Cognitive Behavioral Therapy, also referred to as CBT, is one of the most commonly used approaches to treating cognitive distortions. Focusing on teaching patients how to better understand the connection between their thoughts, feelings, and behaviors, CBT teaches patients how to identify and re-conceptualize maladaptive thought patterns. This technique has been shown to be highly effective, with studies showing upwards of sixty-one percent of participants exhibiting improved depressive symptoms after completing a full course of therapy [34]. Furthermore, it has been shown that the use of empathy in therapeutic settings can result in significant increased recovery rates for patients [15]. However, CBT is a lengthy process, often requiring weekly visits to a trained counselor for several months.

A standard CBT intervention usually covers the following topics [49]:

An overview of the therapy process

The first few sessions of CBT will primarily revolve around educating the patient on the goals of therapy, educating them about their disorders, and exploring how CBT can be used to treat them.

The goal of these sessions is to teach patients that they are not alone in their struggles, and to help build a common vocabulary for the therapist and patient to use in future sessions.

Understanding cognitive distortions

Building upon the basic principles outlined during the patient's introduction to CBT, the next part of the therapeutic process has the patient learning about cognitive distortions and the ways in which they commonly manifest themselves. This often involves the patient reviewing events in their life from an outside perspective and working with the therapist to identify some of the recurrent maladaptive thought patterns that may be causing them to negatively perceive events in their lives.

Understanding and utilizing thought records

Expanding upon the lessons learned from reviewing cognitive distortions, therapists will begin to introduce the concept of a thought record to the patient, a standardized form designed to help them review impactful events in their daily lives. The goal of the thought record is to help patients develop the skills needed to automatically identify the cognitive distortions they commonly face, and ultimately to correct those maladaptive thought patterns.

Throughout these sessions, the patient is given homework assignments to complete outside of therapy. These assignments often involve practicing and applying the skills learned during the sessions to real world scenarios.

An Overview of Emotion Focused Therapy

An alternative approach to treating affective disorders is Emotion Focused Therapy (EFT), a subfield of psychotherapy designed by Greenberg that focuses on the correction of maladaptive emotion schemas and improving affect regulation and coping skills [41]. In EFT, therapists work through each of the patient's emotional problems by using the following guidelines:

1. The discharge of emotion is not enough.
2. It is the therapist's job to make the client feel safe during their sessions.
3. Having a client feel hopeless is not therapeutic, but having them understand the signals behind their feelings is.
4. Avoidance and over control of emotional stimuli are maladaptive solutions.
5. Once a client brings forth a new feeling, it is the therapist's job to help them explore it. I.e., I feel hurt **because...**
6. Bad feelings should act as a stepping-stone towards building new goals and uncovering personal needs.

In EFT, emotional processing and maladaptive emotional responses are viewed using the following paradigm:

Given a stimulus, two levels of processing occur, a high-level process in which emotion responses are chosen based on existing emotional schemas, and a low-level one in which the stimulus is conceptually processed. The processing of these schemas results in the creation of conscious thoughts and emotional reactions that then leads to updated schemas and further processing. These new schemas are then used when a new stimuli occurs, restarting the process.

Based on this, therapists in EFT have two main goals:

Fixing maladaptive emotion schemas

The therapist's primary goal is to identify and correct maladaptive schemas. In each therapy session, the therapist tries to arouse bad feelings within the patient in order to help them explore and establish the generators of these feelings. Once these feelings have been identified, any

maladaptive schemas are then examined: first the patient articulates their beliefs and the underlying needs causing these feelings, and then the therapist helps the client to reframe these emotional schemas into healthy ones.

Buffering through affect regulation and coping skills

The therapist's secondary goal is to work with their patient to help them to become better at affect regulation, the process in which we modulate our emotional states to better adapt to our environment. This is accomplished by teaching the patient regulation techniques such as attention regulation (becoming more aware of one's own physiological senses), breathing regulation, muscle relaxation, and self-nurturing (understanding how to attend to one's mental and physiological state).

With these two goals in mind, a EFT therapist will work with their patients to complete the following three phases:

Phase 1: Bonding

The first phase consists of the therapist establishing their role as someone who will help patients to explore their feelings. This is accomplished by attending to their patients' feelings through empathic feedback and by validating their emotional expressions.

Phase 2: Evoking and exploring

Once a rapport has been established, the second phase begins in which the therapist helps patients talk about their negative feelings or painful experiences. During these discussions, the therapist will alert the patient to the feelings they are expressing, to help promote attention regulation. If a patient is avoiding the expression of certain emotions, it is the therapist's job to

help them become aware and accepting of these avoided emotions, and the expressions related to them.

Phase 3: Emotion restructuring

The final phase of EFT focuses on restructuring the maladaptive schemas that are troubling the patient. Once the patient becomes aware of a specific problem, the therapist helps them focus on their underlying needs and the goals that caused the problem to emerge in the first place. During this process, the therapist primarily acts as a source of validation to help the patient gain confidence in these new needs and goals. Once confidence is gained, the therapist helps the patient focus on reflecting and expanding upon their new beliefs through the use of hypothetical scenarios.

Intelligent Cognitive Behavioral Therapy Systems

While these therapeutic interventions have been shown to be highly effective when delivered in traditional therapeutic settings, they are limited by the barriers of cost, availability, and the social stigma related to receiving treatment [86]. To address this issue, many researchers have attempted to develop automated systems to provide therapeutic counseling to patients from the comfort of their own home. These systems, called Internet Cognitive Behavioral Therapy (iCBT) systems, often involve patients visiting a website or utilizing some interactive program that is designed to train them in the basic concepts of CBT over the course of a few weeks. The two most well-known examples of these types of systems are MoodGYM [106] and Beating the Blues [107].

MoodGYM

MoodGYM is an iCBT program implemented via a series of webpages, in which users interact with a variety of characters representing different maladaptive thought patterns (Figure 2). Users log into the website and, at their own pace, complete five CBT modules lasting thirty to forty-five minutes each.

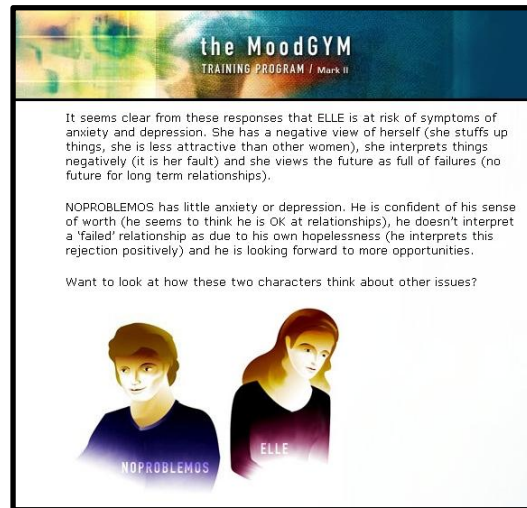


Figure 2: MoodGym

To evaluate MoodGYM, a six-week randomized control trial with 525 participants was conducted comparing it to BluePages (a depression information site) and a weekly phone check-in group [22]. The results of this study showed that MoodGYM significantly decreased depression symptoms in participants when compared to the other two conditions. While promising, the studies noted that MoodGYM had a lower retention rate than the both the phone check-in group and the information site, with over 25% of participants in the MoodGYM condition dropping out during the six-week trial, compared to the 10-15% dropout rate found in the other two.

Beating the Blues

The other widely studied iCBT program, Beating the Blues, is a web based intervention consisting of a fifteen-minute introductory video and eight one-hour interactive sessions. Users of the system are expected to complete one interactive session per week along with supplemental homework activities and weekly progress reports. While shown to be as effective as MoodGYM, Beating the Blues suffers from significantly worse dropout rates, with studies showing that up to 35% of participants dropped out during the eight-week usage period [52].

Agent-Based Counseling

To address the retention rate found in these programs, some researchers have turned to using agent-based systems which have been shown to have higher engagement rates [8], working alliance scores [5], and trustworthiness when compared to traditional computer interfaces [10]. This most notably occurs in embodied conversational agent-based systems, which simulate face-to-face interactions through a combination of verbal and nonverbal behavior [18] (Figure 3).



Figure 3: Embodied conversational agent

It has been shown that these agent-based systems function as effective tools for automated health-behavior change, because the systems' additional displays of nonverbal behavior work to display empathy and other affective cues to users [80].

Longitudinal agent systems

One of the biggest strengths of these agent-based systems is that they can be used by participants over multiple weeks from the comfort of their own homes. To date, these systems have been used in a variety of different applications, ranging from providing social support to older adults [83] to an online health behavior change system that intervenes on over 100 different health factors [38].

Empathic Systems

While these agent-based systems have been shown to be effective tools, the majority of these systems ignore a user's emotional state as a source of input. This is especially concerning when dealing with affective disorders, because as I outlined earlier, human therapists often rely on these emotional cues as part of the therapeutic process. To address this missing modality, researchers are developing complex APIs to help integrate affective understanding into computational systems [87].

What is Affective Computing?

Affective computing is the study of computer systems that recognize, process and/or simulate a human's emotional state [72]. Work in affective computing has led to a vast array of research topics ranging from computational models of emotion [68] to the development of systems that detect a user's emotional state in real time [30,69].

Automated affect detection

One of the most common uses of affective computing is the detection of affective states. This is commonly done using a variety of sensors, ranging from the use of complex medical devices capable of detecting a user's blood volume pulse or systolic blood pressure [43,75], to far less invasive sensors that use speech [30], facial recognition [69], or posture detection [58] to estimate emotional states. While each of these methods vary in efficacy, studies have shown that using a combination of detection methods results in significantly higher rates of recognition [27,58].

While generally promising, with accuracy ratings of up to 88% [105], these sensors often require additional considerations prior to their use. Variability found within these measures often means that baseline signals are required prior to use to account for the inter-person variability [33]. The range of emotions one wishes to detect also needs to be accounted for, since many of these methods are trained to only capture a few distinct emotions [69].

Most concerning however is the potential impact of mental illnesses on the accuracy of these sensors. Disorders such as schizophrenia are often linked to patients having flat affect [62], a severe reduction in emotional expressiveness, which severely diminishing their displays of nonverbal behavior. Additionally, disorders such as depression have been shown to be linked to reduced levels of facial displays of affect [97], meaning that facial detection based emotion detectors would be less effective overall. Because of this, specialized detection methods should be considered when dealing with these populations [23,59].

Automated sympathy

Using these detection systems, researchers have attempted to find new ways to simulate realistic face-to-face interactions between humans and computer systems. One of the most comprehensive examples of this was Burleson et al.'s work on developing a platform for affective agent research [13]. Built upon the idea that a user's emotional state would be accurately detected through a suite of sensors, the multi-modal platform combined various channels of input into a set of affective measures. These measures were then used to control a conversational agent's nonverbal behavior, having it mirror the user's detected emotional state. Separate interfaces were also developed to allow for dialogue systems like Collagen[79] to be connected to the platform to guide the agent's discourse. In their evaluation study, participants interacted with an agent that taught users how to complete the Towers of Hanoi puzzle while mirroring back their behavior. Their results, however, found that this mirroring behavior had no impact on the participant's rating of the system or on the performance for completing the task [12]. This is likely because mirroring back the user's emotion is similar to the reactions a novice therapist may display, which has been shown to negatively affect rapport with patients [40,42].

Empathy

To properly build a rapport with patients, many therapists turn to another technique that is heavily reliant on emotional understanding: empathy. Empathy can be defined as, "a response that demonstrates an accurate understanding and acceptance of the patient's feelings or concerns" [102]. Various interventions have relied on this definition of empathy as a model of emotional intelligence; Studies show that empathic relationships between patients and doctors can significantly increase patient satisfaction [90], cause them to have greater adherence to treatment advice, and lower rates of malpractice suits [35]. Furthermore, it has been shown that even

displaying simple nonverbal empathic behavior during health counseling sessions can increase the perceived warmth and competence of healthcare professionals [60].

Empathic systems

The benefits of empathy apply to human-computer interactions as well. The most prominent example of this is the work by Klein et al. on evoking and responding to a user's emotional state [57]. In this study, participants played a game designed to induce frustration, in which they were asked to interact with one of three different system variants under the guise that they were filling out a questionnaire. After filling out the questionnaire, they were given the opportunity to continue to play the game again for at least three more minutes. The three versions of the system differed in the way they responded to the user's frustration, in which they either empathized with the user, did nothing, or allowed them to vent. The results showed that empathizing with the user caused them to continue playing the game the longest, whereas allowing them to vent caused them to play the least, demonstrating the potential that empathy has on maintaining user engagement during negative experiences.

Using conversational agents, studies have shown that empathic accuracy has a greater positive impact on interaction satisfaction than giving the user the capacity for free input. [6]. However, it was found that patients rarely express their emotions verbally, so these empathic systems may be required to directly ask the user how they are feeling [93].

Chapter 3: The Role of Empathy in Human-Human Counseling

To further understand how emotional understanding and empathy are used by human counselors, I conducted an analysis of instructional counseling videos from the American Psychological Association (APA) to see how depression counseling is conducted in face-to-face cognitive behavioral therapy and emotion-focused therapy [41,49–51]. In each of these videos, the instructor reviews a different aspect of counseling and provides examples of counselor-patient interactions (both real and mock). Across the series of videos, the following topics were covered:

1. The structure of a therapy session in cognitive behavioral therapy
2. The role of thought records in cognitive behavioral therapy
3. The principle and structure of emotion focused therapy
4. Case formulation and treatment plans

The Structure of a Counseling Session

The first lesson learned from these videos has to do with the general structure of counseling sessions, according to which therapists focus on covering the following sequence of topics:

- Orienting the patient
 - Prior to any counseling interaction, patients are asked to fill out measures to assess their current health status. After completing these measures, the counselor will briefly work with the patient to orient them to their therapeutic goals before further advancing the conversation.
- Check-in
 - After establishing these goals with the patient, the counselor will review any collected measures and ask the patient how they are doing. During this time, any differences between the patient's current emotional state and their state during previous sessions are discussed to ensure that the therapist is correctly assessing their emotional state. Additionally, the counselor will look for any verbal or nonverbal behaviors that differ from the patients' reported measures, to further ensure they are correctly assessing the patient. Rapport building between the therapist and patient also occurs during this process with the therapist expressing concern for the patient's well-being when appropriate.
- Agenda setting

- Once the check-in is complete, the therapist will focus their discussion on setting an agenda for the session. This is often a collaborative process, in which the therapist works with the patient to find any new topics that are affecting the patient, along with ensuring that topics from previous sessions are still relevant. As part of this discussion, negative therapeutic behaviors are also discussed, such as whether the patient has been coming late or not doing their homework, or if the patient feels that they are not getting along well with the therapist, to ensure future therapy sessions go smoothly.
- Homework review
 - Upon setting the agenda, the therapist will review any homework assigned during their previous sessions with the patient. During this time, any problems that may have arisen around the completion of the homework are addressed to ensure the patient will be able to complete their assignments in the future. The importance of these homework assignments is also emphasized during these discussions by illustrating their importance as ways to bridge the gap between sessions.
- Main agenda
 - This is the bulk of the session, in which the counselor works with the patient to educate them and to work through any major problems they are currently facing. The exact details of how these agendas are processed differs greatly between the various therapeutic techniques, but they usually consist of discussing the patient's life events and identifying ways in which they can reinterpret these events in a more positive light.
- Assigning homework
 - Prior to ending the session, the therapist will assign a new set of homework for the patient to complete before their next session. It should be noted that these homeworks are often assigned during the main agenda if the appropriate spot arises during that conversation.

Addressing Problems between the Counselor and Patient

In addition to explaining the general structure of a counseling session, the counseling videos pressed the importance of having a good therapeutic relationship and the common problems that cause poor working alliances between the therapist and the patient. These problems were divided into two main categories: session problems and out-of-session problems.

Session problems

One of the most common problems that can occur during a counseling session is when a patient goes off track and begins talking about another issue that was not part of the original agenda.

While changing or adding an item to the agenda mid-session is not necessarily bad, it is important to alert the patient of this deviation in case they are unaware they are doing so, since it may result in them not covering another, more important issue. To address this, the counselor should interrupt the patient when they begin talking about a new topic and attempt to either reorient them towards the main topic or confirm that this new topic is a more important issue.

It should be noted that this is less of an issue in automated counseling systems, because unless the system supports true language understanding, it is hard for the user to go down an unplanned dialogue path.

Out-of-session problems

The other common issue that counselors run into with their patients is a lack of homework compliance. Instead of scolding the patient for not completing their assignments, the counselor should work with their patient to find the reason behind their non-compliance, since it may be indicative of another, more pressing issue. Most commonly, these problems arise from patients being confused about what the homework assignment asks them to do. To resolve this, counselors will often have the patient explain homework assignments back to them to ensure that the patient understands what they are supposed to do.

[How a Counselor Adapts to a User's Affective State](#)

To gain an understanding of how these guidelines were used during real counseling sessions, and what role a patient's emotion played in the counseling process, I transcribed example counseling

sessions from the reference videos (Appendix D). These transcriptions were thematically analyzed to find instances of emotional understanding and empathic feedback.

Addressing emotional discrepancies

One of the most prevalent uses of emotional understanding in the counseling videos occurred when there was a discrepancy between the patient's recorded emotional state (I.e., what they reported during their intake measures) and what they reported to the therapist. The following dialogue exemplifies this issue:

[P]atient: *Ok, yeah, I brought my measures*

[C]ounselor: *Ok, terrific, let me take a look*

[P]: ***The scores look pretty much the same from last week even though I'm feeling better about the social stuff we have been working on.***

[C]: *Good*

[P]: *Even though it's been a really stressful week at work, so the scores are looking the same*

[C]: ***Ok, I'm noting one of the items here, that you still have some suicidal thoughts, but no plans?***

[P]: *Yah, no plan at all*

In this example, the patient has marked down that they are having suicidal thoughts on their intake questionnaires, even though they are verbally expressing to the counselor that they are feeling better. The counselor addresses this discrepancy by bringing it up to the patient directly, in a manner similar to that outlined in the description of the check-in process.

Reflective dialogue

Another way in which the counsellor responds to a patient's emotions during the sessions is reflective dialogue, dialogue that rephrases and repeats emotionally sensitive issues back to the patient to ensure understanding between the therapist and patient, and to convey emotional understanding back to the patient. A prime example of this is:

[C]: *Ok, good so we got two things, let me check, anything else that you wanted to be sure we cover today?*

[P]: *Um, I kinda like to **talk, my parents are coming to town next weekend and it's kinda something I do want to talk about at some point because its anxious** about it I guess.*

[C]: ***Kinda anxious, your parents, are coming over, coming next week**, ok so this is an agenda item that we might want to take up too. Sounds like we got three agenda items, what's going on with work and stress you're feeling and also following up on your homework and the social goals we have been working on and your parents coming over to visit.*

In this example, the therapist probes the patient for any other subjects they wish to discuss during their session. As a result, the patient brings up their anxiety around an upcoming event (here, their parents visiting), as something they wish to discuss during the session. The therapist responds to this by rephrasing and repeating the description of the event back to the patient, with emphasis put on the associated emotional state the patient is expressing (here, anxiety), in order to ensure the therapist is correctly interpreting the situation and to further convey that they are listening to the patient.

Reacting to extreme emotions

The final way emotions present themselves during counseling sessions is through extreme emotional outbursts such as crying. While this was not exhibited during any of the cognitive behavioral therapy videos, emotional outbursts occurred multiple times during the instructional videos on emotion focused therapy, in which the interaction was paused multiple times to acknowledge and allow the patient to cry.

[P]: Well, right now I feel like I am kind of forcing myself to keep getting up and going to work

*[C]: Pushing and Pushing, yah. **I was wonder if you can breathe and let the tears come if you are willing. It's like you are struggling on the brink of them, but they are important tears. So these are the struggles of pushing and pushing***

[P]: Yah, and it just makes me tired and I... (starts to cry) got my bachelors degree

*[C]: **If you were to speak from the tears, and actually let them speak, what would they be saying? I feel?***

*[P]: **Hopeless, I feel like I'm struggling** and*

[C]: Pushing and pushing and can't see the end.

[P]: Yeah, that's exactly how I feel and I can see it in front of me, but I can't seem to get there quick enough

In this example, the counselor acknowledged the expressed emotion (crying), and encouraged the patient to embrace this emotional outburst, stressing that it's ok to take their time to feel it. As a result, the patient is able to better express their feelings (hopelessness in this scenario), and to continue on with the conversation. This technique was repeated multiple times during the session, in which the counselor would accompany the patient's emotional outbursts with statements telling them that their expression of emotion was not only ok, but healthy.

Emotion and Counseling in Research

In addition to the APA videos, another literary analysis was conducted to explore the role of emotions in counseling. Based on the work of several psychologists and researchers, I identified several principles that could be leveraged to develop an affectively-aware system:

Emotions require proper cognitions to promote growth

As emphasized by researchers such as Greenberg [42], having patients simply express their emotional state has no lasting benefits without also having them understand the underlying causes for those states. This is especially prevalent in cognitive behavioral therapy, which focuses on helping patients to understand the connection between their thoughts and feelings. These findings suggest that intelligent counseling systems should both identify a patient's emotional state and discuss the cause of it with the patient in order to ensure that proper reflection occurs.

Positive emotions are indicative of activity continuation

The analysis and encouragement of positive emotions, as demonstrated by Williams et al. [103], is another key factor in understanding a user's emotional state. By identifying strong correlation between a user's positive emotions and the tasks discussed during therapy, we can gain a better understanding of the user's likes and dislikes. This can be used to help gain rapport with the patient and to help guide them in the agenda-setting strategy.

The perceived source of an event affects one's emotional response to it

As shown by researchers like Weiner, the perceived source of an event can greatly impact a person's emotional reaction to it [101]. By gaining insight into a user's perception of an event, one could increase the accuracy of an emotion detection system by taking into account the

directionality and actors in the event (i.e., an event where the user is at fault would be perceived as evoking a different emotional response than one where the fault is caused by an outside actor).

Empathic feedback is key to building relationships

Therapeutic displays of empathy have been shown to be a key component in building quality relationships between patients and their therapists [32]. This suggests that providing real time empathic feedback to users would result in better therapeutic outcomes since there is a strong connection between therapeutic relationships and outcome in psychotherapy [45].

Automating the Empathic Process

Based on this body of work, I propose four features as implementation goals towards creating an affectively aware system for counseling.

Understanding the user's emotional state

For any affectively aware system to work, the system must first understand the user's past and current emotional state. To get information about a user's emotional state during the interaction, one of the affect detection techniques described previously could be used to establish a user's valence and arousal. Additionally, if access to these types of sensors would limit the distribution of the system, one could provide the user with self-report measures to detect their current emotional state. However, since these measures could not be continuously reported, an analysis of the systems dialogue for semantic values would have to occur prior to deployment to best estimate when the user would experience changes in their emotional state. In either scenario, the recorded values should be stored in a database for later retrieval and comparison.

Addressing emotional discrepancies

Once the user's emotional state is assessed, the system should actively look for discrepancies between emotional readings in the same way that counselors do when they receive conflicting information about a user's emotional state. When a discrepancy is found, the system should interrupt its discourse with the user to address it, to both simulate empathic listening and to ensure that its emotion detection system is working accurately.

Simulating reflective dialogue

In addition to alerting users to discrepancies in their emotional states, reflective dialogue statements could be generated based on the user's input to the system. By pre-analyzing system dialogue for semantic values, statements with high emotional salience should be marked to tell the system to generate reflective dialogue statements at runtime based on the user's responses. The goal of these reflective responses would be to ensure that key information provided by the user is correct and to further emulate emotional intelligence.

Reacting to extreme emotions

The final piece of empathic feedback an affectively aware system should provide is a response to extreme emotional states. In a system equipped with a real time emotion detector, extreme emotional reactions such as crying should be monitored by the system to allow the system to provide immediate empathic responses to the user. In a non-real time variant, pre-analyzed text should be marked to predict the points at which extreme emotional reactions may occur, with dialogue choices added to ensure the users responses are caught. In both cases, when such a reaction occurs, the option to pause the interaction should be provided for as long as the user needs, in order to ensure they are in a more relaxed state before continuing the conversation.

Chapter 4: Towards an Affectively Aware Counselor

Before we can begin implementing an affectively aware system for counseling, we must first see whether users are willing to share their emotional state with a system across multiple interactions and whether such a system can impact a user's behavior based on these assessed emotional states. The following section describes a study I conducted to investigate this, and the results of that study. Portions of this work were presented at the Intelligent Virtual Agents conference in 2012 [82].

The Feasibility of User Mood Classification by Human Judges:

Before exploring affectively aware interventions with a virtual character, we must first determine whether human observers are able to reliably identify a user's mood during counseling interventions, based on a user's verbal and nonverbal behavior.

Using videotaped recordings of longitudinal user-agent conversations collected as part of a study on an eldercare companion agent [98], fifteen conversations conducted by three participants were selected for reliability analysis. Two-minute segments were extracted from the beginning, middle and end of each conversation, resulting in a total of 41 video clips for analysis, with four conversations being dropped due to their short duration. Three research assistants were asked to view each of the 41 video clips and rate each for arousal and valence using an Affect Grid.

Judges were also asked to provide a single English word that best described the user's mood. The video clips were provided for the judges to view, and they could be viewed multiple times if needed.

Results

Arousal scores assigned by judges ranged from 3 to 9 (mean 6.57, SD 1.15) and valence scores ranged from 4 to 9 (mean 6.59, SD 1.17). Judges used 26 English words to describe the moods they observed. The most commonly used words were: "happy" (42 instances), "content" (16), "good" (12), "neutral" (9), and "calm" (8). Ratings of arousal and valence were significantly correlated among the three judges, with intraclass correlation coefficients of 0.662 for arousal ($p < .001$) and 0.646 for valence ($p < .001$). Of the 41 video clips, judges only agreed on English mood labels 12 times: 11 of these were pairs of judges, and only once did all 3 judges volunteer the same label (in all of these cases the label was "happy").

Through this analysis, we demonstrated that a user's affective state can be reliably assessed by human judges using an affect grid on the basis of observed verbal and nonverbal behavior.

Likewise, we showed that English words were not a reliable measure of affect as there was essentially no agreement among the judges in terms of usage.

The Effects of Form of Request and Mood on Persuasion

Following this analysis, I decided to investigate whether subtle changes in an agent's dialogue could produce behavioral changes. This was accomplished by modeling an agent dialogue based on work done by Aderman et al. [1] in which participants were asked to sort a stack of cards, with the request being phrased as either a study requirement or a favor to the experimenter, following a positive or negative mood induction. Participants in the negative mood condition were found to sort significantly more cards when the task was phrased as a requirement, whereas those in the positive condition were found to sort significantly more cards in the favor condition.

Using this model, I decided to adapt this methodology to investigate the effects of mood and persuasive request phrasing on exercise motivation. This specific area was chosen due to previous literature showing that agents are effective exercise counselors, and that they elicit similar effects from dialogue phrasing as found in human-human interactions [70,88].

The study was conducted in the context of the "Virtual Laboratory" system [7], in which a standing group of participants interact with a virtual exercise promotion agent up to once a day from their home computers. The agent encourages participants to walk every day and tracks their progress through a supplied pedometer that the agent discusses with them.

Our manipulation consisted of the agent asking participants to exercise, phrased as either a favor to the agent, or a direct request. Our hypothesis was that participants would walk significantly more steps than when they are in a negative mood and are told to walk using a favor dialogue, and when they are in a positive mood and are told to walk using a request dialogue.

Hypothesis

- Participants will walk significantly more steps than when they are in a negative mood and are told to walk using a favor dialogue.
- Participants will walk significantly more steps than when they are in a positive mood and are told to walk using a request dialogue.

Measures

An Affect Grid was used by participants to rate their mood at the start of each session.

Participants also uploaded the amount of steps they walked since their last session via a pedometer provided at the beginning of each session with the system.

Experiment

This study was divided into two separate interaction phases: a desensitization phase, and a collection phase. In the desensitization phase (5 days), participants did not interact with the agent, but instead were given an Affect Grid each session for five sessions. This was done to both reduce habituation effects from prior interactions with the agent, and to collect baseline valence and arousal measurements for each participant. This data was used to calculate the change in valence and arousal each day in the following phase.

In the collection phase (2 months), participants first filled out the Affect Grid at the beginning of each daily session, then conducted their usual counseling conversation with the agent but with the following change: instead of negotiating daily pedometer step count goals the agent asked participants to walk as either a favor or as a request. The exact language used was:

Favor: I was wondering if you'd mind doing me a favor and take a walk before our next session.

Request: Would you take a walk before our next session?

The manipulation was randomly selected every day for every participant (within-subjects).

Results

Twenty-one participants (mean age 61.5) interacted with the system over two months, resulting in 696 unique interactions (mean=33.1 per participant, SD = 16.2) with the agent, with one participant dropping out of the study. For each interaction, the number of steps the participant had walked since their last session along with their valence and arousal were recorded.

A linear mixed-effects regression model was used to fit the data. This model is an extension of linear regression models that allows for the linear predictors to contain both random and fixed

effects. This model used the study condition of favor (Coded as 0) versus request (Coded as 1), the number of interactions, and the difference in participant's valence and arousal from their baseline to estimate the number of steps they walked since their last interaction. Baseline arousal and valence was estimated for each participant using their average valence and arousal recorded via the Affect Grid during the desensitization phase of the study. The averages of these scores were used to model the participant specific baseline affect found in study 1. Steps were put on a logarithmic scale to restrict the range of outcomes to greater than 0 steps, and to account for the right tail skew of the measure. Since exact p values and confidence intervals cannot be calculated for mixed effect models analytically, a semi-parametric bootstrap was used, as described by Carpenter, et al. [16]. [17]All statistics were calculated using R-2.14.1 and the lme4 package [3,95].

Table 1: A Linear Mixed-Effect Regression Model Predicting Participant’s Step Count (log-transformed). Inter-subject Variance: (Estimate: .258, 95% CI [.142, .343]), Residual Variance: (Estimate: .623, 95% CI [.566, .678]).

Parameter	Estimate	SE	p
	6.19e-03	1.96e-03	0.93
Valence X Arousal	-1.45	-4.22e-03	0.01
Valence X Dialogue Variant	1.07	-1.977e-03	0.01
Valence X Arousal X Session	1.02e-01	4.45e-04	0.03
Valence X Dialogue Variant X Session	-8.53e-02	-2.42e-06	0.03

Using this models on the data, we see a significant correlation between a user's valence, the dialogue they received and the amount of steps they walked. In particular, we found that when the agent used the request dialogue while the participant was in a positive mood they walked significantly more steps, and when the agent used the favor dialogue while the participant was in

a negative mood they walked significantly more steps ($p < .01$). Additionally, it was found that participants walked significantly more steps when their valence and arousal scores were opposite in sign ($p < .01$). Thus, when a participant is in a high arousal, low valence state, a favor message predicts more walking, whereas when a participant is in a low arousal, high valence state, request predicts more walking (Figure 4).

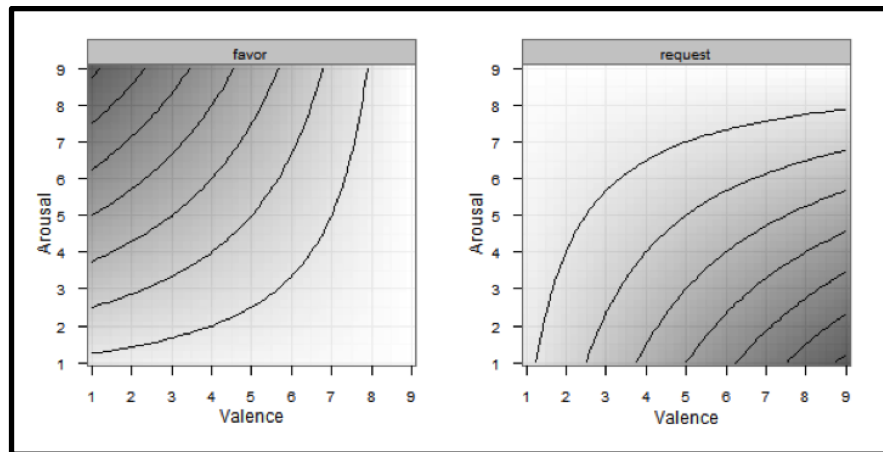


Figure 4: Change in the number of steps walked based on mood and dialogue manipulation. Darker areas represent where each dialogue had the most positive effect on step count.

However, the effect of the manipulation decreased over time, so that it was no longer significant after a month. This habituation effect is consistent with previous research on affect [26,96], showing the decay of the manipulation through the course of the study.

Discussion

We found that the form of a persuasive message should be tailored based on user mood in order to be maximally effective. These results are contrary to our hypotheses and findings in the previous literature, but our experiment differs from the earlier work in three key aspects. In Aderman's original work, participants were asked to do a favor or request for the experimenter, whereas in our experiment the participant is doing a favor for the agent. However, due to the

virtual nature of the agent, the agent cannot benefit from this request; therefore the participants are indirectly doing a favor for themselves. This change in perspective could account for the reversal of the observed trend since the persuasive outcome of interest is self-efficacy instead of altruistic behavior. Additionally, the majority of studies on mood observed only a single session of affect while disregarding the longitudinal property of mood in the process.

The results of this study also stand as an interesting comparison point to other studies that have explored the role of politeness in virtual agents. Researchers like Wang et al. found that polite agents were generally preferred over direct agents in pedagogical settings, especially for less experienced users [99]. While interesting, their study compared the use of polite statements to face threatening statements, which were harsher than the direct statement used in this study.

While the results of our study show that direct phrasing is more effective for participants with positive emotions, further research would be required to see if the same holds true for harsher variants.

Chapter 5: An Affectively Aware Dialogue Framework for Counseling

The first study suggests that subtle dialogue manipulations can have significant effects in a user's behavior. However, this study had several limitations compared to the theoretical goals set forth previously. The system did not respond directly to a user's affective state, but instead simply responded to the user's emotional state randomly. Additionally, the system did not try to evoke emotional responses in the user or detect them during interaction.

To address this, I developed the following theoretical framework to illustrate the necessary components of an affectively aware dialogue system, how it should be implemented, and how it should respond to users. The following section outlines this framework and describes an example implementation.

Overview of Framework

As shown in my literature review, empathy is a key component to successful counseling interactions. Taking inspiration from this, I developed this framework, taking the concept of properly conveying empathy to our users as its core. To convey this empathic understanding to our users, we must first understand several pieces of information about them: what their current and prior emotional state is, the context in which these emotional states were detected (either conversationally or through an automated process) and what the user is currently discussing with the system. With this information, we are able to automatically generate different empathic responses based on where the user is in their discourse with the system. The three different types of empathic responses to be generated are as follows: reflective statements, statements about emotional discrepancies and responses to emotionally reactions.

Reflective dialogue

The first type of empathic response generated by the system is the reflective dialogue statement.

Used to emulate a deeper understanding of a user's input into the system, these utterances consist of rephrasing the user's response back to them in the form of a question using different terminology.

Agent: *What depressive symptoms are you experiencing?*

User selects: "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?*

Just as in human-to-human counseling, these utterances should only be generated and used after evoking emotionally sensitive responses from the user to prevent repetitiveness.

Emotional discrepancies

The second type of empathic response generated by the system reacts to emotional discrepancies.

Again, as in human-human counseling, when a user gives conflicting information to the system as to their emotional state, the system generates an utterance that addresses this discrepancy and allows for the user to either correct themselves or update the system's current perception of the user's emotional state.

After detecting the user is doing better than normal from a weekly survey.

Agent: So how are you feeling today?

User selects: I'm feeling pretty down

Agent: Oh, you seemed to be doing pretty good based on your survey, is everything ok?

These statements primarily occur at the beginning of any conversation, because these types of emotional conflicting messages often result from reviewing questionnaires and survey measures given prior to counseling sessions.

Responding to extreme emotions/emotionally sensitive material

The final type of empathic response generated by the system acknowledges extreme emotional responses or following up the elicitation of emotionally sensitive material. These utterances acknowledge the user's emotional state to emulate emotional understanding.

After detecting negative affect during a script.
Agent: You sound pretty sad, do you need a minute before we go on?
Button Prompts:
• Yah.
• I'm fine, let's continue.

In cases where the detected emotion is negative, the system gives the user a chance to collect themselves and relax before continuing their interaction.

Example Implementation

Using this framework, I began development of an affectively-aware virtual agent system for depression counseling. To implement the framework, the following three system components were created: a dialogue engine, an emotion detector, and an empathy generator (Figure 5).

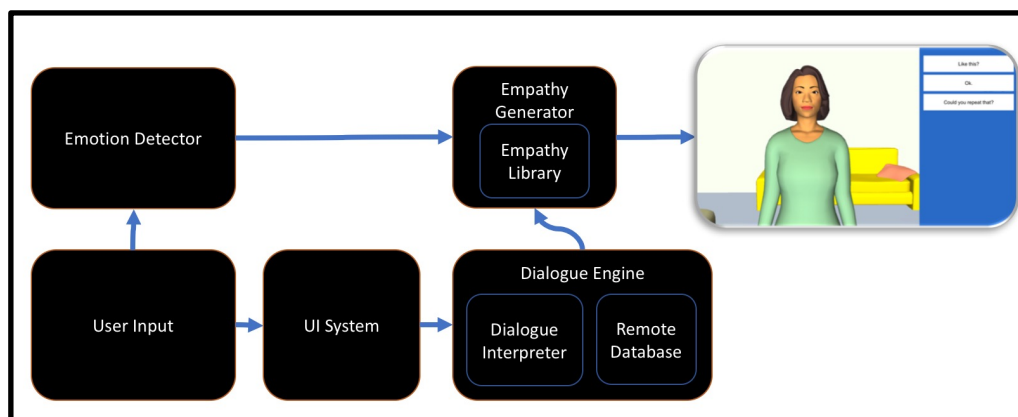


Figure 5: Illustration of Framework

Dialogue engine

The dialogue engine is designed to control the overall flow of the system, from the selection of utterances outputted by the system to the retrieval and transference of parameters from one module to another. Developed in C# within the Unity3D game engine, the dialogue engine runs a custom XML scripting language that was designed for output by an embodied conversational agent.

```
<script>
  <state name="Leadin">
    <speech>So lets start with talking about depression</speech>
    <buttons>
      <button nextState="Depression Info">Ok</button>
      <button nextState="Something Else">Can we talk about something else</button>
    </buttons>
  </state>
</script>
```

Since the system was designed to react to a user's emotional state in real time, the scripting language allowed for inline function calls to generate dialogue statements during runtime based on a user's responses. Additionally, the scripting language allowed for the specification of key points in the dialogue where a user's emotional state should be assessed, in the case that the emotion detection system was not running in realtime.

Emotion detector

Primarily responsible for assessing a user's emotional state, the emotion detection module is designed to return numeric representations of a user's current emotional state and any prior states detected by the system. Designed to run either continuously or at polled intervals, the emotion detector is impervious to the sensors being used to assess the user's emotional state, and is just expected to return back the proper values when invoked. The emotion detector also has support

for custom dialogue statements to be used when assessing the user's emotional states, in case a non-sensor based approach is needed.

To account for potential failures in the emotion detection process, this module should also be able to respond to detection failures by providing alternative options to the user whenever emotional understanding is being conveyed. By presenting alternative options to the user, the conversation can continue if a detection failure occurs and the system can update the sensors models of emotion if possible. Depending on the severity of the failure (I.e., detecting sadness as happiness), repair strategies may be needed to maintain rapport with the user. These strategies are heavily dependent on the context of the failure and the task at hand, ranging from simple acknowledgement of the mistake to allowing the user to change prior dialogue choices to correct the systems understanding [91].

In the counselling domain, emotion detection failures should be treated with extra concern, since they may be viewed as actions similar to those of a therapist experiencing therapeutic burnout [66]. To address this, additional repair strategies may be needed, such as letting the patient vent about their frustration in the miscommunication or having the system further emulate a counselor by leading a discussions about the detection breakdown [78].

Empathy generator

The final, but most important module is the empathy generator, which generates the agent's empathic utterances. When invoked by the dialogue system, the generator calls upon the emotion detector to retrieve any emotional assessments conducted during the current and previous interactions. Using a combination of the user's emotional state and the current script context, the empathy generator creates and returns back one of the following responses:

Reflective statements

Reflective statements are generated when the empathy generator detects that the user's last input into the system is emotionally salient (via pre-marked semantic cues). Based on their responses, synonyms for their last input into the system are found and formed into a new utterance that rephrases and reiterates the user's statement back to them through utterance concatenation.

Emotional discrepancy

The second type of response generated by the empathy generator are those based on discrepancies resulting from conflicting emotional assessments. These discrepancies are addressed by randomly selecting from an assortment of utterances, designed to alert the user to their discrepancies, and to provide empathic follow up that mimics the dialogue found in human-to-human counseling.

Responding to extreme emotions/emotionally-sensitive material

The final type of empathic statements are those following the elicitation of emotionally sensitive material from the user, in which the system randomly selects from an assortment of statements designed to emulate empathic understanding of the user's emotional state. In the case that a negative emotion was detected, the generator will also include an option for the user to pause the interaction, moving them to a timeout state that waits for them to return to a more relaxed state of mind.

Responding to other emotions

While this framework primarily focuses on responding to changes in a user's valence, other commonly expressed emotions such as anger, fear/anxiety or shame often play a large role in

counseling. The following section briefly explains how these emotions should be detected and responded to the context of this framework based on therapeutic frameworks such as EFT [42].

Anger

Anger is one of our most primitive emotions that stems from our biological need for self-defense. When not released naturally, anger can build up and be released in other scenarios, or result in the individual hurting themselves due to avoidance of expressing their feelings to others. The maladaptive anger that a counselor aims to correct is anger (or the lack thereof) that no longer protects the individual but hurts them.

When dealing with a patient's anger issues, it is common to see them have emotional outburst of anger followed by tears or dialogue that tries to trivialize/rationalize their anger by displacing the blame onto others. Based on these outbursts, one can categorize anger as being caused by violations/abuse or by unmet needs/betrayal. In the violation case, rage/disgust/contempt is more commonly expressed whereas sadness is more common in the betrayal case. Additionally anger is often used to suppress other emotions such as pain or stress. In either case, it is the goal of the counselor is to help the patient understand the underlying cause of their anger and help them restructure it.

Using this information, an affect aware counseling system could easily assess anger and it's sources by looking at changes in vocal prosody [11]. Once assessed, the system should aim to help the user understand the sources of their by alerting them to the other emotion expressions they are exhibiting following their outbursts.

Fear and Anxiety

Fear is another primal emotion that increasing our arousal and focusing our attention to any perceived threat to help us survive. Anxiety is a similar sensation that is caused by psychological stimuli or symbolic threats resulting in a state of confusion and increased internal attention.

These emotions become problematic when they are focused on false threats, such as in a phobia or a lack of self confidence. In counseling, the counselor aims to help individuals diffuse their feelings by helping them find the root cause of their fear/anxiety and helping them face it.

While the exact source of these problems range greatly between individuals, the detection methods needed to assess them are relatively the same, in which the use of sensors that measure Galvanic Skin Response, Blood Volume Pulse, Pupil Diameter and Skin Temperature can be used to assess the user's level of arousal [104], while valence is assessed through another channel of input such as vocal prosody [94]. Once detected, the system should aid the user by alerting them to their expressions of fear/anxiety when discussing a given topic, and letting them explore them in a safe environment through gradually exposure.

Shame

Shame is a feeling that makes one worry about their actions. Characterized by increased self-consciousness, shame can be defined as a concern for one's worth due to events like a public failure or being scorned by others. Experiencing some shame in one's life is normal, but when it is internalized to the point that an individual has a hostile view towards themselves, it becomes problematic. This is often seen through chronic low self-esteem, feelings of worthlessness, inferiority complexes and chronic depression from self-contempt. Unacknowledged shame can also cause other emotions to emerge, such as anger towards others as a result from poor self perceptions. It is the counselor's goal to help individuals overcome these feelings by helping

them find worth in themselves so that then can move on and redeem any wrongdoings they may have done.

While a bit harder to detect than the prior emotions, shame is often most easily detected through discourse analysis [77]. If the system were to allow a user to express their feelings freely through free-text input or natural language understanding, self deprecating statements or innerly directed expressions of anger could be identified to let the system know what emotion it is trying to resolve. Once detected, the system should lead discussions about the cause of their shame, and provide positive reinforcement towards any expressions of self worth.

Chapter 6: Evaluating the Feasibility of Deploying an Affect-Aware Virtual Agent for Counseling

Using this framework, I conducted a feasibility study using a depression counseling system. In this section, I describe the evaluation test conducted with the prototype system and the lessons learned from my study. Portions of this work were presented at CHI 2016 [81].

Prototype System

The goal of the prototype system was to recreate the one-on-one, face-to-face therapeutic interaction found in the reviewed counseling material. To accomplish this, I applied my theoretical framework to an embodied conversational agent system (Figure 6) and a dual sensor emotion detector. Counseling scripts for the system were based on a manualized cognitive behavioral therapy intervention for depression, developed by my clinical collaborator, Dr. Pedrelli, an assistant in psychology from Massachusetts General Hospital who specializes in CBT.

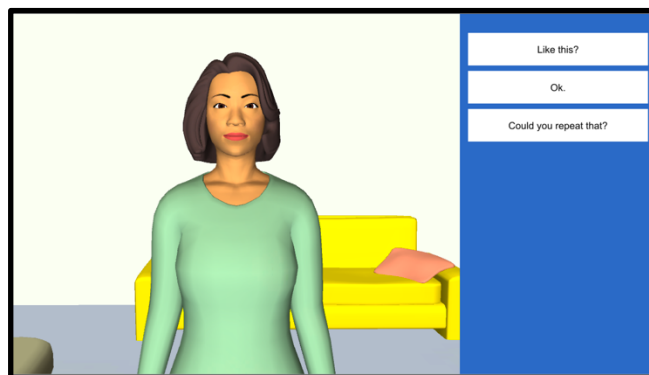


Figure 6: Affect-aware agent

The virtual counselor spoke using a text-to-speech engine, with automatically generated nonverbal behaviors such as hand gestures and posture shifts inserted via the BEAT engine [19],

which assigns nonverbal behavior based on linguistic and contextual analysis to typed text. Interaction with the virtual agent occurred by displaying a list of possible responses for the user to select to the right of the agent (as seen in Figure 6), which were selectable by clicking the touch-screen interface or by repeating the displayed options verbatim. This interaction format allows for natural-feeling conversation and speech-based affect detection, while avoiding the potential issues associated with the use of unconstrained natural language input in the healthcare domain, such as the improper acknowledgment of negative health behaviors such as drug use or suicidality.

The final architecture of the system is as follows (Figure 7):

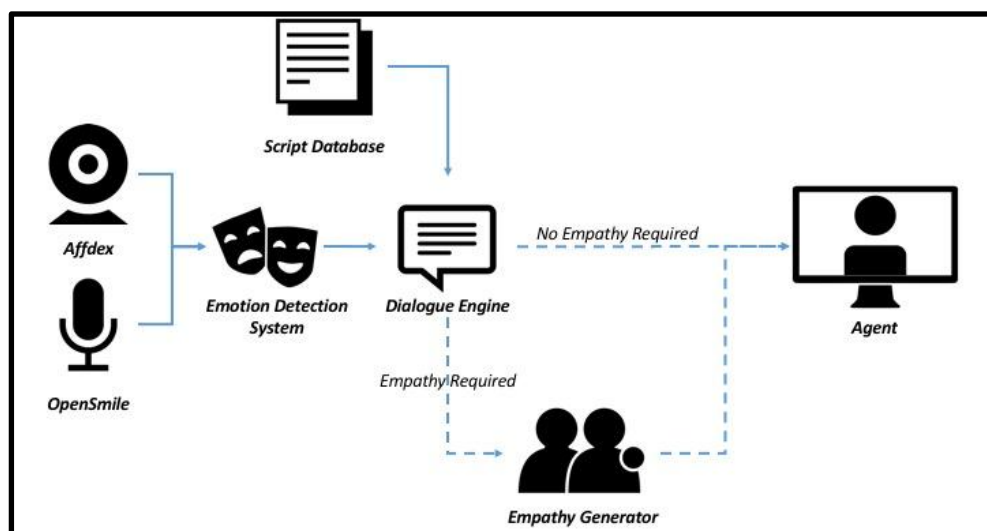


Figure 7: System architecture

Emotion detection

To detect the user's emotions, the user speech input is passed to two subsystems responsible for speech recognition and affect detection. The speech recognition system uses pocketsphinx [46] to create a grammar-based speech recognizer using the US-English acoustic model and dictionary. Audio recordings of user utterances are also passed to the affect detection system,

which classifies the utterance into the three valence categories: happy, neutral, or sad. The classifier was trained using the OpenSmile system with libsvm [30] on the emotional prosody and transcripts database [65] for these three categories of emotion using approximately 160 samples per category. Due to the short duration of the individual utterances spoken to the agent, the audio analysis was performed on a concatenation of the utterances within a dialogue topic for more accurate results.

User affect was also classified based on their facial displays via the Affdex SDK [69]. This system ran in parallel with the speech-based affect detection system, but it was only used when the user did not interact with the system via speech.

Pilot Study

I conducted a pilot study to evaluate the acceptance and feasibility of our automated counseling system among individuals with mild to moderate depression.

Study design

Using the affectively aware agent described above, we recruited participants to go through the first counseling session in a cognitive behavioral therapy intervention. In this interaction, participants discussed the following topics with the agent: How to interact with the agent; What is depression; A review of the user's depressive symptoms; What the user thought about therapy; and A brief introduction into the concept of CBT.

Participants

Participants were recruited via online postings and local flyers put around the Northeastern University Campus. Participants were eligible if they scored 5-14 on the PHQ-9 [63] (mild to

moderate depression), were not currently enrolled in therapy, and were not on antidepressant medication.

Measures

Participants received a depression screener (PHQ-8 [64]) and a state anxiety questionnaire before and after interacting with the system. After interacting with the system, participants filled out 7-point scale measure questionnaires to evaluate the agent, and participated in a semi-structured interview. All interactions with the agent were video recorded for review and evaluation by our clinical collaborator.

Results

Quantitative results

Ten participants, 5 males and 5 females, between the ages of 18-28 (mean = 22.4, sd = 2.4) with mild to moderate depression (PHQ-9 score mean: 6.6, sd = 2.7) were recruited to interact with the agent. All participants were paid \$15 for their time.

Pre-post testing conducted immediately before/following the agent interaction found no significance differences in depression or anxiety (Table 2), although both were in a positive direction. 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 likeability (mean = 4.4, sd = 1.7) scoring around the mid-point. Participants did however report that they did not feel close with the agent (mean = 2.1, sd = 1.29) and that they felt it was more like interacting with a stranger (mean = 2.1, sd = 1.19). This was likely due to the short duration of the interaction and the minimum amount of social dialogue present in the system.

Table 2: Outcome Measures from Pilot Study

	Pre - Mean (SD)	Post - Mean (SD)	p
Depression (PHQ-8)	8.0 (4.62)	6.4 (3.13)	.38
Anxiety (State-Anxiety)	23.3 (6.46)	21.78 (7.61)	.65

Qualitative results

The transcripts of the semi-structured interviews were thematically analyzed for the evocation and understanding of emotion by the system. The analysis showed that half of the participants felt that the agent evoked emotional responses in them during the interactions, stating that they felt emotional because the agent was presenting them with “information they did not realize” (Patient 5). Two thirds of the participants expressed that they felt the agent understood their emotions, stating that they felt the agent, “... could decipher some of my attitudes” (Patient 10) and “... understood my emotions because I felt that it gave me the right responses” (Patient 8).

With the aid of our clinical collaborator, I conducted a video review to validate the ability of the system to detect and respond to user emotion during the counseling sessions. Video segments from the beginning of a session to the first point of potential empathic feedback were extracted and reviewed for half of the participants. The collaborator was instructed to classify the valence expressed in each video segment on a scale from 0 to 100, along with a determination of whether empathy should have been expressed after the segment. Their ratings classified 80% (4/5) of the segments as requiring empathy and 20% (1/5) as not, while the emotion detection system rated all of the segment’s as requiring empathy. Valence ratings for the video segments were also higher for the expert (Mean = 55, SD = 5) when compared to the ratings generated by the emotion detection system (Mean = 34.4, SD = 10.5).

This analysis confirmed that there were instances in which the agent successfully evoked and correctly responded to participant’s emotional states during the conversation, primarily through

offering pauses in the conversation during moments of emotional distress. However, these results do suggest that the emotion detection system used may be biased towards detecting negative affect.

Behavioral results

The counseling dialogue allowed participants to question the relevance of the therapeutic content and, through a subsequent prompt, terminate the session early if desired. Only one of the ten participants chose to click the first of these prompts, and none of the participants chose to terminate the session early.

Discussion

This study demonstrates that it is possible to elicit self-reported emotion and respond to a user's emotional state in real time during automated counseling sessions with an affectively aware agent. Although the study was not powered to produce significant changes in depressive symptoms, the majority of users expressed that they felt the agent understood their emotions and responded appropriately.

Detection limitations

While the system was generally well accepted, issues were discovered with how it detected the user's emotional state. The affect system was found to be unreliable when the user expressed extreme emotional outbursts (such as crying), since they often would move their hands in front of their face, resulting in a loss of detection. Additionally, the audio based emotion detection system required multiple turns of dialogue to have enough audio to process, and was biased towards detecting negative affect.

Design limitations

My example system also lacked an opportunity to address emotional discrepancies from the user, since the interaction only consisted of a single session with no pre-assessed emotional states to compare against. Finally, the XML language used proved to be difficult during implementation since the classes containing runtime methods required full system recompilation whenever a change was made.

Chapter 7: A Longitudinal Evaluation of an Affective-Aware Virtual Agent for Depression Counseling

Building upon the lessons learned in Chapter 6, I revised the underlying system used by the depression counseling system to accommodate a full, five-week, in-home cognitive behavioral therapy intervention. This section outlines the changes made to the system, the study conducted with it, and the study results.

System Changes

Scripting language improvements

During the development process of the prototype system, it became clear that a more robust scripting engine was needed for the full intervention due to the complexity of writing the systems dialogue in the XML-based language and the difficulty in inlining custom script commands. To remedy this, I developed RAGScript, a JSON scripting language that allows for inline JavaScript code.

```
{
  "StateName": "Example",
  "ActionSets": {"Speech": "Hello, How are you doing today?"},
  "Ui": {
    "Menu": {
      "Text": "Go to next state",
      "Execute": "if(True) FindNextState();"
    }
  }
}
```

Using this new scripting language, the systems dialogue did not require any pre-compilation, allowing for an improved workflow and more complex calculations to be performed at runtime. This language was used to script out the full intervention, which is provided in human-readable format in Appendix A.

Script structure

To expand the dialogue used in Study 2, I scripted out four additional sessions based on the manualized therapy intervention and the structure outlined in our review of cognitive behavioral therapy. This resulted in each session following this general structure:

1. Assessing the user's emotional state based on standardized measures (PHQ-8 and State Anxiety)
2. Checking in with the user/building rapport with them
3. Reviewing any homework assigned during the previous session/reviewing the lessons learnt in their last session
4. Practicing their latest homework assignments together
5. Covering new topics with the user
6. Assigning new homework for the user to complete before their next session

Improved agent design and conversational features



Figure 8: Counseling agent

In addition to adjustments made to the dialogue engine, a new conversational agent was designed for the system (Figure 8). Based on the therapists and their rooms from the APA videos, the new agent was designed to have a more professional appearance. Additionally, an interactive

whiteboard was added to the scene to give the agent the ability to display charts and images during the interaction.

Changes to emotion detection

Due to the limitations of the emotion detection system used in Study 2 in terms of both accuracy and robustness, especially during extreme displays of emotion, combined with the fact that depressive participants have less expressive nonverbal behavior [97], a more accurate emotion detection method was needed for this study. To address this, I decided to move away from a sensor-based emotion detection system to a conversational and self-assessment based one. This change ensured that all participants would receive the same accuracy of emotion detection regardless of their level of emotional expressivity and that the system would robustly work across all computer setups equally. To assess their emotional state, a PHQ-8 questionnaire was given at the start of each session to assess changes in their depressive symptoms over the last week. To assess the user's emotional state during the session, conversational dialogue was delivered by the agent to ask the user how they were feeling.

Semantic script analysis

Since the emotion detection system was moved from a real-time system to a dialogue invoked one, the dialogue engine needed to know what scripts were most likely to evoke emotional responses in the users. To solve this, I developed a semantic analysis program that analyzed the scripts used by the system to predict where users would have the strongest emotional responses to the agent's dialogue. Built upon the Empath toolkit [31], a textual analysis tool designed to find similar words from a library of 1.8 billion terms, a lexical model of semantically negative words was developed. Seed words for the model were selected from the Affective Norms for English Words database [9], which contains a list of 1000 words ranked by valence.

The resulting program was run on each script in the intervention (27 total), and produced a ranked list of normalized means representing the number of matching terms found using the empath model. Sets of seed words based on valence thresholds were compared to the empathy placement spots originally decided upon by our clinical collaborator during script development to assess the accuracy of the model. The various valence thresholds selected for evaluation were used to see if more negatively/positively charged words had an impact greater impact on optimal empathy placement.

While the results were promising, with an 80% agreement level between the system and the collaborators on the lower valence levels (Figure 9), the collaborators assessment was ultimately used to ensure an optimal patient experience. This resulted in the empathic statements taking place after discussing the main agenda item each week, with empathic statements generated from the results of the conversational emotion detection dialogue that occur during interaction.

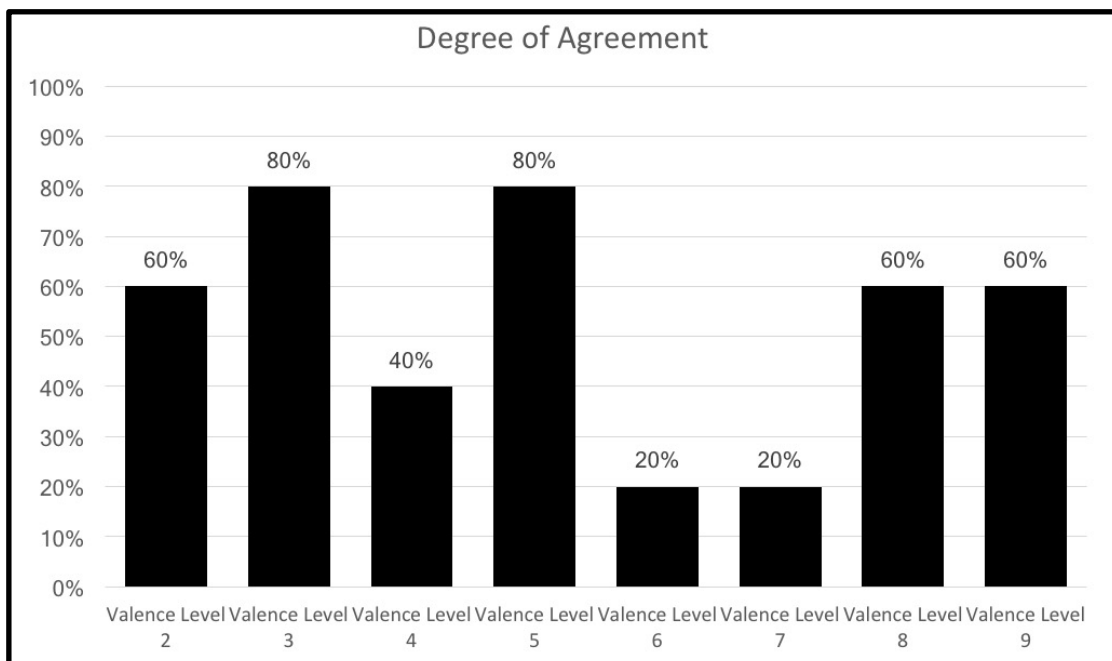


Figure 9: Number of session correctly identified by the program at each threshold level

Empathy changes

In addition to planning exactly where the empathic feedback would occur in each script, I expanded upon the types of empathic statements the system could generate. In Study 2, empathic feedback was generated as a response to a user's negative emotions. Due to the longitudinal nature of the expanded study, temporal differences in a user's emotional state were used to generate utterances based on how their emotional state changed across their interaction. This was accomplished by developing a library of empathic responses that accommodated four different states: Positive Valence, Negative Valence, Improved Valence and Decreased Valence (Figure 10).

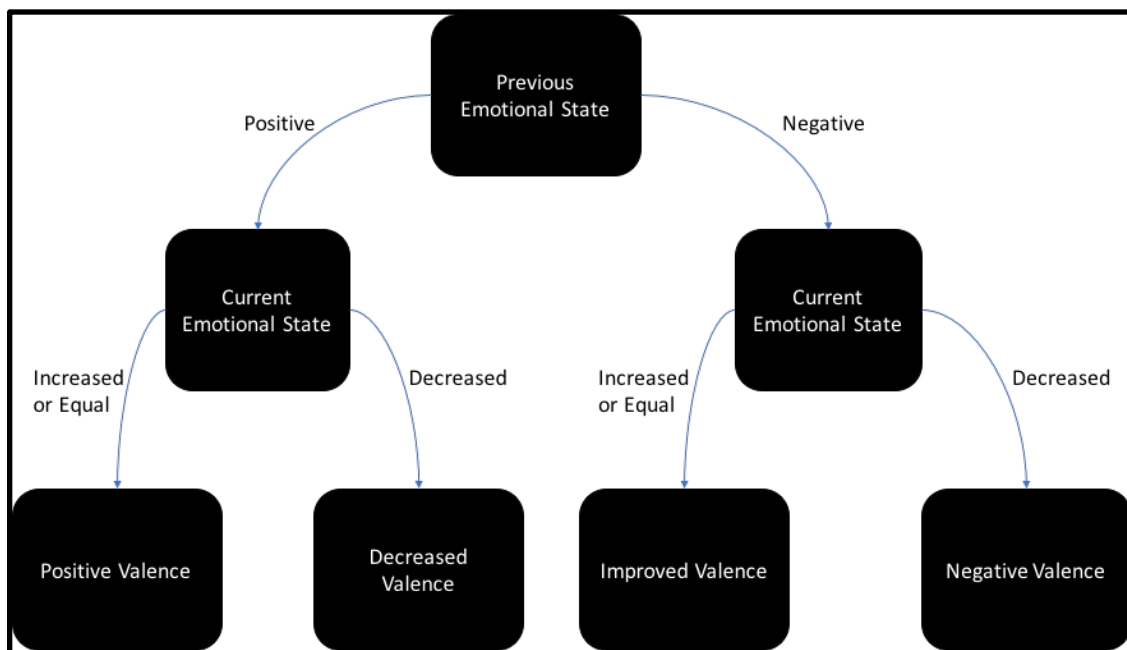


Figure 10: Logic used to generate empathy statement

This library consisted of multiple variants of each statement to ensure that a user never heard the same utterance twice.

Study Design

To evaluate the final system, a five-week within-subjects experiment was performed in which participants interacted with a virtual depression counselor from their home computer.

Participants

To enroll in the study, all participants were asked to fill out an online questionnaire that assessed their depressive symptoms (using the PHQ-9 form), their mental health history, and if they were currently enrolled in therapeutic treatment. All participants who completed the questionnaire and passed the following eligibility criteria were contacted to participate in the study.

1. Scored between 5-14 on the PHQ-9 questionnaire
2. No suicidal tendencies
3. No history of psychosis or Bipolar Disorder
4. Not currently in therapy
5. Had not completed a CBT therapy course in the last 6 months

Ineligible participants were sent information about local mental health resources.

Enrollment and conditions

Responding participants were randomly assigned to one of three conditions and brought into the lab for final screening. The three randomly assigned conditions were:

1. Affective – The full version of the system described above
2. Standard – A version of the system without any emotion detection/empathic feedback
3. Control – A version of the system in which participants completed weekly PHQ-8/State Anxiety Questionnaires

Upon arriving at the lab, participants were reassessed for mild to moderate depression via a PHQ-8 questionnaire. Disqualifying participants were debriefed and compensated for their time.

Qualifying participants were given instructions on how to download and run the program, and then asked to return five weeks later for follow-up and debriefing.

Measures

To assess the efficacy of the system, the user's system usage (the number of sessions and the session duration), along with depressive symptoms (PHQ-8 and State Anxiety scores) were monitored remotely. Following the five-week period, participants were given the following questionnaires to assess the system:

1. PHQ-8
2. State Anxiety
3. Working Alliance (For non-control conditions)
4. Satisfaction with agent (For non-control conditions)

Additionally, a semi-structured interview (Appendix C) was conducted with the participant to further evaluate their experience with the system.

Study Results

235 participants signed up for the study via the online questionnaire posted on a campus wide recruitment site. Of those who signed up, 47 were found eligible for the study and 187 were found ineligible. From those who were eligible, four were disqualified at intake due to PHQ-8 scores, leaving 43 participants across the three conditions (15 affective, 14 standard, 14 control). Out of the 43 participants enrolled in the study, five dropped out (one due to time commitments, four who never responded) and two had to be disqualified from the study due to study contamination (the participants sharing information about the different conditions with each other), resulting in 36 participants completing the study (Table 3).

Table 3: Baseline measures and demographics

Variable	All (n = 36)	Control (n = 8)	Standard (n = 13)	Affective (n = 15)
	15 (41.67%)	3 (37.5%)	3 (23.08%)	9 (60%)
	21 (58.33%)	5 (62.5%)	10 (76.92%)	6 (40%)

	22.92 (2.23)	22.5 (2.39)	23.46 (2.03)	22.67 (2.38)
(Intake)	42.42 (12.11)	43.13 (13.65)	39.69 (11.12)	44.4 (12.5)
(Intake)	6.46 (2.91)	7.5 (3.51)	5.73 (2.31)	6.53 (3.07)

Dropout rates between groups were compared using a chi-squared test (Table 4), in which a significant difference was found between the three conditions ($p < .005$), due to there only being dropouts in the control group.

Table 4: Participant dropout and disqualification rates

	Control	Standard	Affective
Drop-outs	5	0	0
Disqualified	1	1	0

Baseline Measures

Prior to data analysis, participant data was checked to insure there were no significant differences between the groups at intake. Using an ANOVA, intake PHQ-8 and state anxiety scores were compared between all conditions, finding no significant differences between the groups on either metric ($p > .4$). Gender comparisons were also conducted on the intake scores: no differences were found in PHQ-8 scores, but significant difference were found between males and females in state anxiety scores ($p < .05$).

Table 5: Participant depression metrics

	Control	Standard	Affective	p	Males	Females	p
Mean PHQ-8 (sd)	7.5 (3.51)	5.73 (2.31)	6.53 (3.07)	.434	6.1 (3.25)	6.97 (2.38)	.44
Mean State Anxiety (sd)	43.13 (13.65)	39.69 (11.12)	44.4 (12.5)	.601	37.57 (9.94)	49.2 (11.88)	

Participants in the agent conditions were also asked if they had ever discussed their depressive symptoms with others during debrief, to explain how their prior experiences differ from those

with the agent. During this process however, I found that over half of the participants in the study stated had never talked to anyone regarding their depressive symptoms, with only one participant stating that they had previously talked to a therapist.

Have you talked with others about depression?	Yes	No
Affective	6	9
Standard	4	8

The lack of talking with others was attributed to several factors, ranging from cultural stigmas related to seeking mental health help to simply having a lack of time to do so since they “[are] working 3 jobs so it doesn’t really work, I think the computer program made it easy because I would get home from work and be like oh okay” (P28-A). Introversion was also commonly cited, in which participants stated that they are “just not comfortable talking to people” (P29-S) or that they were “a bit of an introvert so I can’t talk a lot really to someone else about the depression so I just keep it in me” (P41-S).

Fear of judgement and negative experiences with talking to others about depression was also discussed: participants found it “easier to talk to a computer because you don’t know how other people are going to respond to your problems so definitely for someone who is an introvert or who does not want to express his feelings the computer is really going to help you”(P40-A), and they found that talking with others was stressful because “I was thinking what is she going to think or what is the doctor going to think and [the agent] you know that no one is going to judge you...I usually talk both to friends and family but some situations I don’t discuss with them so with this program I can speak about everything” (P19-A).

Advice from friends was also brought up, in which participants stated that they had “tried talking to a friend and that didn’t really feel all that good. Funny enough I felt like the program was much more of a help ... because it actually had solutions as opposed to

‘yeah okay I understand, you’ve spoken enough my turn now’ and that comes in between friends but I didn’t have to worry about that. I knew that I’m talking and it’s going to listen like that” (P35-S) and that “even then it’s not like in the same objective way I think also because it’s your friend it’s hard to be objective about it so... I mean sometimes they are objective but it’s nice to have that sometimes....” (P22-A)

Usage Metrics

The usage of the system across the three conditions was compared using the 149 unique interactions generated by the participants. No significant differences were found in the average number of sessions completed by each participant ($p > .75$). Significant differences were found between average session durations across the three conditions ($p < .001$), due to the difference in average session duration between the control condition and the agent conditions. A post-hoc analysis of the agent conditions revealed no significant differences between the mean system usage.

Table 6: System usage

	Control	Standard	Affective	p (All Conditions)	p (Agent Conditions)
Average Session Count (sd)	4.75 (0.463)	4.54 (1.13)	4.33 (1.29)	0.743	.689
Average Session Duration (seconds/sd)	144.75 (61.73)	820.15 (211.02)	922.13 (265.88)		.276
Average Session Duration without Affective Tailoring	144.75 (61.73)	820.15 (211.02)	869.05 (264.08)		.594

(sd)					
------	--	--	--	--	--

Using linear models to compare the session durations with the session number and id as random variables, interactions between the conditions were compared on a per-session basis.

BaselineModel = Duration ~ (1|SessionNumber) + (1|ID)

ConditionModel = Duration ~ Condition + (1|SessionNumber) + (1|ID)

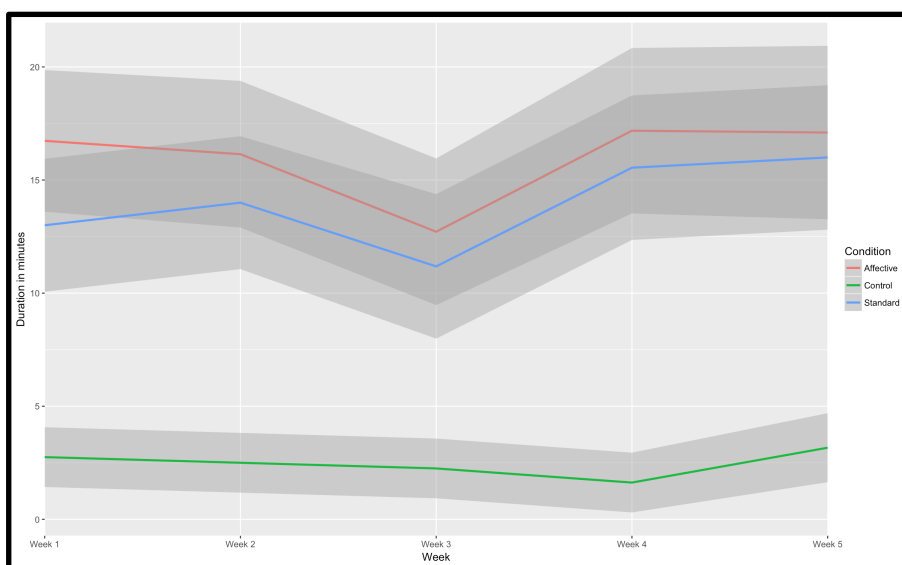


Figure 11: Average system usage in minutes versus number of weeks using the system

Both the full data set and the agent-only dataset were compared using these models via an ANOVA model. In the full data set, the control condition was again found to be used for significantly shorter durations than the agent models (In both cases, the Condition Model was found significant, in which the control condition was used for a significantly shorter duration (AIC = 4505.4, $p < .001$). In the agent dataset, no significance was found in duration, although the data did suggest that the affective condition was used for slightly longer than the standard condition (AIC = 3470.5, $p < .21$).

Depression Metrics

PHQ-8 and State Anxiety was assessed at intake and debrief for all participants. Additionally, PHQ-8 and State Anxiety was collected at the start of each session with the system.

Table 7: Depression changes

	Control	Standard	Affective	p (All Conditions)	p (Agent Conditions)
PHQ-8 Change (sd)	-1.125 (4.39)	-1.5 (3.25)	-1.462 (3.62)	.866	.851
State Anxiety Change (sd)	1.75 (5.18)	-3.55 (10.86)	-6 (7.8)		.563

Pre-post analysis

A one-way ANOVA model was used to compare the pre-post PHQ-8 and State Anxiety scores between the three conditions. No significant differences were found between the changes in PHQ-8 scores across the three conditions ($p > .8$). Significant differences were found between State Anxiety changes ($p < .05$). Post-hoc analysis found that participants in the affective condition experienced a significant reduction in their State Anxiety scores ($p < .01$), while those in the agent ($p > .12$) and control ($p > .37$) conditions experienced no significant changes.

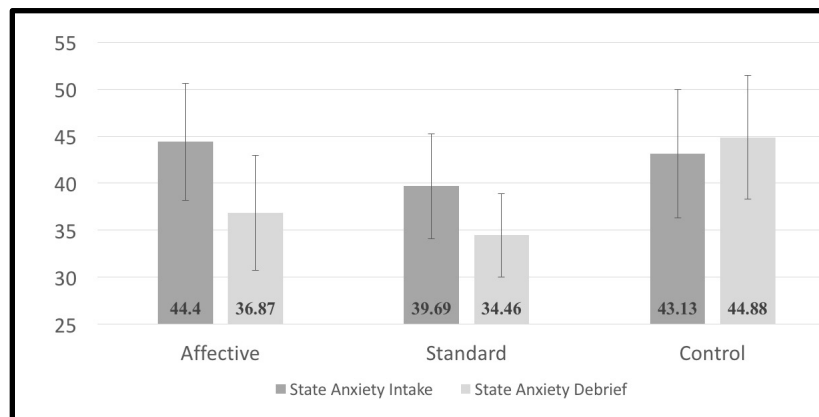


Figure 12: State anxiety changes versus condition

Time series analysis

Linear models were created to compare the PHQ and State Anxiety scores collected weekly by the programs. A random factor was added to account for participant variance.

The models used were:

BaselineModel = Measure ~ (1|ID)

GenderModel = Measure ~ Gender + (1|ID)

ConditionModel = Measure ~ Condition + (1|ID)

SessionModel = Measure ~ NumSessions + (1|ID)

FullModel = Measure ~ Condition + Gender + NumSessions + (1|ID)

InteractionModel = Measure ~ Condition * Gender * NumSessions + (1|ID)

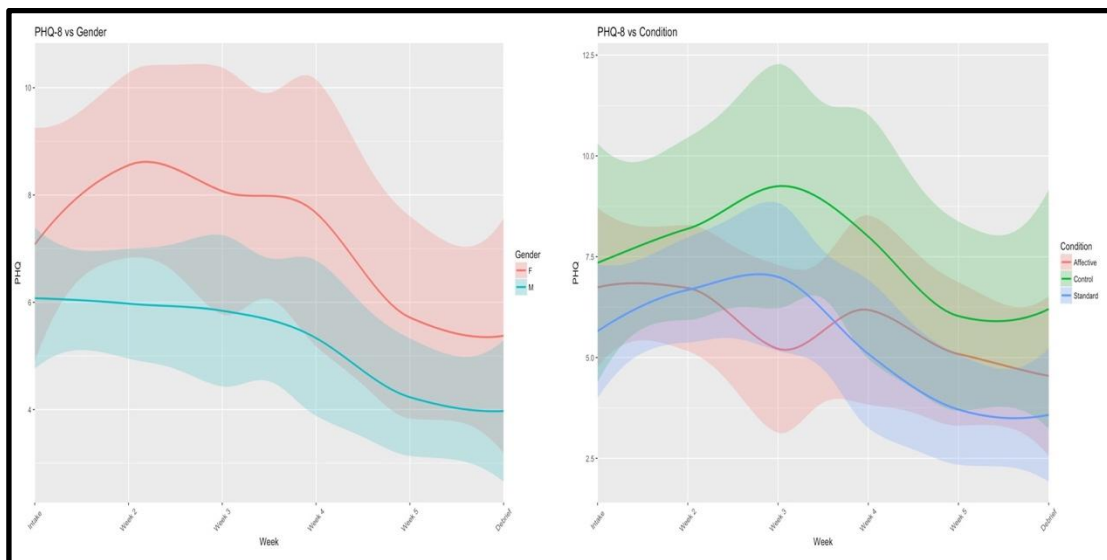


Figure 13: PHQ-8 changes across condition and gender

Using an ANOVA to compare across the full dataset, significance was found in PHQ-8 scores in the gender (AIC = 1033.128, $p < .05$), sessions (AIC = 1017.421, $p < .01$), and full model (AIC =

1015.487, $p < .05$). Analysis of these models found that male participants had significantly lower weekly PHQ-8 scores (Est: -1.88, SD: 2.77) and participant's PHQ-8 scores lowered in relation to their session number (Est: -0.49, SD: 2.61).

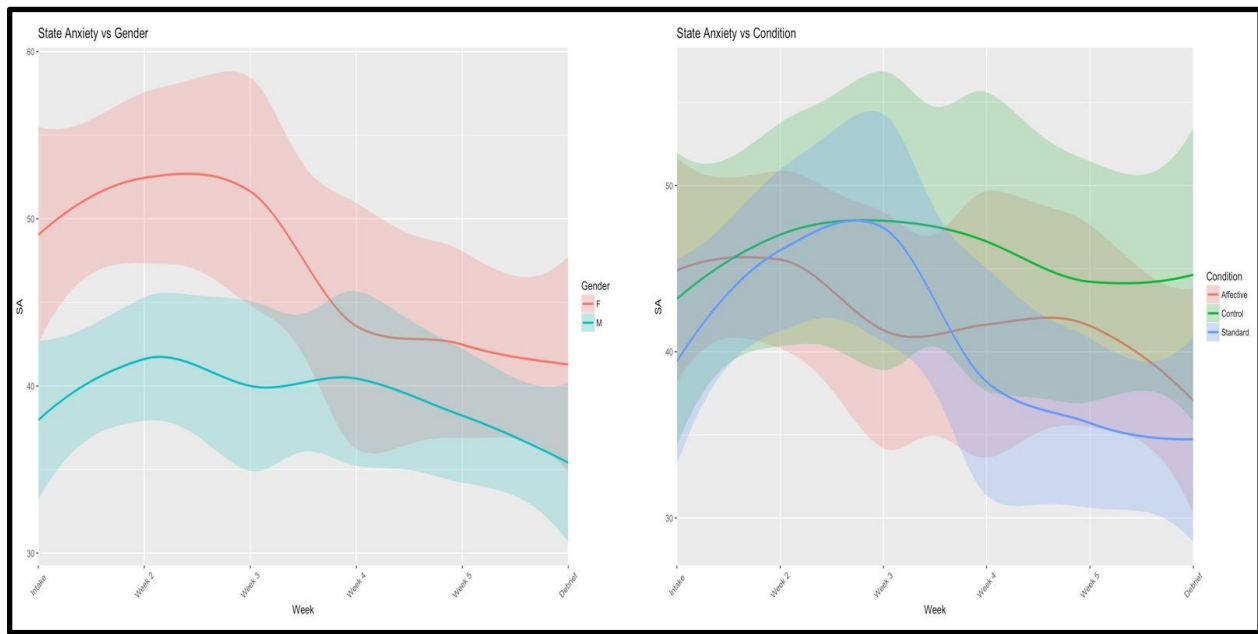


Figure 14: State anxiety changes across condition and gender

There were similar findings for State Anxiety Scores, in which significance was found in the gender (AIC = 1477.090, $p < .05$), week (AIC = 1467.573, $p < .01$), and interaction models (AIC = 1459.147.227, $p < .01$). Trends were also found in the condition (AIC = 1482.203, $p < .08$) and full models (AIC = 1466.601, $p < .08$). Analysis of these models found that male participants had lower State Anxiety Scores (Est: -7.24, SD: 8.48). All participants experienced reduced State Anxiety Scores that were lower in relation to the number of sessions they had completed (Est: -1.28, SD: 8.1). Finally, participants in the control condition reported higher State Anxiety scores than those in the agent conditions (Est: 4.29, SD: 8.47). In the interaction model, a gender difference was found for those using the standard agent, in which males reported lower weekly state anxiety scores than females (Male Est: 20.85, SD: 7.6; Female Est: 17.87, SD: 7.6).

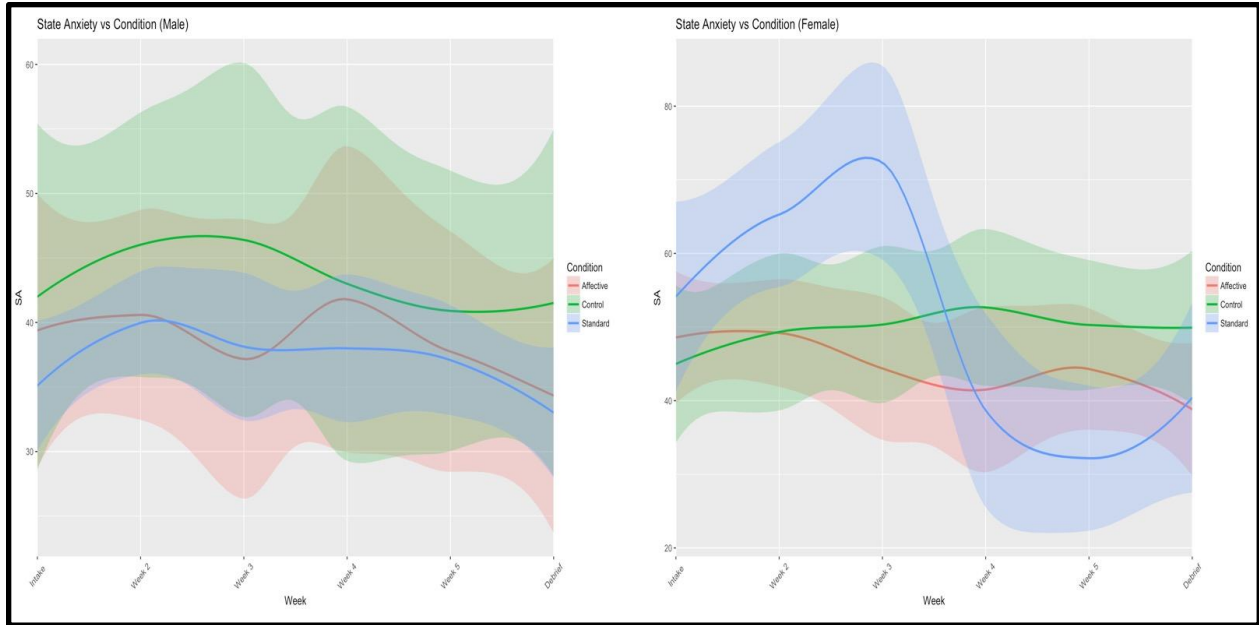


Figure 15: Differences in state anxiety between males and females

Working Alliance

T-tests were conducted to test for differences between reported working alliance measures (Bond, Goal and Task) and both condition and gender. No significant results were found between any of the measures. However, a slight trend was found between the working alliance bond measure and gender ($p < .12$), in which females had a higher bond with the agent than males.

Table 8: Working Alliance Measure

	Standard	Affective	p	Males	Females	p
Bond (sd)	37.62 (11.10)	37.8 (11.05)	0.97	34.94(10.42)	41.42(10.76)	0.12
Task (sd)	28.38 (10)	29.73 (9.31)	0.72	27.25 (10.53)	31.58 (7.59)	0.22
Goal (sd)	18.62 (9.96)	19.3 (9.42)	0.85	17.88 (9.63)	20.5 (9.54)	0.48

Agent Ratings

Agent ratings given at debrief for the affective and standard conditions were analyzed as individual ordinal values (Table 9) using the align ranked transform tool in R (ARTOOL), in which interactions between both condition and gender were tested for.

Post-hoc analysis was conducted on all measures, finding the following results:

Table 9: Agent ratings

Measure (Rated via 7-Point Scale)	Standard (sd)	Affective (sd)	Standard Male (sd)	Standard Female (sd)	Affective Male (sd)	Affective Female (sd)
How Close do you feel to the Agent?	4.69(1.18)	4.2(1.52)	5(1.05)	3.83(1.47)	3.67(1.15)	4.44(1.59)
How Satisfied are you with the Agent?	5.31(1.11)	5.47(0.99)	5.5(1.18)	5.17(0.98)	4.67(0.58)	5.67(1)
How much would you like to Continue using the Agent?	5.54(0.97)	4.93(1.87)	5.5(1.08)	4.67(1.97)	5.67(0.58)	5.11(1.9)
How much do you Trust the Agent?	5.46(1.13)	5.47(1.06)	5.3(1.16)	5(1.1)	6(1)	5.78(0.97)
How much do you Like the Agent?	5.31(1.18)	5.07(1.22)	5.4(1.26)	5(1.67)	5(1)	5.11(0.93)
How Repetitive was the Agent? (lower is better)	4(1.41)	4(1.85)	3.5(1.08)	3.5(2.35)	5.67(1.15)	4.33(1.5)
How Easy was it to talk with the Agent? (lower is better)	3.31(2.06)	2.87(1.68)	3.6(2.22)	2.17(1.33)	2.33(1.15)	3.33(1.8)
How Interesting was the Agent?	4.77(1.09)	4.33(1.91)	4.9(1.2)	4.33(2.42)	4.33(0.58)	4.33(1.66)
How would you characterize your Relationship with the Agent? (Stranger to Friend)	4.46(1.27)	4.13(1.51)	4.5(1.27)	4.33(1.51)	4.33(1.53)	4(1.58)
How much do you feel the Agent Cares for you?	4.77(1.42)	4.8(1.61)	5(1.33)	4.17(1.6)	4(1.73)	5.22(1.56)
How much do you feel you and the Agent Understand each other?	4.85(1.07)	4.53(1.77)	5(0.94)	4.33(1.86)	4.33(1.53)	4.67(1.8)
How Honest do you feel the Agent is towards you?	5(1.53)	4.53(1.81)	5.4(1.17)	4.17(1.72)	3.67(2.08)	4.78(1.92)

Closeness

A trend was found between the closeness measure, condition and gender ($p < .11$). Post-hoc analysis found a trend between how close males felt with the agent and the condition, with the standard condition being rated as closer with them ($p < .11$). Across both conditions, closeness was in the positive direction.

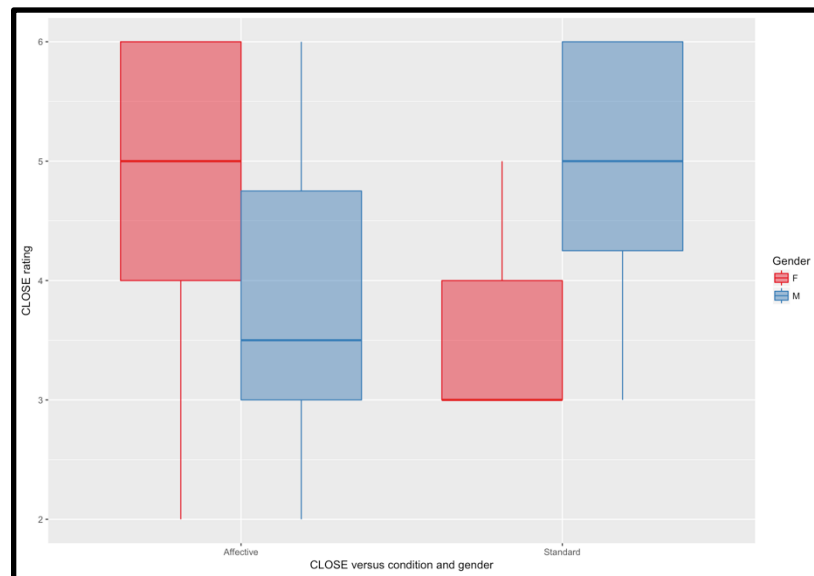


Figure 16: Closeness ratings between conditions and genders

Satisfaction

No significant differences were found in the participants' satisfaction with the system and between the standard and affective conditions. Across both conditions, satisfaction was in the positive direction.

Willingness to Continue

No significant differences were found in the participants' willingness to continue using the system between the standard and affective conditions. Across both conditions, willingness to continue was in the positive direction.

Trust

No significant differences were found between the two conditions in the perceived trustworthiness of the agent. Across both conditions, trust of the agent was in the positive direction.

Likeability

No significant differences were found in the likeability of the agent between the two conditions. Across both conditions, likeability was in the positive direction.

Repetitiveness

Significant differences, divided according to gender, were found concerning repetitiveness, in which females found the system to be more repetitive than males ($p < .05$). Both conditions found the agent to be slightly repetitive.

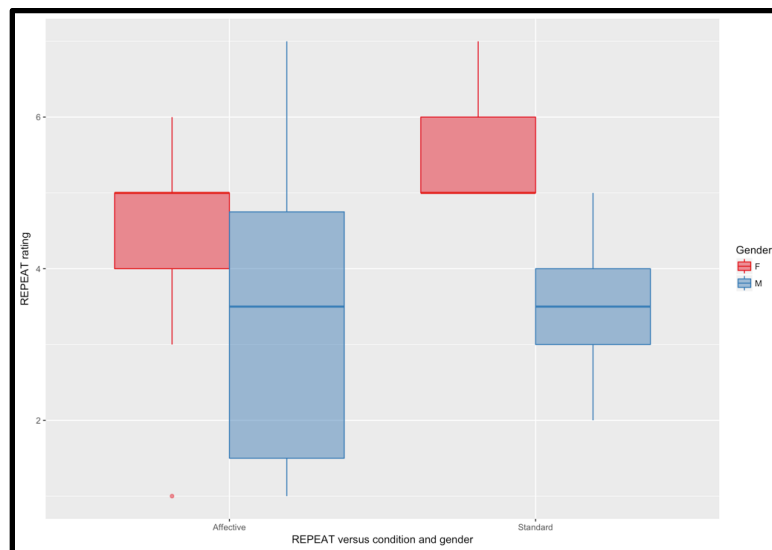


Figure 17: Repetitiveness ratings between conditions and genders

Ease of Use

No significant differences between the two conditions as to how easy participants found the system to use. Across both conditions, the agent was rated relatively easy to use.

Interest

No significant differences were found between conditions as to how interesting the agent was.

Across both conditions, interest was in the positive direction.

Relationship

No significant differences were found between the two conditions as to the participants' perceived relationship with the agent. Across both conditions, they saw the agent as a friend rather than a stranger.

Caring

A trend was found between how caring the agent was perceived to be, condition and gender ($p < .11$). A post-hoc analysis found no significant differences between conditions or gender. Across both conditions, they saw the agent as caring.

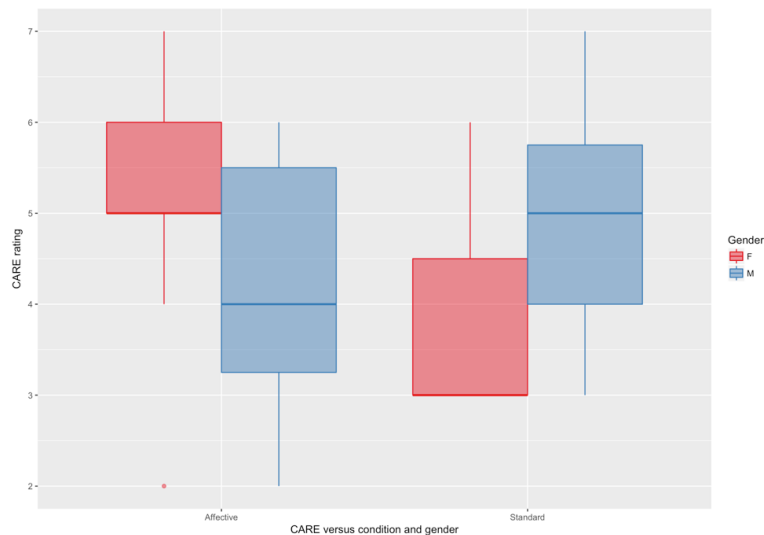


Figure 18: Caring ratings between conditions and genders

Understanding

No significant differences were found in the extent to which users perceived the agent to be understanding. Across both conditions, they saw the agent as understanding.

Honesty

A trend was found between the honesty measure, condition and gender ($p < .1$). Post-hoc analysis found a trend between how honest the agent was perceived to be by males and the condition, with the standard condition being rated as more honest by males ($p < .1$).

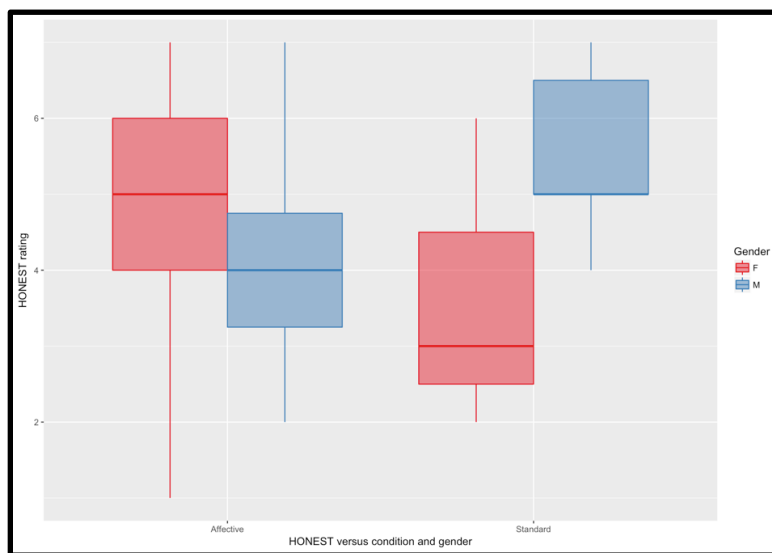


Figure 19: Honesty ratings between conditions and genders

Semi-Structured Interview Analysis

Semi structured interviews were conducted during participant debrief to gain insight on their experiences with the system, what areas needed changing, and how the system compared to existing therapeutic care options. All transcribed questions were coded and compared via a chi-squared test when appropriate.

General system impressions

Across all conditions, participants had overwhelmingly positive opinions of the system, with the only negative comments coming from those in the control condition ($p < .005$). Participants expressed that “the experience was good” (P4-S) and that “[it was] really helpful and the procedures are really easy to follow” (P19-A). Those in the control condition who did enjoy the system stated that their enjoyment was due to the system encouraging them to think about their problems, saying that “It was pretty good actually, in real life you don’t analyze the things that were asked here like how you are tense and how you are strained so when you are filling the questionnaire you get to analyze that thing so yeah it's good” (P30-C). The most common complaint in the control condition was related to the questionnaires given during each interaction, since they were “very plain and it’s the same thing every week so you sort of knew what it was going to ask” (P5-C).

General System Impression	Positive	Negative
Affective	15	0
Standard	13	0
Control	5	3

Changes in depressive symptoms over the course of the study

The vast majority of participants reported that they felt as if their depressive symptoms had decreased due to system usage, with a significant number of participants reporting they felt better in the agent conditions ($p < .05$). Participants often explained that the program made them attribute their feelings better, since some of them “used to feel like everything was my fault and I realized that it’s just important to do your best and yeah it helped” (P3-A) and that “... it has helped me because sometimes when there’s not a person you can speak to this is really helpful and I know that she’s not going to tell anyone about my feelings so I feel secure with her” (P19-

A). For those who did not report a reduction in depressive symptoms, they often mentioned that the program did help them think about their problems in a new way, saying that "... I've been more conscious about a lot of it and like I feel like it's helped me be more comfortable with a lot of those ideas which was cool too" (P22-A) and that "... I can say it helped me. The ideas were really good" (P25-A). External factors did come into play with some participants depressive symptoms however, with a few mentioning that "yeah, [the system] helped me work on [my symptoms] but again some new circumstances..." (P4-S).

Do you feel your depressive symptoms changed?	I feel less depressed	I feel more aware of my symptoms	I don't think they have changed
Affective	13	1	1
Standard	9	2	2
Control	2	1	5

Emotional experiences with the system

There were mixed responses related to participant's emotional experiences with the system. Many participants reported that they did not become emotional while using the system, often explaining that they were "not that emotional of a person" (P16-A) or "pretty tough" (P10-A). Some attributed this to the setting in which they were using the system from, stating that since they use it "[at] home in a place where I can sit peacefully and so I didn't get [emotional] in any situations like that" (P1-A). Those who did report feeling emotional attributed it to overwhelming real-life situations that occurred close to system usage, such as "when I'm coming out of a very super emotional state of mind and recalling all of that I did get emotional..." (P14-S) or when the system "asked me to list [my thoughts] and one of those moments yeah I really did actually [get emotional]" (P35-S).

Did you get emotional while using the system?	Yes	No
Affective	3	12
Standard	5	8
Control	1	7

Emotional intelligence of the system

The question of the system’s emotional intelligence was confounded by the system’s contents for many participants, in which they felt that the agent’s emotional understanding could be attributed to its assessment of the user’s emotional state while discussing thought records. For those who saw a distinction between the therapeutic content of the script and the agent's emotional understanding, the responses were mixed across groups, where some participants felt that the system could not understand their emotions since it’s responses were just “the extent of what a computer can do” (P23-S) or that the understanding was “not on the same level of human understanding but a lot more than what you can expect from a computer character” (P35-S).

Did the system understand your emotions?	Yes	No
Affective	11	4
Standard	9	4

Preference of real therapist or system

A strong trend was found in the affective condition in which participants were more open to the idea of engaging in future therapy sessions with the agent than a real-life therapist ($p < .075$). This was attributed to the openness they felt with discussing these topics with the agent, because “it’s like a generated program so in that way I feel much more better than I would be able to express myself” (P13-A). Another said, “Probably I wouldn’t open up very easily to a therapist so definitely to begin with the computer character would help me to get accustomed to it and

then get a real therapist” (P37-A). Those in the standard condition were much more open to the thought of trying a therapist instead, because they felt that a therapist's responses “would be more accurate” (P32-S) and that they would “have more options in the conversation” (P23-S).

Would you have preferred talking to a real therapist or the system?	Therapist	System	Undecided
Affective	2	8	5
Standard	7	4	2

System engagement

Engagement was generally rated positive, with participants enjoying the companionship of the agent throughout the interaction. Many participants reported feeling a stronger connection with the agent by the end of the intervention, in which they felt as if “there was a mutual respect..Especially the last session as I mentioned. Getting scores like that helped me understand that my answers were interpreted” and this participant went on to say that “By the end of the 4th session I was actually looking forward to the 5th session so I think that helped yeah. I found the system engaging and I was happy with it when I realized it was helping me” (P14-S). The empathic tailoring was also mentioned by two participants in which they felt especially connected with the agent when “In the middle of the therapy she would stop and she would ask ‘can we continue, is it okay?’ and then she would go on” (P1-A).

Was the System Engaging?	Yes	No
Affective	9	6
Standard	11	2

Comments about system usage

Participants generally liked the five-session structure of the system, with a few suggesting that they would have liked more frequent and longer sessions. Only two participants expressed that the structure was too long and that the sessions should be shorter in duration or number.

Session Duration/Length Comments	Fine as is	Sessions should be longer	Sessions should be shorter	There should be more sessions	There should be less sessions
Affective	8	2	1	4	1
Standard	8	1	0	5	0

Recommending the system to others

Almost every participant in the study stated they would recommend the system to others, with a few participants directly referring their friends and family to the study. Often, they felt the system would be a great tool to get people started with therapy, saying that “I think for beginners this would be a good thing to do because not everyone would be willing to go to a therapist.

When you say therapist, it freaks them out so this is something that tried to help you out it’s a nice beginner. It’s less intimidating than a therapist so I would recommend it” (P11-S) and “I have a lot of friends who also have mental health issues and I feel like for some of them who haven’t been through therapy it would be really good for them” (P22-A).

Would you recommend the system to others?	Yes	No
Affective	13	2
Standard	13	0

Affective Response Analysis

An additional sub-analysis was conducted on the user’s responses to the empathic prompts given by the system in the affective condition. This analysis consisted of their reported emotional

states, their acceptance or rejection of the empathic prompts given by the system, and whether they took a break when the system offered one.

Analysis of user's choices

Emotional assessments occurred at three points during each interaction, once at the start of each session via the PHQ-8 questionnaire, and twice within the session via dialogue prompts given by the agent. These prompts occurred at the start of the sessions for all sessions except the first, and again approximately half-way through the interaction at the point that was determined to have the most emotional impact. In total, the 15 participants experienced 113 emotional assessments, which were used in the following analysis. Responses to the agent were categorized into one of the following three categories:

- Continuation – Responses in which the user chooses to continue their interaction with the system. These choices result from the user agreeing with a positive emotional assessment or choosing the option to continue with the interaction.
- Empathy – Responses in which the user chooses to acknowledge the agent's perception that they were in a negative emotional state.
- Mislabel (Better or Worse) – Responses in which the user corrects the agent about their emotional state, in which it was either better or worse than the agent perceived it to be.

A flowchart illustrating the user's choices based on their emotional state during the interaction was generated using these labels to better understand how participants responded to the agent.

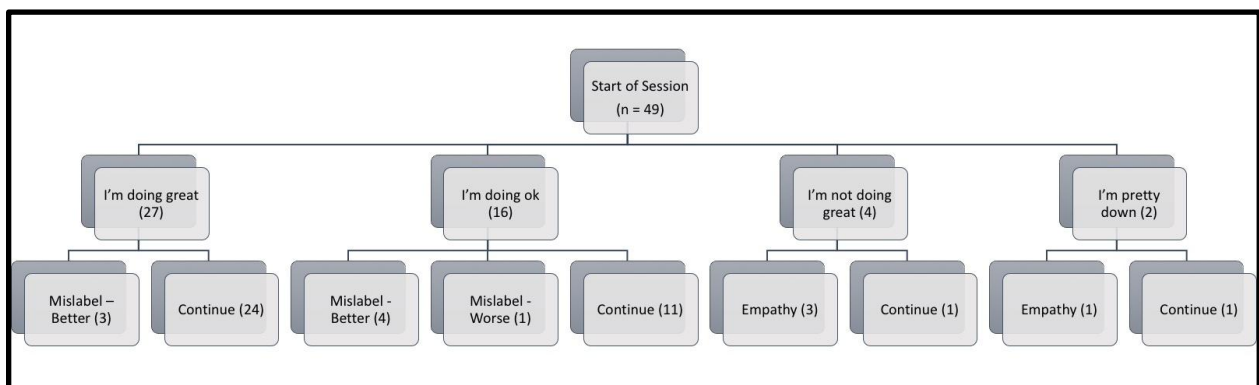


Figure 20: Empathic acceptance at the start of the session

The initial empathic response generated by the agent, based on the differential between their current and prior PHQ-8 scores and their response to the agent’s emotional prompt in the beginning of the session, primarily resulted in continuation responses (37). Mislabels were the next most common, in which seven users reported feeling better than the system assessed, and one in which the participant reported feeling worse (eight total). Finally, four participants accepted the agent’s empathic prompts and chose to hear empathic statements from the agent.

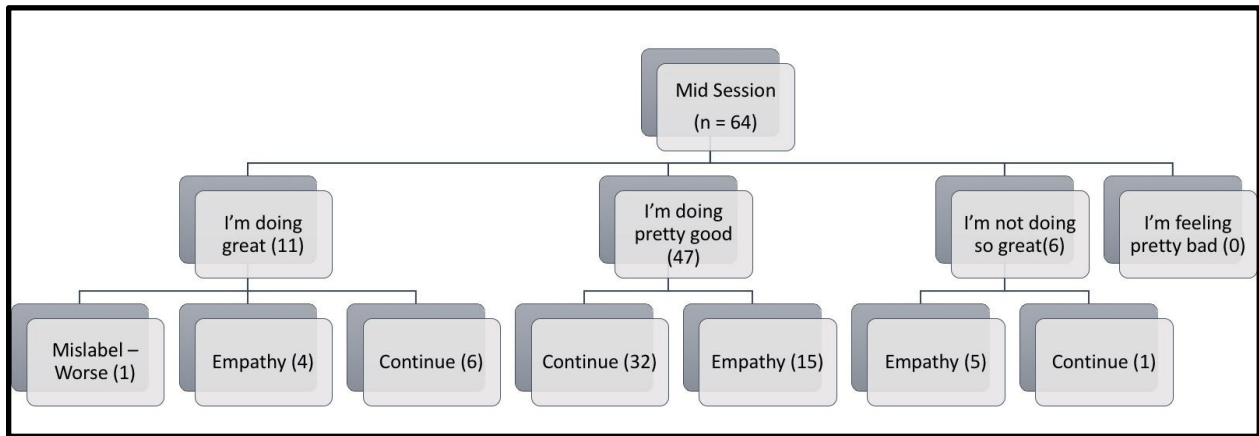


Figure 21: Empathic acceptance in the middle of the session

Interestingly, mid-session responses, which were generated based on the differential between the starting emotional assessment and the mid-session emotional assessment, were more varied. Out of the 64 total responses, 39 of them asked to continue the conversation, while 24 choose to receive empathic feedback from the agent. Accuracy of the assessments also seemed to be better, with only one participant reporting a mislabelled emotional response.

	Continue	Empathy	Incorrect Assessment
Male	21	6	0
Female	18	18	1

Gender differences between the responses given during the mid-session conversation were analyzed using a chi-squared test, in which female participants were found to be significantly more likely to choose the empathic responses compared to male participants ($p < .05$).

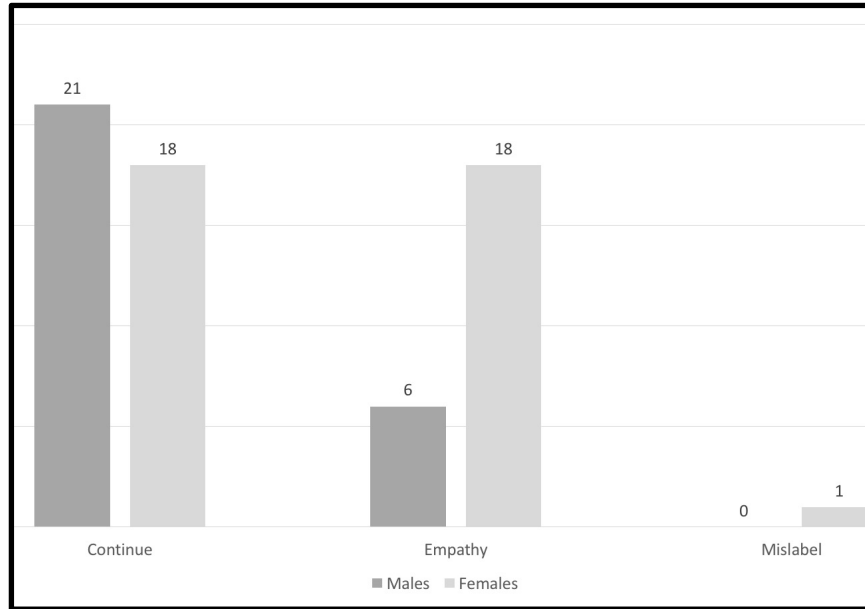


Figure 22: Empathy uptake between genders

Homework and Thought Record Analysis

At the end of each session, participants are asked to complete weekly homework assignments in which they are instructed to write down their thoughts and feelings on life events that occur between sessions. At the start of the subsequent session, the agent asks them if they were able to complete their homework and if they would like to use what they have written to fill out a thought record. Across both agent conditions the homework completion rates were relatively high, with no significant differences between the two conditions.

Homework Compliance	Completed	Not-Completed
---------------------	-----------	---------------

Affective	35	15
Standard	39	10

The thought records resulting from this task consisted of the participant recording the situation in which their thought took place, the thought they had regarding that situation, any possible distortions they may have had regarding that thought, and how they felt after reflecting on the situation. Since completing a thought record can be difficult to do for novice patients, the option to defer completion of the thought record was given to allow them to continue on with the conversation if they got stuck.

Upon study completion, our clinical collaborator reviewed de-identified versions of the thought records entered into the system and rated them based on the following metrics:

- Thought Completion - A measure of assessing if the participant completed the thought record task for a given entry. Since participants learnt how to fill out a thought record occurred across multiple sessions, a separate category was designated to evaluate how many thought records were completed once the full cognitive restructuring process was learnt. Positive thoughts were also allowed to be entered into the system, but did not require the participant to fill out the related distortion fields, so they were marked separately. Thought completion ratings were classified as either Completed, Completed (W/ Restructuring), Incompleted or Positive.
- Distortion Accuracy - A measure of the accuracy in which a participant assessed the cognitive distortion they were having in association with a given thought. Distortion accuracy was classified as either Correct, Related, or Incorrect.
- Thought Record Quality - A measure of the overall quality of a given entry in the thought record, based on the descriptions provided, the evidence for/against that thought and the

new thought provided. Thought record quality was classified as either Correct, Close to Correct, or Incorrect.

Based on these ratings, an analysis of the thought records was conducted with the 96 thought records entered into the system.

Table 10: Thought record usage

	Completed Thoughts	Completed Thoughts (W/ Restructuring)	Incompleted Thoughts	Positive Thoughts
Affective (<i>n</i> = 15)	20	9	10	10
Standard (<i>n</i> = 14)	16	8	11	12

Using a chi-squared test, no significant differences were found for thought record completion rates between the two conditions ($p > .78$).

Table 11: Distortion accuracy:

	Correct Distortion	Related Distortion	Incorrect Distortion
Affective (<i>n</i> = 15)	2	6	7
Standard (<i>n</i> = 14)	3	8	8

No significant differences were found for distortion accuracy rates between the two conditions ($p = 1$).

Table 11: Thought record quality:

	Correct Record	Close Record	Incorrect Record
Affective (<i>n</i> = 15)	0	7	2
Standard (<i>n</i> = 14)	2	2	4

A trend was found for thought record quality and condition, in which the number of correct/close records was greater for those in the affective condition compared to those in the standard condition ($p < .087$). Since thought records rely heavily on the connects between one's thoughts,

feelings and behaviors, it is possible that the affective agent promoted higher levels of affective awareness in the participants, resulting in deeper introspection during the thought records.

Power Analysis

While there were plenty of significant results in the study, many important ones were left trending or non-significant. To assess the effect size of these trends and number of participants required to make them significant, a power analysis was conducted for the following measures:

Measure	Effect Size (Cliff's Delta)	Sample Size Needed
<i>PHQ-8</i>	.14	416
<i>Number of Sessions</i>	.09	323
<i>Working Alliance - Bond</i>	.39	10
<i>Gender Effects - Closeness</i>	.18	50
<i>Gender Effects - Caring</i>	.15	437
<i>Gender Effects - Honesty</i>	.14	69

Discussion

This study explored the importance of affective understanding in agent based health counseling interactions. Over the course of a five-week cognitive behavior therapy intervention, participants across three conditions were assessed on their system usage, enjoyment, and changes in their depressive symptoms. Results of the study found that those in the affectively-aware agent condition received significantly increased benefits as measured by changes in state anxiety compared to those interacting with a standard one, and that both agent groups showed significant improvements over the control condition.

Differences in system usage

While there were no significant differences between the number of sessions completed between the three conditions, the amount of time the participants spent with the system per session differed greatly. While the differences between the control and agent condition were obvious due to the difference within the interaction, there was evidence that participants spent close to 40 seconds more on average with the affective agent per session, even when accounting for the additional dialogue. This suggests that the affective dialogue may have been successful at capturing the user's interest, and could be a useful tool in increasing user engagement at a minimal cost.

Differences in agent ratings

There were several interesting trends that emerged from the analysis of the agent rating questionnaires, especially regarding gender effects. In closeness, caring and honesty, the data suggested that females preferred the affectively aware agent while men preferred the standard agent. This suggests that the participants gender should be taken into account when using emotionally tailored dialogue, and that alternative forms of tailoring may be needed for male participants.

Changes in depressive symptoms

One of the most prevalent effects of the affective agent was the resulting changes in the participants pre-post outcomes. While there were no significant differences in PHQ-8 scores across the three conditions, significant differences were observed in the participant's level of anxiety. In the affective condition, participants demonstrated a significant decrease in anxiety

through pre-post comparisons, especially when compared to the control condition which showed a slight increase in anxiety due to the intervention.

Acceptance of affective tailoring

Analysis of the affective tailoring options found results to be in line with those found in the agent ratings, showing that females were more open to receiving empathic feedback from the agent than males were. The majority of male participants opted to continue on with the conversation when given the option to, whereas half of the female participants asked to receive empathic feedback when the option was given to them.

Limitations

While the study successfully demonstrated the impact of an affectively aware virtual agent on health counseling systems, there were a few factors that diminished the potential efficacy of the study. The most obvious of these were issues related to the small sample size used for the experiment and the demographics of that population. While the study found significance on a variety of measures, additional study participants may have brought to light some of the trends found in the data, especially regarding gender effects, since there were less females than males in two of the three condition groups. Additionally, the relatively low depression requirements used in the study may have limited the impact of depression changes, since those with lower depressive symptoms often experience lower changes in PHQ-scores than those with more severe symptoms [89].

Analysis of the debriefing interviews also suggested that personality metrics, especially those related to introversion/extroversion may have been correlated to the participant's opinion of the system, suggesting that it would be a worthwhile metric to explore in future agent based studies.

Future Work

While this study explored the fundamental differences between an affect-aware agent and a non-affective one, there are a myriad of other study conditions that could have been explored. By comparing the affective agent to a dialogue only variant of the system (no agent), I could have explored the impact of embodiment on the framework. Likewise, comparing the system to variants missing one or more of the empathic tailoring techniques used (such as one without reflective dialogue) could have provided a greater insight into the efficacy of each tailoring technique. Finally, the impact of empathic frequency could have been explored by comparing the agent to variants that delivered the empathic content more or less frequently during the interaction.

Chapter 8: Conclusions

In this dissertation, I demonstrate the importance of empathic understanding in automated health counseling systems and provide a theoretical framework outlining how this can be accomplished. Specifically, I answered the three questions I set forth at the beginning of this work, and answered them as follows:

How does a user's emotional state impact their reaction to dialogue given by a health counseling system?

In a study with 21 participants exploring the role of emotions in human-human interactions, I demonstrated that computer systems can produce significant behavioral changes by tailoring dialogue to a user's emotional state. During a two-month automated health behavior change intervention, the relationship between a user's emotional states and the messages they received were examined to find changes in their compliance based on system requests. Results of this study showed that there was a significant correlation between a user's emotional state and their receptiveness to the system's requests. Specifically, users were more receptive to positively framed requests when in a negative mood, and more receptive to negatively framed requests when in a positive mood.

Is it possible for a health counseling system to adapt to real time changes in a user's emotional state?

Through the exploration of work done on the importance of emotional understanding in health counseling, I developed a computational framework outlining ways in which an affect-aware system should react to a user's emotional state in a health counseling setting. To evaluate this framework, I conducted an exploratory study with 10 participants in which they interacted with a

virtual counselor designed to teach them about cognitive behavioral therapy. During this interaction, the system detected their emotional state in real time through a combination of facial recognition and speech analysis and provided tailored dialogue based on their emotional state. Results of the study illustrated that the system was capable of evoking extreme emotional responses from participants. Most participants responded positively to the system's empathic understanding, and reported improved feelings after the interaction. Potential problems with the detection techniques were also identified, since participants often obscured their face or stopped speaking when being emotionally overwhelmed.

How does emotional understanding impact system efficacy in longitudinal health behavior change interventions?

To fully evaluate the potential efficacy of the proposed framework and its applicability for longitudinal use, I conducted an empirical study evaluating an affect-aware variant of the depression counseling system against a non-affect-aware one and a non-intervention control. In a five-week study, 36 participants interacted with a virtual depression counselor from the comfort of their own home, in which their system usage, depressive symptoms, and ratings of the system were evaluated remotely. Results of this study showed significantly decreased anxiety and increased engagement for participants using the affect-aware version of the system compared to those in the other two conditions.

Future Work

While the work presented in this dissertation illustrates the importance of creating empathic systems, there are still four main questions left unanswered; the efficacy of the framework, how it could be expanded to accommodate for the use of real time sensors, its applicability outside of the healthcare domain and what other forms of dialogue adaptation could be explored:

Comprehensive System Evaluation

While the studies presented here explore the potential efficacy of my framework, they lacked the numbers to fully explore this potential. The results of the five-week long depression counseling study found a number of statistical trends related to gender differences and system preference. It is highly possible that gender specific tailoring would be required by this framework to account for differences in response to empathy [84]. Additionally, since the study only included those with mild to moderate depression, the efficacy of the framework for those suffering from more severe emotional disorders is still in question.

Responding to Real Time Emotion Sensors

Although the use of real time empathic feedback via sensors input was explored in Chapter 6, the five-week long evaluation study did not include the use of any sensors due to issues with accuracy and system deployment. While the framework does outline how these sensors could be used, it is highly likely that overuse of the empathic cues triggered by a sensor based system would have a negative effect on user experience. This leaves us with the question of what the exact emotional cues are that should be used to trigger empathic feedback by the system, and how often they should occur. Other types of sensors should also be explored since the facial detection and speech based sensors used in this dissertation presented issues when used by participants who were emotionally overwhelmed. Other detection methods that rely on the participant's full body or physiological states, such as posture detection systems [24], or those built upon monitoring a user's heart rate, could potentially alleviate these issues [56].

Applications in Non-Healthcare Domains

While the framework presented here was specifically tailored to health behavior change systems, there are many other domains that could potentially benefit from emotional understanding.

Disciplines like customer service [76], and marketing [55], have begun to see the importance of incorporating this understanding into workflow, and there are many more areas where this has yet to be explored. Ultimately, future studies are required to understand if building empathic systems as a feature should be generalized for all computer systems, or if some domains would be better without this system.

Dialogue Adaptation

While the framework presented in this dissertation explores a number of ways in which dialogue could be tailored to a user's emotional state, there are many other possibilities. Currently, I explored the insertion of new dialogue states into the discourse as a way to acknowledge the user's emotional state. However, one could imagine the whole structure of a conversation being adjusted based on how the user is feeling. Therapeutic frameworks such as emotion-focused therapy are designed to constantly adapt to a user's emotions, requiring precise moment-to-moment assessments of the patient's feelings [40]. Furthermore, one could adapt the general sentiment of the dialogue based on the user's emotions, since previous studies have found that emotions can be assessed via discourse analysis [100].

Appendix A: Agent Dialogue from Longitudinal Evaluation Study

The following section contains human readable versions of the the dialogue used in the automated depression counseling system described in Chapters 6 & 7. State transitions calculated by the engine are abstracted out.

Script 1: Control

State:CheckControl

Engine: Performing internal calculations

State:QuestionnairePrompt

Action:

Display Text: Welcome, Please complete the following questionnaires

Menu:

Choice 1: Start Surveys -> PHQ-8

State:QuestionnairePrompt2

Engine: Performing internal calculations

State:Exit

Action:

Display Text: Thank you. Please fill out these questionnaires again next week.

Engine: Performing internal calculations

Menu:

Choice 1: Ok -> Performing internal calculations

State:ControlLockout

Action:

Display Text: Thank you for returning. Please come back [RETURNDATE] to fill out the next set of questionnaires.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 2: EmotionCheck

State:CheckCondition

Engine: Performing internal calculations

State:CalculatePath

Agent: <camera name="closeup"/> So, I know talking about these topics can be tough. I was just wondering how you are feeling right now?

Agent Alternative 1: <camera name="closeup"/> Hey, Before we go further, I was wondering how are you feeling right now?

Agent Alternative 2: <camera name="closeup"/> Before we continue on, I was wondering how our discussion is making you feel?

Agent Alternative 3: <camera name="closeup"/> I was just wondering, how are you feeling right now?

Menu:

Choice 1: Pretty Good -> Performing internal calculations

Choice 2: Great -> Performing internal calculations

Choice 3: Not so great -> Performing internal calculations

Choice 4: Pretty bad -> Performing internal calculations

Choice 5: DEBUG ONLY - MANUALLY SELECT STATE -> DebugEmotion

State:DebugEmotion

Agent: <camera name="closeup"/> For testing, please select your emotional state

Menu:

Choice 1: Worse than the previous check -> WorseEmotion

Choice 2: Better than the previous check -> BetterEmotion

Choice 3: Still bad -> BadEmotion

Choice 4: Still good -> GoodEmotion

State:WorseEmotion

Agent: Yeah, You seem kind of down. I hope our conversation hasn't been too upsetting?

Agent Alternative 1: I noticed you don't seem as upbeat as earlier. Is everything OK?

Agent Alternative 2: Yeah, You seem pretty low at the moment compared to earlier. Are you OK?

Agent Alternative 3: You do seem a bit sad at the moment, compared to earlier. I totally understand if our chat has been getting you down, sometimes these topics are hard to talk about.

Menu:

Choice 1: I feel Ok actually, let's just carry on with the chat.|I'm great. Let's carry with what we were talking about.|I'm good. Let's keep talking.|I'm alright, can we just carry on with the conversation? -> Continue

Choice 2: Really? I feel great!|I feel completely fine!|You know what? I'm absolutely fine.|Actually I'm feeling good -> PositiveBreak

Choice 3: Yeah I'm not feeling great actually, although it wasn't our chat|It's not because of our conversation, but yeah, I'm not doing great|I'm not in a good place right now, but actually I don't think it's our chat.|Yeah I'm feeling kinda low, but actually it's not because of what we were talking about. -> EmpathyBreak

Choice 4: Yes, our chat has been getting me down actually.|To be honest with you our conversation has been getting me down a bit.|Yes, I've been finding our chat quite upsetting.|Yes, talking about these issues has got me feeling quite low. -> EmpathyBreak

State:BetterEmotion

Agent: Great, you seem to be doing better than you were earlier in our chat. How are you feeling?

Agent Alternative 1: It does seem like you're feeling better than earlier today, am I right?

Agent Alternative 2: You do seem to be feeling better than you were before. How are things?

Agent Alternative 3: It does seem like you're in a better place than you were earlier in the conversation. How are you feeling?

Menu:

Choice 1: I feel Ok actually, let's just carry on with the chat.|I'm feeling great. Let's carry with what we were talking about.|I'm good. Let's keep talking.|I'm alright, can we just carry on with the conversation? -> Continue

Choice 2: Yes I'm really good now thanks!|Yeah, I'm feeling a lot better than before!|Yeah. I'm doing better thanks, in fact, I'm doing really well!|I'm doing a lot better than before, yes thanks. -> PositiveBreak

Choice 3: Yeah, I'm doing better, but I'm still not feeling great to be honest.|I'm doing better than I was before, I'm still not feeling great.|Yeah, better than before, but I don't feel like I'm doing great|Better than before, sure, but I still don't feel great. -> EmpathyPositiveBreak

Choice 4: Actually I'm still feeling low|To be honest, I'm still not doing well at all|I feel just as bad as before actually.|I feel the same as before, I'm not doing great at the moment. -> EmpathyBreak

Choice 5: To be honest with you, I feel worse than earlier.|Actually, I feel worse than now than I did earlier.|Actually I'm not doing better, I'm feel worse now than I did earlier.|Honestly. I feel worse now than I did before. -> EmpathyBreak

State:BadEmotion

Agent: Yeah, I noticed you still seem pretty down.

Agent Alternative 1: Yeah, I noticed you seem pretty down, like you were earlier.

Agent Alternative 2: I thought that might be the case, it seems like you're not feeling great?

Agent Alternative 3: Yeah, it does sound like you're still not feeling so great?

Menu:

Choice 1: I feel Ok actually, let's just carry on with the chat.|I'm great. Let's carry with what we were talking about.|I'm good. Let's keep talking.|I'm alright, can we just carry on with the conversation? -> Continue

Choice 2: Yeah, I'm still feeling pretty low.|Yes, I'm really not doing well today.|Yes, like earlier, I'm not doing well|Yeah, I feel the same as before, I'm not doing well at the moment. -> EmpathyBreak

Choice 3: Actually I'm feeling worse than earlier|To be honest I'm doing worse than earlier|I'm actually feeling worse than I was before.|To be honest, I'm doing worse than I was before. -> EmpathyBreak

Choice 4: To be honest I feel a bit better.|Actually I'm doing somewhat better than I was before.|You know what, compared to earlier, I'm doing fine.|I'm feeling OK now actually. -> PositiveBreak

Choice 5: Really? I feel great actually!|Actually, I'm doing really well right now!|You know what, I'm actually feeling really good now!|Really? I'm actually feeling really good at the moment! -> PositiveBreak

State:GoodEmotion

Agent: Awesome, I just wanted to say I'm really enjoying our chat and I'm really happy that you seem to be doing well today!

Agent Alternative 1: Great! I'm really glad to see that you're feeling good today!

Agent Alternative 2: Good to hear, you seem to be doing really good today, that's great!

Agent Alternative 3: So, it seems like you're in a good place today, that's great to see!

Menu:

Choice 1: Thanks, I am doing great!|Yeah, I feel like I really am in a good place today!|Yeah, today, I do feel really great!|Thanks yeah, I'm doing really good. -> Continue

Choice 2: I'm feeling Ok I guess.|Yeah I suppose I'm doing fine.|Well, I feel like I'm doing alright.|I feel OK, but not great. -> MildBreak

Choice 3: Thanks, but I'm not actually doing well to be honest.|Actually, I'm not in a good place at all at the moment.|Actually, I don't feel great all at the moment.|You know, honestly I'm actually not doing well at all right now. -> EmpathyBreak

State:PositiveBreak

Agent: Ok, well I'm glad to hear that. Let me know if you want a quick break anyway.

Agent Alternative 1: Oh right, well that's great. Do you want to take a short break anyway?

Agent Alternative 2: Oh, right, great. I was going to ask if you wanted to take a minute, since you didn't seem to be doing well. Do you want to break anyway?

Agent Alternative 3: I'm glad to hear that! Let me know anyway if you would like to pause for a minute.

Menu:

Choice 1: I don't need a break, lets continue. -> Continue

Choice 2: I could use a break. -> Break

State:MildBreak

Agent: I'm glad you're doing OK. Let me know if you want to take a break.

Agent Alternative 1: Oh, well I'm glad you're feeling fine. Would you like a break?

Agent Alternative 2: OK, well good to know you're OK – do you want to pause for a minute?

Agent Alternative 3: Oh OK, well I'm glad to hear you're doing alright – let me know if you do want to pause for a bit.

Menu:

Choice 1: I don't need a break, lets continue. -> Continue

Choice 2: I could use a break. -> Break

State:EmpathyPositiveBreak

Agent: I'm glad you're doing somewhat better than before – let me know if you would like to take a short break.

Agent Alternative 1: I'm glad you're a bit better than earlier. Do you want to take a break now?

Agent Alternative 2: I'm sorry you're still not doing great, but I'm really glad you're doing better than earlier. Do you want to break for a bit?

Agent Alternative 3: Sorry you're still not doing great: let me know if you would you like to pause for a bit?

Menu:

Choice 1: I don't need a break, lets continue. -> Continue

Choice 2: I could use a break. -> Break

State:EmpathyBreak

Agent: I'm really sorry to hear that. Would you like to take a break?

Agent Alternative 1: I'm sorry you're not doing well, do you want a quick break?

Agent Alternative 2: I'm sorry to hear that, would you like to take a minute?

Agent Alternative 3: I'm sorry to hear you're not doing well. Do you want to pause for a bit?

Menu:

Choice 1: I don't need a break, lets continue. -> Continue

Choice 2: I could use a break. -> Break

State:Continue

Agent: <camera name="agent"/>Ok, let's continue.

Engine: Performing internal calculations

State:Break

Agent: Ok, let me know when you want to continue.

Menu:

Choice 1: I'm ready to continue. -> Continue

Script 3: Menu

State:SessionChoice

Agent: Please select a session

Menu:

Choice 1: Session 1 -> Session1

Choice 2: Session 2 -> Session2

Choice 3: Session 3 -> Session3

Choice 4: Session 4 -> Session4

Choice 5: Session 5 -> Session5

Choice 6: Cross Session Scripts -> CrossSessionScripts

State:Session1

Agent: Please select a section

Menu:

Choice 1: Tutorial -> Session1.Tutorial

Choice 2: Intro -> Session1.Intro

Choice 3: Meeting Review -> Session1.MeetingReview

Choice 4: Depression -> Session1.Depression

Choice 5: Symptoms Review -> Session1.Symptoms

Choice 6: Therapy Thought -> Session1.Therapy

Choice 7: CBT -> Session1.CBT

Choice 8: Homework -> Session1.Homework

State:CrossSessionScripts

Menu:

Choice 1: EmotionCheck -> EmotionCheck

Choice 2: PHQ-8 -> PHQ-8

Choice 3: State Anxiety -> StateAnxiety

State:Session2

Agent: Please select a section

Menu:

Choice 1: Checkin -> Session2.Checkin

Choice 2: Review Session 1 -> Session2.Review1

Choice 3: Homework Practice -> Session2.HomeworkPractice

Choice 4: Cognitive Distortions -> Session2.CognitiveDistortions

Choice 5: Homework -> Session2.Homework

State:Session3

Agent: Please select a section

Menu:

Choice 1: Checkin -> Session3.Checkin

Choice 2: Review Session 2 -> Session3.Review2

Choice 3: Homework Practice -> Session3.HomeworkPractice

Choice 4: Automatic Thoughts -> Session3AutomaticThoughts

Choice 5: Homework -> Session3.Homework

State:Session4

Agent: Please select a section

Menu:

Choice 1: Checkin -> Session4.Checkin

Choice 2: Review Session 3 -> Session4.Review3

Choice 3: Homework Practice -> Session4.HomeworkPractice

Choice 4: Having Fun -> Session4.HavingFun

Choice 5: Homework -> Session4.Homework

State:Session5

Agent: Please select a section

Menu:

Choice 1: Checkin -> Session5.Checkin

Choice 2: Review Session 4 -> Session5.Review4

Choice 3: Homework Practice -> Session5.HomeworkPractice

Choice 4: Relaxation -> Session5.Relaxation

Choice 5: Wrapup -> Session5.Wrapup

Script 4: PHQ-8

State:PHQ-P1

Questionnaire:

Prompt: Over the last 2 weeks, how often have you been bothered by any of the following problems?

Action: Performing internal calculations

State:PHQ-P2

Questionnaire:

Prompt: Over the last 2 weeks, how often have you been bothered by any of the following problems?

Action: Performing internal calculations

Script 5: Session1 CBT

State:CBT

Agent: So let's talk about one of the most effective types of therapy, Cognitive behavioral therapy.

Menu:

Choice 1: What is cognitive behavioral therapy? -> CBT2

State:CBT2

Agent: Cognitive Behavioral Therapy, often called CBT, suggest that we experience ourselves, and the environment at three levels, via our thoughts, feelings and behaviors.

Menu:

Choice 1: Ok -> CBT3

State:CBT3

Agent: The concept behind CBT is that by changing your behaviors and thoughts you can help improve your mood. With cognitive behavioral therapy, you should experience improvements in your depressive symptoms by developing skills to change the way you think and behave.

Menu:

Choice 1: Ok -> CBT4

State:CBT4

Agent: Now let's take a second to break down the three main elements of CBT. First there are thoughts, which are things you tell yourself, then there are actions, which are the behaviors you engage in, and finally there are feelings, which are the various moods you experience, like happiness and sadness.

Menu:

Choice 1: So how are these things related? -> CBT5

State:CBT5

Agent: Our thoughts, feelings and actions are all connected and influence each other. When we have helpful or accurate thoughts, we tend to feel better and do things that help us achieve our goals. However, when we have unhealthy or inaccurate thoughts, we tend to feel worse and do things that interfere with achieving our goals. This is because our thoughts are not always accurate or helpful.

Menu:

Choice 1: Can you give me an example? -> CBT6

State:CBT6

Agent: Sure. Let's say you sit down to eat lunch in the dining hall, and someone else gets up to leave at the same time.

Menu:

Choice 1: Ok -> CBT7

State:CBT7

Agent: Your automatic thought might be: She must have walked away because she does not like me. Think about how you would feel and act if you said this to yourself. You would probably feel disappointed, sad or down, or you might feel angry. These feeling may lead to you not talking to people and to refrain from making new friends, which in turn will make you feel even more sad and isolated.

Menu:

Choice 1: Ok -> CBT8

State:CBT8

Agent: However, you may have interpreted the situation incorrectly. Each of us has a pattern of thinking that is automatic, and this can keep us stuck with bad feelings. Another way of thinking about this situation could be, I wonder why she's leaving. She seems to like me enough, so I don't think it's because I am sitting here. Maybe she had to go to class. Given this new thought, you might have a new feeling or behavior. You might still be curious about why she left the table, but you probably wouldn't be feeling down or angry about it.

Menu:

Choice 1: Thanks for the example -> Performing internal calculations

Choice 2: Ok -> Performing internal calculations

Script 6: Session1 Depression

State:Depression

Agent: Now that we have the logistics out of the way, Let's talk about depression. Depression is a leading cause of disability in the world, affecting over 350 million people worldwide.

Menu:

Choice 1: Ok, but what exactly is depression? -> Depression2

Choice 2: Go on -> Depression2

State:Depression2

Agent: Depression is diagnosed when a person experiences a depressed mood or a loss of interest in activities they used to enjoy. Several other symptoms, such as low energy, are common in depressed individuals.

Menu:

Choice 1: What can cause depression? -> Depression3

State:Depression3

Agent: Depression can be due to a genetic vulnerability or to stressful life events, such as a breakup, the death of someone close, or a big change in one's life routine, such as starting college.

Menu:

Choice 1: Ok, I understand -> Depression4

Choice 2: How does this genetic vulnerability work? -> Depression4

State:Depression4

Agent: Some people who have a low genetic vulnerability to depression may never develop it if they never encounter a stressor to trigger it. On the other hand, some people with a strong vulnerability to depression can develop symptoms when there have no stressors in their life and without a clear precipitating event.

Menu:

Choice 1: I see -> Depression5

Choice 2: What changes can come with depression? -> Depression5

State:Depression5

Agent: Depressive symptoms can cause people to have difficulty functioning in school, at work, and in relationships. Low levels of motivation, sadness, low energy, feeling helpless and overwhelmed, as well as difficulty with concentration are common experiences for people with depression.

Menu:

Choice 1: What else can happen? -> Depression6

Choice 2: Ok -> Depression6

State:Depression6

Agent: Perhaps most importantly, depression can cause a person to withdraw from life and from people. Isolation and low levels of activity may lead to a person developing a more negative view towards life.

Menu:

Choice 1: Why is that bad? -> Depression7

Choice 2: Go on -> Depression7

Choice 3: So what? -> Depression7

State:Depression7

Agent: Most treatments for depression emphasize the importance of social support. Social and emotional support from others can be an important part of the healing process, but depression itself sometimes makes it difficult to put those support networks in place.

Menu:

Choice 1: Interesting -> Performing internal calculations

Choice 2: That makes sense. -> Performing internal calculations

Choice 3: Ok -> Performing internal calculations

Script 7: Session1 Homework

State:Homework

Agent: Now that we have covered the basics, I want you to think a bit about your thoughts and feelings. Over the next week try and take notes on when you feel good or bad.

Engine: Performing internal calculations

Menu:

Choice 1: Ok -> Homework2

State:Homework2

Agent: If possible, try to write when and where you were when you had these feelings, what the feelings were and the thoughts you were having at that time. When you have written down a few of these thoughts you can come back to talk about them a bit with me.

Menu:

Choice 1: Ok -> Homework3

State:Homework3

Agent: Here is an example of what your thoughts might look like after you write them down.

Whiteboard Display:

Action: Performing internal calculations

State:Homework4

Agent: Engine Generated Response

Menu:

Choice 1: Bye! -> Performing internal calculations

Choice 2: See you then! -> Performing internal calculations

Script 8: Session1 Intro

State:Intro

Agent: <camera zoom=".8"/> Great! My name is Tanya, and I hope to be working with you for the next few weeks.

Menu:

Choice 1: Great to meet you -> CheckTime

Choice 2: Hi -> CheckTime

State:CheckTime

Agent: We are going to need about 20 minutes to chat today, is that ok?

Menu:

Choice 1: Yeah, let's start -> RapportBuilding

Choice 2: I don't have that much time right now -> NoTime

State:NoTime

Agent: That's ok, when you have some more time come back to talk with me.

Menu:

Choice 1: Ok, talk to you later. -> Performing internal calculations

Choice 2: Actually, I have time right now. -> RapportBuilding

State:RapportBuilding

Agent: Great! So before we start working together, I would like to get to know you a bit more.

Menu:

Choice 1: Ok -> RapportBuilding2

Choice 2: Do we have to? -> ReasonsWhy

State:ReasonsWhy

Agent: I understand it may be strange talking to me, but the more we work together and understand each other the better our sessions will go.

Menu:

Choice 1: Ok, we can talk a bit -> RapportBuilding2

Choice 2: Let's move on -> Performing internal calculations

State:RapportBuilding2

Agent: Great, where are you from?

Menu:

Choice 1: New England -> NEResponse

Choice 2: New York -> NYResponse

Choice 3: Another State -> AnotherStateResponse

Choice 4: Outside of the US -> OutsideResponse

State:NEResponse

Agent: Me Too!

Menu:

Choice 1: Oh right, cool -> CheckStudent

Choice 2: Ok -> CheckStudent

State:NYResponse

Agent: Awesome! One of my developers is from New York!

Menu:

Choice 1: Awesome -> CheckStudent

Choice 2: Ok -> CheckStudent

State:AnotherStateResponse

Agent: That's exciting, I have never been outside of Boston before!

Menu:

Choice 1: You should travel sometime -> CheckStudent

Choice 2: Ok -> CheckStudent

State:OutsideResponse

Agent: Wow! I hope you are enjoying your time here!

Menu:

Choice 1: I am -> CheckStudent

Choice 2: It's ok -> CheckStudent

Choice 3: I kinda miss being home... -> OutsideSorry

State:OutsideSorry

Agent: I'm sorry to hear that. Let's talk about something else, are you currently a student?

Menu:

Choice 1: Yes -> YesStudent

Choice 2: No -> NoStudent

State:CheckStudent

Agent: So, are you currently a student?

Menu:

Choice 1: Yes -> YesStudent

Choice 2: No -> NoStudent

State:NoStudent

Agent: Must be exciting to be out in the real world. I know it can be tough, but I'm sure by working together we can make it easier.

Engine: Performing internal calculations

State:YesStudent

Agent: How exciting! What year are you in?

Menu:

Choice 1: Freshman -> FreshmanResponse

Choice 2: Sophomore -> StudentResponse

Choice 3: Middler -> StudentResponse

Choice 4: Junior -> SeniorResponse

Choice 5: Senior -> SeniorResponse

State:FreshmanResponse

Agent: That's great. Starting school can be tough but it can also be a really exciting experience!

Engine: Performing internal calculations

State:StudentResponse

Agent: That's great. The first few years of school can be tough but I'm sure we can work together to help you get through it!

Engine: Performing internal calculations

State:SeniorResponse

Agent: That's great! The last year of school can be tough, but I'm sure we can work together to help you get through it!

Engine: Performing internal calculations

Script 9: Session1 MeetingReview

State:Review

Agent: So let's get down to business. Over the next few weeks we will be working together to learn new skills to help manage your mood. Each session will last about thirty minutes. However, you are free to take as much or as little time as you want during each interaction.

Menu:

Choice 1: Ok -> Review2

Choice 2: What will each session consist of? -> Review2

State:Review2

Agent: During each session, we will go over how you have been feeling, discuss techniques you can try which might help you feel better and review those we had talked about you trying in previous sessions.

Menu:

Choice 1: Ok -> Weekly

State:Weekly

Agent: Before we go on, I would like to try and schedule a time each week for us to work together.

Menu:

Choice 1: Sure -> SetDay

Choice 2: Why? -> ScheduleExplain

State:ScheduleExplain

Agent: Many people have found that sticking to a schedule helps with the therapeutic process. I won't be forcing you to commit to anything, so think of it more as a suggestion than a fixed appointment.

Menu:

Choice 1: Ok -> SetDay

State:SetDay

Agent: What day of the week works best for you?

Menu:

Choice 1: Monday -> Performing internal calculations

Choice 2: Tuesday -> Performing internal calculations

Choice 3: Wednesday -> Performing internal calculations

Choice 4: Thursday -> Performing internal calculations

Choice 5: Friday -> Performing internal calculations

Choice 6: Saturday -> Performing internal calculations

Choice 7: Sunday -> Performing internal calculations

State:SetTime

Agent: Engine Generated Response

Menu:

Choice 1: Morning -> Performing internal calculations

Choice 2: Afternoon -> Performing internal calculations

Choice 3: Evening -> Performing internal calculations

State:Recap

Agent: Engine Generated Response

Menu:

Choice 1: Ok -> Performing internal calculations

Script 10: Session1 Symptoms

State:Symptoms

Agent: While some symptoms are common in every case of depression, not everyone experiences the same symptoms or at the same intensity. I would like to ask you a bit about some of the symptoms you have experienced, to get to know you better.

Menu:

Choice 1: Sure -> CheckWeek

Choice 2: Why? -> SymptomsWhy

State:SymptomsWhy

Agent: Since depression affects everyone differently, the more I know about you the better I can try to help.

Menu:

Choice 1: Ok -> CheckWeek

State:CheckWeek

Agent: In the past week have you experienced any of the following symptoms? Please check off all of the symptoms you have experienced

Checkbox:

Prompt:What symptoms have you experienced in the last week

Option 1: Persistent sad or empty mood

Option 2: Anxiety, angst

Option 3: Feelings of hopelessness

Option 4: Feelings of guilt, shame

Option 5: Worthlessness

Option 6: Helplessness

Option 7: Loss of interest or pleasure in hobbies and activities

Option 8: Decreased energy, fatigue, feeling slowed down

Option 9: Difficulty concentrating, remembering, making decisions

Option 10: Changes in appetite and/or weight

Option 11: Irritability

Action: Performing internal calculations

State:ReflectWeek

Agent: Engine Generated Response

Menu:

Choice 1: Yeah -> CheckEvent

Choice 2: Can I see the list again? -> CheckWeek

State:CheckEvent

Agent: Now I want you to think about your worst depressive experience and what was happening when you experienced it

Checkbox:

Prompt:What was happening when you had your worst depressive experience?

Option 1: Family issues

Option 2: Relationship issues

Option 3: Problems at work

Option 4: Problems at school

Option 5: Something else

Action: Performing internal calculations

State:WorstSymptoms

Agent: What symptoms did you experience during this? Please check off all of the symptoms you experienced

Checkbox:

Prompt:What symptoms did you have during your worst depressive experience?

Option 1: Persistent sad or empty mood

Option 2: Anxiety, angst

Option 3: Feelings of hopelessness

Option 4: Feelings of guilt, shame

Option 5: Worthlessness

Option 6: Helplessness

Option 7: Loss of interest or pleasure in hobbies and activities

Option 8: Decreased energy, fatigue, feeling slowed down

Option 9: Difficulty concentrating, remembering, making decisions

Option 10: Changes in appetite and/or weight

Option 11: Irritability

Action: Performing internal calculations

State:ReflectWorst

Agent: Engine Generated Response

Menu:

Choice 1: Yeah -> Performing internal calculations

Choice 2: Can I see the list again? -> WorstSymptoms

Script 11: Session1 Therapy

State:Therapy

Agent: Ok. So let's switch topics a bit. By being here today you have expressed interest in treating your depressive symptoms. I would like to talk to you about one of the most effective ways to treat depression, Therapy, also know as Talk Therapy or Psychotherapy.

Menu:

Choice 1: I'd like to talk about therapy actually -> Therapy2

Choice 2: Ok -> Therapy2

Choice 3: I'm not sure I want to talk about therapy... -> TherapyResist

State:TherapyResist

Agent: I know many people are hesitant about therapy, and I don't want to force you to commit to anything. I just wanted to get your thoughts on therapy before we continue.

Menu:

Choice 1: Ok -> Therapy2

State:Therapy2

Agent: Ok. So what do you think are some of the benefits of attending therapy?

Checkbox:

Prompt:What do you think are some of the benefits of attending therapy?

Option 1: I may feel better emotionally

Option 2: I may feel better physically

Option 3: My relationships may improve

Option 4: I may learn to cope with problems better

Option 5: I may be able to accomplish more

Option 6: Something Else

Action: Performing internal calculations

State:Therapy3

Agent: Thanks. Now let's talk a bit about the negative side. What are some of your worries about attending therapy?

Checkbox:

Prompt:What do you think are some of the negatives of attending therapy?

Option 1: It may take too much of time

Option 2: I have to make room for it in my schedule

Option 3: I'm worried about what people will think

Option 4: I'm worried about the confidentiality of what I say in therapy

Option 5: It hurts to think about depression

Option 6: I feel uncomfortable talking about my feelings

Option 7: Something Else

Action: Performing internal calculations

State:TherapyGood

Agent: It looks like you found more positives than negatives with the idea of attending therapy. It's great to hear that you are open to the idea of it!

Menu:

Choice 1: Thanks -> Performing internal calculations

State:TherapyNeutral

Agent: Thanks for sharing that with me.

Menu:

Choice 1: No problem -> Performing internal calculations

State:TherapyBad

Agent: It sounds like you have a few worries about attending therapy. I know it can seem overwhelming at first but I'm sure that if we work together we can make it worth it.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 12: Session1 Tutorial

State:Intro

Agent: Hi! Feel free to talk to me by pressing one of the options on the right.

Engine: Performing internal calculations

Menu:

Choice 1: Like this? -> Session1.Intro

Choice 2: Ok -> Session1.Intro

Script 13: Session2 Checkin

State:Checkin

Agent: <camera zoom=".8"/> Welcome back. Before we begin today's session I would like you to fill out two quick questionnaires.

Engine: Performing internal calculations

Menu:

Choice 1: Ok -> PHQ-8

Choice 2: Ok (Debugging Only - Skip Questionnaires) -> Followup

State:PHQ-Return

Agent: Thanks, I have one more questionnaire for you to fill out.

Menu:

Choice 1: Ok -> StateAnxiety

Choice 2: Ok -> StateAnxiety

State:Advance

Agent: Thanks for filling those out.

Engine: Performing internal calculations

State:Followup

Agent: Thanks for filling those out. So how are you doing today?

Menu:

Choice 1: I'm doing great -> Performing internal calculations

Choice 2: I'm doing ok -> Performing internal calculations

Choice 3: Not so great -> Performing internal calculations

Choice 4: I'm pretty down -> Performing internal calculations

State:NeutralContinue

Agent: Ok

Engine: Performing internal calculations

State:GoodEmotion

Agent: That's great to hear!

Engine: Performing internal calculations

State:BadEmotion

Agent: I'm sorry to hear that, hopefully you will feel a bit better after our talk today.

Engine: Performing internal calculations

State:BetterEmotion

Agent: Oh, you seemed to be doing pretty good based on your questionnaires, is everything ok?

Menu:

Choice 1: Not really -> BadEmotion

Choice 2: Actually, I'm doing ok. -> GoodEmotion

State:WorseEmotion

Agent: Oh, I noticed that you seemed a bit down based on your responses to the questionnaires, is everything ok?

Menu:

Choice 1: Yeah -> NeutralContinue

Choice 2: Actually, I am a bit down -> BadEmotion

Script 14: Session2 CognitiveDistortions

State:Agenda

Agent: This leads us to the topic I wanted to cover today, common errors people have when tracking their thoughts and feelings. During this discussion I may draw upon some examples to help make things clearer.

Menu:

Choice 1: Ok -> CD1

State:CD1

Agent: Great. So now I want to talk a bit about something called cognitive distortions. Cognitive distortions are ways in which we twist our realities when we become stressed out or depressed.

Menu:

Choice 1: Ok -> CD2

State:CD2

Agent: Here are a few of the most common distortions, let's take a minute and go through them.

Menu:

Choice 1: Overgeneralizing -> Overgeneralizing

Choice 2: Mental filtering -> MentalFiltering

Choice 3: Mind reading -> MindReading

State:Overgeneralizing

Agent: Overgeneralizing is when you see a negative event as a never-ending pattern of defeat. An example of this would be thinking that you are horrible at math due to one bad score on a math test.

Engine: Performing internal calculations

Menu:

Choice 1: Mental filtering -> MentalFiltering

Choice 2: Mind reading -> MindReading

Choice 3: Ok -> CheckSet1

State:MentalFiltering

Agent: Mental filtering is when you focus only on the things that went wrong, rather than all the things that went correctly. It is an inability to see the positive because you are dwelling on the negative, imagine you are having fun at a party and then someone makes a snide comment about your outfit and now your night is ruined, that would be mental filtering.

Engine: Performing internal calculations

Menu:

Choice 1: Overgeneralizing -> Overgeneralizing

Choice 2: Mind reading -> MindReading

Choice 3: Ok -> CheckSet1

State: MindReading

Agent: Mind reading is when you assume others are thinking negatively about you when there is no evidence for this, like, for example, if you see a friend in the bookstore who doesn't say hello, and you conclude they don't like you anymore.

Engine: Performing internal calculations

Menu:

Choice 1: Overgeneralizing -> Overgeneralizing

Choice 2: Mental filtering -> MentalFiltering

Choice 3: Ok -> CheckSet1

State: CheckSet1

Agent: Do you feel like you experience any of these distortions in your thinking pattern?

Menu:

Choice 1: Yes -> WhichSet1

Choice 2: No -> ShowSet2

State: WhichSet1

Agent: Which ones? Check off all the ones you have experienced.

Checkbox:

Prompt: Which distortions have you experienced?

Option 1: Overgeneralizing

Option 2: Mental Filtering

Option 3: Mind Reading

Action: Performing internal calculations

State: ShowSet2

Agent: Ok, let's go through a few more common distortions.

Menu:

Choice 1: Discounting the positives -> Discounting

Choice 2: Catastrophizing -> Catastrophizing

Choice 3: All or Nothing thinking -> AllOrNothing

State:Discounting

Agent: Discounting the positives is when you reject positive experiences by insisting they don't count, Devaluing compliments, Taking responsibility for bad things that happen, or attributing the good things that happen to luck. An example of this is when you are complimented on your performance and think, They are just being nice, or Anyone could have done as good of a job as I did.

Engine: Performing internal calculations

Menu:

Choice 1: Catastrophizing -> Catastrophizing

Choice 2: All or Nothing thinking -> AllOrNothing

Choice 3: Ok -> CheckSet2

State:Catastrophizing

Agent: Catastrophizing is when you expect a bad result or the worst result in a situation. An example of this is thinking that you will fail a class because you got one bad grade, even if all of your other grades were good.

Engine: Performing internal calculations

Menu:

Choice 1: Discounting the positives -> Discounting

Choice 2: All or Nothing thinking -> AllOrNothing

Choice 3: Ok -> CheckSet2

State:AllOrNothing

Agent: All or Nothing thinking is the tendency to see everything as good or bad, black or white. An example of this would be thinking that you are a failure at life because you didn't get a perfect score on something.

Engine: Performing internal calculations

Menu:

Choice 1: Catastrophizing -> Catastrophizing

Choice 2: Discounting the positives -> Discounting

Choice 3: Ok -> CheckSet2

State:CheckSet2

Agent: So, out of these, do you feel like you experience any of them in your thought patterns?

Menu:

Choice 1: Yes -> WhichSet2

Choice 2: No -> Followup

State:WhichSet2

Agent: Which ones? Check off all the ones you have experienced.

Checkbox:

Prompt:Which distortions have you experienced?

Option 1: Discounting the positives

Option 2: Catastrophizing

Option 3: All or Nothing thinking

Action: Performing internal calculations

State:Followup

Agent: Ok. There are two more common distortions that I wanted to talk to you about.

Menu:

Choice 1: Ok -> Should

State:Should

Agent: The first of these are should statements. Should statements are thoughts in which you think of the world in absolute right or wrong when in fact there often is no absolute. You have expectations about yourself or the world that are arbitrary. Shoulds often do not help us but they imply that the way we are doing something now is wrong. For example, I should be a better student, a better friend.

Menu:

Choice 1: Ok -> Label

State:Label

Agent: Finally, there is labeling and mislabeling. Labeling and Mislabeling is when you misattribute things based on faulty logic. An example of this would be to think something like I am fat because you ate a dish of ice cream while you are on a diet. This is illogical thinking because it is overly simplistic. Being accepting of ourselves is better for our minds and hearts than being judgmental.

Menu:

Choice 1: Ok -> CheckSet3

State:CheckSet3

Agent: Do you feel like you have experienced either of these distortions?

Menu:

Choice 1: Yes -> WhichSet3

Choice 2: No -> Performing internal calculations

State:WhichSet3

Agent: Which ones? Check off all the ones you have experienced.

Checkbox:

Prompt:Which distortions have you experienced?

Option 1: Should Statements

Option 2: Labeling and Mislabeling

Action: Performing internal calculations

State:Response

Agent: Engine Generated Response

Menu:

Choice 1: Yeah -> End

Choice 2: I guess -> End

Choice 3: Not really -> End

State:End

Agent: I know this can be a lot to go over. If you want to review any of these again you can always talk to me later and go over them.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 15: Session2 Homework

State:Homework

Agent: So, with these distortions in mind, I would like you to observe and track your thoughts and feelings over the next week. Whenever you find yourself feeling bad, or doing something you wish you hadn't done, just write down the situation you were in, what you were feeling, and what your thoughts were. Once you have done that, I want you to look over the situation, and decide whether it counts as one of the cognitive distortions we talked about.

Engine: Performing internal calculations

Menu:

Choice 1: Ok -> Homework2

State:Homework2

Agent: Here is an example of what this might look like.

Whiteboard Display:

Action: Performing internal calculations

State:Homework3

Agent: Also, I want you to start thinking about some of the problems you have been dealing with and your goals for our session together. Next week we will start to talk about them a bit more.

Menu:

Choice 1: Ok -> Homework4

State:Homework4

Agent: Engine Generated Response

Menu:

Choice 1: Bye! -> Performing internal calculations

Choice 2: See you then! -> Performing internal calculations

Script 16: Session2 HomeworkPractice

State:Practice

Agent: Ok, So I would really like to take a few minutes to talk about a thought you had over the last week. Take a moment to think about one and let me know when you're ready to talk about it.

Menu:

Choice 1: I'm ready -> GetThought

Choice 2: What kind of thought? -> WhatThought

State:WhatThought

Agent: Any kind of thought, good or bad, that you have had over the last week and would like to think about a bit more critically.

Menu:

Choice 1: Ok, I have a thought ready -> GetThought

State:GetThought

Agent: Ok, so what was your thought?

Text Prompt:

Prompt:What was your thought?

Action: Performing internal calculations

State:WhereThought

Agent: And where were you when you had this thought?

Menu:

Choice 1: At school -> Performing internal calculations

Choice 2: At work -> Performing internal calculations

Choice 3: Outside -> Performing internal calculations

Choice 4: At home -> Performing internal calculations

State:GetDay

Agent: On what day?

Menu:

Choice 1: Monday -> Performing internal calculations

Choice 2: Tuesday -> Performing internal calculations

Choice 3: Wednesday -> Performing internal calculations

Choice 4: Thursday -> Performing internal calculations

Choice 5: Friday -> Performing internal calculations

Choice 6: Saturday -> Performing internal calculations

Choice 7: Sunday -> Performing internal calculations

State:GetDay

Agent: On what day?

Menu:

Choice 1: Monday -> Performing internal calculations

Choice 2: Tuesday -> Performing internal calculations

Choice 3: Wednesday -> Performing internal calculations

Choice 4: Thursday -> Performing internal calculations

Choice 5: Friday -> Performing internal calculations

Choice 6: Saturday -> Performing internal calculations

Choice 7: Sunday -> Performing internal calculations

State:GetActivity

Agent: And what were you doing at this time?

Text Prompt:

Prompt:What were you doing?

Action: Performing internal calculations

State:GetFeeling

Agent: And how did that make you feel?

Menu:

Choice 1: Angry -> Performing internal calculations

Choice 2: Disgusted -> Performing internal calculations

Choice 3: Fearful -> Performing internal calculations

Choice 4: Happy -> Performing internal calculations

Choice 5: Sad -> Performing internal calculations

Choice 6: Surprised -> Performing internal calculations

State:ShowChart

Agent: Great, so when you take notes of your thoughts like we just did, a chart like this can be helpful to look at them.

Whiteboard Display:

Action: Performing internal calculations

State:ChartFollowup

Agent: By writing them out like this, we can start to try and find relationships between our thoughts, feelings, and actions.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 17: Session2 Review1

State:Review

Agent: So before we get into today's session, I would like to get your thoughts on our last session, so I can learn what did, and did not work for you.

Menu:

Choice 1: Ok -> Review1

State:Review1

Agent: Great. So how did you feel after our last session?

Menu:

Choice 1: Great! -> ReviewPositive

Choice 2: Ok -> ReviewPositive

Choice 3: A bit down -> ReviewNegative

State:ReviewPositive

Agent: Great, was there anything in particular from our last session that you liked?

Menu:

Choice 1: Yes -> PositiveFollowup

Choice 2: Not really -> HomeworkFollowup

State:ReviewNegative

Agent: I'm sorry to hear that, was there something in our last session that you did not enjoy?

Menu:

Choice 1: Yes -> NegativeNegativeFollowup

Choice 2: Not Really -> HomeworkFollowup

State:PositiveFollowup

Agent: Awesome, could you tell me what that was so I can try to do it more in the future?

Menu:

Choice 1: Learning more about depression -> HomeworkFollowup

Choice 2: Learning more about therapy -> HomeworkFollowup

Choice 3: Just chatting with you -> HomeworkFollowup

Choice 4: Your reactions to me -> HomeworkFollowup

Choice 5: I'm not really sure actually -> HomeworkFollowup

Choice 6: I appreciated the fact that you understood my mood -> HomeworkFollowup

Choice 7: I was glad you knew how I was feeling -> HomeworkFollowup

State:PositiveNegativeFollowup

Agent: I'm sorry to hear that, could you tell me what it is so I can try to avoid doing that in the future

Menu:

Choice 1: Talking about depression -> HomeworkFollowup

Choice 2: Talking about therapy -> HomeworkFollowup

Choice 3: Talking about myself -> HomeworkFollowup

Choice 4: I didn't like being asked how I was doing all the time -> AskedFollowup

Choice 5: Occasionally you told me how I seemed to be feeling -> FeelingFollowup

Choice 6: I wouldn't say I was upset, but I didn't exactly enjoy talking about depression -> HomeworkFollowup

Choice 7: I'm not really sure actually -> HomeworkFollowup

State:NegativeNegativeFollowup

Agent: I'm sorry to hear that, could you tell me what it is so I can try to avoid doing that in the future

Menu:

Choice 1: Talking about depression -> HomeworkFollowup

Choice 2: Talking about therapy -> HomeworkFollowup

Choice 3: Talking about myself -> HomeworkFollowup

Choice 4: Being asked constantly about how I'm feeling -> AskedFollowup

Choice 5: I didn't like it when you told me how I seemed to be feeling. -> FeelingFollowup

Choice 6: Your reactions to my responses -> HomeworkFollowup

Choice 7: I'm not really sure actually -> HomeworkFollowup

State:AskedFollowup

Agent: I'm sorry to hear that. Can you tell me why it upset you?

Menu:

Choice 1: I felt like I was being analyzed -> HomeworkFollowup

Choice 2: I felt like you didn't really know how I was feeling -> HomeworkFollowup

Choice 3: I felt like I was being put on the spot -> HomeworkFollowup

Choice 4: I don't know, it just did -> HomeworkFollowup

State:FeelingFollowup

Agent: I'm sorry that upset you. Can you tell me why it upset you?

Menu:

Choice 1: Mainly because you kept getting my mood wrong -> HomeworkFollowup

Choice 2: I felt like was being analyzed -> HomeworkFollowup

Choice 3: I just felt like I was being put on the spot -> HomeworkFollowup

Choice 4: I don't know, it just did -> HomeworkFollowup

State:HomeworkFollowup

Agent: Ok, thanks for sharing that with me. Last session we had also discussed tracking your thoughts and feelings. Did you get a chance to do this?

Menu:

Choice 1: Yes -> YesHomework

Choice 2: No -> NoHomework

State:NoHomework

Agent: Was there any reason why you didn't track them?

Menu:

Choice 1: I didn't have the time -> NoHomeworkTime

Choice 2: I wasn't interested in doing the activity -> NoHomeworkInterest

Choice 3: I'm not sure -> NoHomeworkGeneric

State:NoHomeworkTime

Agent: I understand. I know it can be time consuming but these tasks can really help to make you feel better in the long run.

Engine: Performing internal calculations

State:NoHomeworkInterest

Agent: I understand some of these activities can be boring, but they can really help to making you feel better in the long run.

Engine: Performing internal calculations

State:NoHomeworkGeneric

Agent: Ok. Well it would be great if you could try and complete these tasks in the future. I know they can feel like a hassle but they can greatly help in making you feel better in the long run.

Engine: Performing internal calculations

State:NoFollowup

Agent: Looking at the connection between your thoughts and feelings is a key component to learning how to feel better.

Menu:

Choice 1: Ok -> Performing internal calculations

State:YesHomework

Agent: That's great! What did you think about the tracking?

Menu:

Choice 1: I enjoyed doing it -> HomeworkGood

Choice 2: It made me kinda sad -> HomeworkBad

Choice 3: It was ok -> Performing internal calculations

State:HomeworkGood

Agent: I am really glad to hear that. Was there a particular aspect of the homework you enjoyed the most? Feel free to select more than one choice.

Checkbox:

Prompt:What aspects of the homework did you enjoy?

Option 1: I liked reflecting on my own thoughts and feelings

Option 2: It was interesting to see the patterns in my feelings to understand my own moods better

Option 3: Because I knew it would be good for me in the long term

Option 4: I liked setting aside some time to reflect on my thoughts

Option 5: I just enjoyed the writing since I don't normally write very much

Option 6: It helped me understand my feelings and how to share them

Option 7: I'm not sure of anything specific

Action: Performing internal calculations

State:HomeworkBad

Agent: I'm sorry to hear that. Was there anything specific that upset you during the homework? Feel free to select more than one choice.

Checkbox:

Prompt: What aspects of the homework upset you?

Option 1: Thinking about my feelings all the time

Option 2: Feeling as if I was overthinking things

Option 3: I found it boring

Option 4: I found it tiring

Option 5: I found it hard to write about myself

Option 6: I'm not sure of anything specific

Action: Performing internal calculations

Script 18: Session3 AutomaticThoughts

State: AT

Agent: So now let's get to today's topic, how to better identify your automatic thoughts and how to determine whether they are accurate.

Menu:

Choice 1: Ok -> AT1

Choice 2: Right -> AT1

State: AT1

Agent: Up until this point, we have focused on identifying the situation when you are upset, the emotions you feel in those situations, and the thoughts you have that are unhelpful or inaccurate.

Menu:

Choice 1: Right -> AT2

Choice 2: Go on -> AT2

State: AT2

Agent: Once you have determined that a thought is not helpful, it actually becomes easier to identify thoughts that are more accurate or positive. For example, the thought, I am stupid because I failed the test, can be substituted with the thought, although I did poorly on that test, I am smart and I know what to do to prepare for the next test.

Menu:

Choice 1: Ok -> AT3

Choice 2: Go on -> AT3

State: AT3

Agent: The best way to learn how to identify accurate and helpful thoughts is to begin by writing down unhelpful thoughts, such as distortions or negative evaluations. Once we have gotten those out of the way, we can begin to write more helpful responses to the situation.

Menu:

Choice 1: Ok -> AT4

Choice 2: Go on -> AT4

State:AT4

Agent: To help with this, I have a short list of questions that I often use to help identify automatic thoughts. Feel free to take a minute to look them over.

Whiteboard Display:

Action: Performing internal calculations

State:AT5

Agent: Engine Generated Response

Whiteboard Display:

Action: Performing internal calculations

State:QuestionsHelpful

Agent: Ok. If you ever get stuck, here are some more questions you can think about to identify your thoughts. Also, you can always come back to me to see these lists again.

Whiteboard Display:

Action: Performing internal calculations

State:QuestionsMore

Agent: Ok. If you ever get stuck, here are some more questions you can think about to identify your thoughts. Also, you can always come back to me to see these lists again.

Whiteboard Display:

Action: Performing internal calculations

State:QuestionsProblem

Agent: Ok. If you ever get stuck, here are some more questions you can think about to identify your thoughts. Also, you can always come back to me to see these lists again.

Whiteboard Display:

Action: Performing internal calculations

Script 19: Session3 Checkin

State:Checkin

Agent: <camera zoom=".8"/> Welcome back for our third session. Before we begin today's session I would like you to fill out two quick questionnaires.

Engine: Performing internal calculations

Menu:

Choice 1: Ok -> PHQ-8

Choice 2: Ok (Debugging Only - Skip Questionnaires) -> Followup

State:PHQ-Return

Agent: Thanks, I have one more questionnaire for you to fill out.

Menu:

Choice 1: Ok -> StateAnxiety

Choice 2: Ok -> StateAnxiety

State:Advance

Agent: Thanks for filling those out.

Engine: Performing internal calculations

State:Followup

Agent: Thanks for filling those out. So how are you doing today?

Menu:

Choice 1: I'm doing great -> Performing internal calculations

Choice 2: I'm doing ok -> Performing internal calculations

Choice 3: Not so great -> Performing internal calculations

Choice 4: I'm pretty down -> Performing internal calculations

State:NeutralContinue

Agent: Ok

Engine: Performing internal calculations

State:GoodEmotion

Agent: That's great to hear!

Engine: Performing internal calculations

State:BadEmotion

Agent: I'm sorry to hear that, hopefully you will feel a bit better after our talk today.

Engine: Performing internal calculations

State:BetterEmotion

Agent: Oh, you seemed to be doing pretty good based on your questionnaires, is everything ok?

Menu:

Choice 1: Not really -> BadEmotion

Choice 2: Actually, I'm doing ok. -> GoodEmotion

State:WorseEmotion

Agent: Oh, I noticed that you seemed a bit down based on your responses to the questionnaires, is everything ok?

Menu:

Choice 1: Yeah -> NeutralContinue

Choice 2: Actually, I am a bit down -> BadEmotion

Script 20: Session3 Homework

State:Homework

Agent: So, I would like you to continue to track your thoughts throughout the week to try and identify potential distortions in your thinking.

Engine: Performing internal calculations

Menu:

Choice 1: Ok -> Homework1a

State:Homework1a

Agent: Whenever you find yourself feeling down or doing something you wish you hadn't done, just write down the situation you were in, what you were feeling, and what your thoughts were.

Menu:

Choice 1: Ok -> Homework1b

State:Homework1b

Agent: Once you have done that, I want you to look over the situation and decide whether it counts as one of the cognitive distortions we talked about. Try to use the questions we discussed today to help you think about these distortions.

Menu:

Choice 1: Ok -> Homework2

State:Homework2

Agent: By writing these down, we can try to identify some of your common thought distortions. Expand upon the chart we used earlier by adding evidence for and against your thoughts, and a more beneficial thought that could have helped get you through the situation.

Whiteboard Display:

Action: Performing internal calculations

State:Homework3

Agent: Engine Generated Response

Menu:

Choice 1: Bye! -> Performing internal calculations

Choice 2: See you then! -> Performing internal calculations

Script 21: Session3 HomeworkPractice

State:Practice

Agent: So I would really like to take a few minutes to talk about a thought you had over the last week. Take a moment to think about one and let me know when you're ready.

Menu:

Choice 1: I'm ready -> GetThought

Choice 2: What kind of thought? -> WhatThought

State:WhatThought

Agent: Any kind of thought, good or bad, that you have had over the last week and would like to think about a bit more critically.

Menu:

Choice 1: Ok, I have a thought ready -> GetThought

State:GetThought

Agent: Ok, so what was your thought?

Text Prompt:

Prompt:What was your thought?

Action: Performing internal calculations

State:WhereThought

Agent: And where were you when you had this thought?

Menu:

Choice 1: At school -> Performing internal calculations

Choice 2: At work -> Performing internal calculations

Choice 3: Outside -> Performing internal calculations

Choice 4: At home -> Performing internal calculations

State:GetDay

Agent: On what day?

Menu:

Choice 1: Monday -> Performing internal calculations

Choice 2: Tuesday -> Performing internal calculations

Choice 3: Wednesday -> Performing internal calculations

Choice 4: Thursday -> Performing internal calculations

Choice 5: Friday -> Performing internal calculations

Choice 6: Saturday -> Performing internal calculations

Choice 7: Sunday -> Performing internal calculations

State:GetDay

Agent: On what day?

Menu:

Choice 1: Monday -> Performing internal calculations

Choice 2: Tuesday -> Performing internal calculations

Choice 3: Wednesday -> Performing internal calculations

Choice 4: Thursday -> Performing internal calculations

Choice 5: Friday -> Performing internal calculations

Choice 6: Saturday -> Performing internal calculations

Choice 7: Sunday -> Performing internal calculations

State:GetActivity

Agent: And what were you doing at this time?

Text Prompt:

Prompt:What were you doing?

Action: Performing internal calculations

State:GetFeeling

Agent: And how did that make you feel?

Menu:

Choice 1: Angry -> Performing internal calculations

Choice 2: Disgusted -> Performing internal calculations

Choice 3: Fearful -> Performing internal calculations

Choice 4: Happy -> Performing internal calculations

Choice 5: Sad -> Performing internal calculations

Choice 6: Surprised -> Performing internal calculations

State:AskDistortion

Agent: So thinking over this situation, do you think you may have had a cognitive distortion related to your thought?

Menu:

Choice 1: Yes -> GetDistortion

Choice 2: No -> NoDistortion

State:NoDistortion

Agent: Can you think of another situation that you think may have had a distortion?

Menu:

Choice 1: Yes -> GetThought

Choice 2: No -> NoDistortionFollowup

State:NoDistortionFollowup

Agent: That's fine, I know this can be difficult at first, but after some practice it should become easier. In the mean time, lets look at we have for now.

Menu:

Choice 1: Ok -> Performing internal calculations

State:GetDistortion

Agent: What was the distortion you think you had?

Menu:

Choice 1: Overgeneralizing -> Performing internal calculations

Choice 2: Mental filtering -> Performing internal calculations

Choice 3: Mind Reading -> Performing internal calculations

Choice 4: Discounting the positives -> Performing internal calculations

Choice 5: Catastrophizing -> Performing internal calculations

Choice 6: All-or-Nothing thinking -> Performing internal calculations

Choice 7: Should Statements -> Performing internal calculations

Choice 8: Labeling and Mislabeled -> Performing internal calculations

Choice 9: Not sure -> Performing internal calculations

State:PreChart

Agent: Great, I know that it can be hard to see these distortions when you are in a situation like this, but if you keep taking note of them it will become easier to identify these distortions. So now let's take a moment to see what these notes would look like in a chart.

Menu:

Choice 1: Ok -> ShowChart

State:ShowChart

Agent: Here is what your chart might look like.

Whiteboard Display:

Action: Performing internal calculations

State:ChartFollowup

Agent: As we discussed last time, by writing them out like this, we can start to try and find relationships between our thoughts, feelings, and actions.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 22: Session3 Review2

State:Review

Agent: So today I want to talk a bit more about the connections between our thoughts and behaviors. As we have discussed, your thoughts can affect how you feel and act in certain situations. Today we are going to examine our patterns of thought and then explore some of the areas we can change.

Menu:

Choice 1: Ok -> Review1

State:Review1

Agent: Before we dive into that however, I would like us to talk a bit about some of the activities we discussed during our last meeting.

Menu:

Choice 1: Ok -> Review2

Choice 2: Which activities? -> Review2

State:Review2

Agent: Last time we talked about tracking your thoughts and feelings in certain situations, and identifying the possible distortions related to your feelings. Did you get a chance to write up a description of any of these situations?

Menu:

Choice 1: Yes -> YesHomework

Choice 2: No -> NoHomework

State:NoHomework

Agent: Was there any reason why you didn't track them?

Menu:

Choice 1: I didn't have the time -> NoHomeworkTime

Choice 2: I wasn't interested in doing the activity -> NoHomeworkInterest

Choice 3: I'm not sure -> NoHomeworkGeneric

State:NoHomeworkTime

Agent: I understand. I know it can be time consuming but these tasks can really help to make you feel better in the long run.

Engine: Performing internal calculations

State:NoHomeworkInterest

Agent: I understand some of these activities can be boring, but they can really help to making you feel better in the long run.

Engine: Performing internal calculations

State:NoHomeworkGeneric

Agent: Ok. Well it would be great if you could try and complete these tasks in the future. I know they can feel like a hassle but they can greatly help in making you feel better in the long run.

Engine: Performing internal calculations

State:NoFollowup

Agent: Looking at the connection between your thoughts and feelings is a key component to learning how to feel better.

Menu:

Choice 1: Ok -> Performing internal calculations

State:YesHomework

Agent: That's great! What did you think about the tracking?

Menu:

Choice 1: I enjoyed doing it -> HomeworkGood

Choice 2: I didn't like it but I know it is important -> HomeworkImportant

Choice 3: It was fine but it didn't feel useful -> HomeworkUseful

Choice 4: It made me kinda sad -> HomeworkSad

Choice 5: It was ok -> HomeworkOk

State:HomeworkGood

Agent: That's great hear. I'm glad you're enjoying it.

Menu:

Choice 1: Ok -> Performing internal calculations

State:HomeworkImportant

Agent: I'm sorry to hear that you're not enjoying it, but you are right, in the long run, it can have a really positive impact.

Menu:

Choice 1: Ok -> Performing internal calculations

State:HomeworkUseful

Agent: That's completely reasonable. You probably won't feel the effects immediately, but, over a long period it will have a really positive effect.

Menu:

Choice 1: Ok -> Performing internal calculations

State:HomeworkSad

Agent: Sorry to hear that. I know it can be difficult to spend a lot of time reflecting on these issues. In the long run though, it can have really positive effects.

Menu:

Choice 1: Ok -> Performing internal calculations

State:HomeworkOk

Agent: OK, but remember, keeping track of your feelings and thoughts can help a lot in the long run.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 23: Session4 Checkin

State:Checkin

Agent: <camera zoom=".8"/> Hi! Welcome back for our fourth session. Before we begin today's session I would like you to fill out two quick questionnaires.

Engine: Performing internal calculations

Menu:

Choice 1: Ok -> PHQ-8

Choice 2: Ok (Debugging Only - Skip Questionnaires) -> Followup

State:PHQ-Return

Agent: Thanks, I have one more questionnaire for you to fill out.

Menu:

Choice 1: Ok -> StateAnxiety

Choice 2: Ok -> StateAnxiety

State:Advance

Agent: Thanks for filling those out.

Engine: Performing internal calculations

State:Followup

Agent: Thanks for filling those out. So how are you doing today?

Menu:

Choice 1: I'm doing great -> Performing internal calculations

Choice 2: I'm doing ok -> Performing internal calculations

Choice 3: Not so great -> Performing internal calculations

Choice 4: I'm pretty down -> Performing internal calculations

State:NeutralContinue

Agent: Ok

Engine: Performing internal calculations

State:GoodEmotion

Agent: That's great to hear!

Engine: Performing internal calculations

State:BadEmotion

Agent: I'm sorry to hear that, hopefully you will feel a bit better after our talk today.

Engine: Performing internal calculations

State:BetterEmotion

Agent: Oh, you seemed to be doing pretty good based on your questionnaires, is everything ok?

Menu:

Choice 1: Not really -> BadEmotion

Choice 2: Actually, I'm doing ok. -> GoodEmotion

State:WorseEmotion

Agent: Oh, I noticed that you seemed a bit down based on your responses to the questionnaires, is everything ok?

Menu:

Choice 1: Yah -> NeutralContinue

Choice 2: Actually, I am a bit down -> BadEmotion

Script 24: Session4 HavingFun

State:Intro

Agent: So let's get to today's topic, the importance of fun. I know that being depressed can make it seem like it is impossible to have fun, but often times we overlook simple activities we can do to make our lives more enjoyable.

Menu:

Choice 1: Ok -> Fun1

Choice 2: Sure -> Fun1

Choice 3: I don't even know if I can have fun anymore -> Fun1

State:Fun1

Agent: While it may seem impossible to have fun, engaging in pleasant activities is very important for our emotional health. Our moods are often best when we have a balance between the things we have to do and the things we want to do.

Menu:

Choice 1: Ok -> Fun2

State:Fun2

Agent: Since we often have more control over the things we have to do, it is important to keep them in mind and do them. Once you have done that, it is also important to do activities that can be fun. This doesn't require a special event, pleasant activities can be as simple as reading a good book, watching some funny videos, going for a nice walk or calling up a friend.

Menu:

Choice 1: Ok -> Fun3

State:Fun3

Agent: To help you try and schedule more pleasant activities in your life, I would like to take a minute to try and identify some activities you might enjoy doing. Here is a brief list of activities that might interest you.

Whiteboard Display:

Action: Performing internal calculations

State:Fun4

Agent: Great! Now, the trick is to try and engage in these activities. Often times, people with depression have problems doing these activities because of a few distorted thoughts. Some of these thoughts may be: I am boring. people do not really like me. I do not want to be a burden to others. I have no energy today. or I will not have fun anyway. It is important to overcome them by either focusing on how beneficial the activity will be or by checking whether they are actually correct. You may reflect on these thoughts using some of the tools we have discussed together like the list of cognitive distortions or the questions we discussed last time.

Menu:

Choice 1: Ok -> Fun5

Choice 2: What are the other reasons? -> Fun5

State:Other

Agent: Other times, people are afraid to reach out to other people because they feel as if they are boring or a burdens to them. However, by isolating yourself, you can end up feeling more depressed and hopeless. Try to push yourself to interact more with the people in your life. Even if you feel like it doesn't work out right away, try your best to keep at it. Making these social connections will ultimately help you in the long run.

Menu:

Choice 1: Ok -> Fun5

Choice 2: Sure... -> Fun5

Choice 3: Are there any other reasons? -> Fun5

State:Fun5

Agent: Procrastination can often play a big role in limiting the amount of fun we let ourselves have. By constantly delaying the things we have to get done in our life, we may feel overwhelmed due to them piling up on us unexpectedly, which may lead to us feeling even more burned out. Sometimes doing something as simple as changing the order in which you do events can make you feel a lot better. By doing something as simple as going to the gym or watching a movie before doing work, one can gain the clarity and energy you need the rest of your activities done better and faster.

Menu:

Choice 1: Ok -> Fun6

State:Fun6

Agent: Finally, I want to quickly touch on the importance of sleep. Often times we sacrifice our sleeping schedule to get other tasks done. While this may seem effective in the short term, a regular sleep schedule can greatly improve your overall health and help you accomplish your daily tasks better.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 25: Session4 Homework

State:Homework

Agent: So, this week I want you to continue to track your thoughts to try and identify potential distortions in your thinking. Next week we will continue to talk about these topics.

Engine: Performing internal calculations

Menu:

Choice 1: Ok -> Homework2

Choice 2: How should I track my thoughts? -> HomeworkRemind

State:HomeworkRemind

Agent: Like we discussed earlier, it can be helpful to write these down to try and find common thought distortions and ways to reframe your thoughts. Try to write them down in a chart similar to this.

Whiteboard Display:

Action: Performing internal calculations

State:Homework2

Agent: Also, I want you to try and schedule atleast one pleasant activity into your schedule. Take a few seconds to look over this list and select the activities you think you might want to do over the next week.

Checkbox:

Prompt:What activites do you want to try and schedule?

Option 1: Cook or treating yourself to a nice meal

Option 2: Watch a movie or playing some games at home

Option 3: Go to the gym or taking a walk

Option 4: Hanging out or calling your friends

Option 5: Visit local museums

Option 6: Go to a concert

Option 7: Talk to or visiting your family

Option 8: Watch a funny videos on youtube

Option 9: Do a craft activity

Option 10: Play a musical instrument

Action: Performing internal calculations

State:PleaseSelect

Agent: I know it may seem like a burden to commit to doing these activities, but as we discussed, incorporating pleasant activities into your schedule can greatly help. Try to select atleast one activity.

Checkbox:

Prompt:What activites do you want to try and schedule?

Option 1: Cook or treating yourself to a nice meal

Option 2: Watch a movie or playing some games at home

Option 3: Go to the gym or taking a walk

Option 4: Hanging out or calling your friends

Option 5: Visit local museums

Option 6: Go to a concert

Option 7: Talk to or visiting your family

Option 8: Watch a funny videos on youtube

Option 9: Do a craft activity

Option 10: Play a musical instrument

Action: Performing internal calculations

State:Homework3

Agent: Engine Generated Response

Menu:

Choice 1: Bye! -> Performing internal calculations

Choice 2: See you then! -> Performing internal calculations

Script 26: Session4 HomeworkPractice

State:Practice

Agent: So, like we did last time, I would really like to take a few minutes to talk about a thought you had over the last week. Take a moment to think about one and let me know when you're ready.

Menu:

Choice 1: I'm ready -> GetThought

Choice 2: What kind of thought? -> WhatThought

State:WhatThought

Agent: Any kind of thought, good or bad, that you have had over the last week and would like to think about a bit more critically.

Menu:

Choice 1: Ok, I have a thought ready -> GetThought

State:GetThought

Agent: Ok, so what was your thought?

Text Prompt:

Prompt:What was your thought?

Action: Performing internal calculations

State:WhereThought

Agent: And where were you when you had this thought?

Menu:

Choice 1: At school -> Performing internal calculations

Choice 2: At work -> Performing internal calculations

Choice 3: Outside -> Performing internal calculations

Choice 4: At home -> Performing internal calculations

State:GetDay

Agent: On what day?

Menu:

Choice 1: Monday -> Performing internal calculations

Choice 2: Tuesday -> Performing internal calculations

Choice 3: Wednesday -> Performing internal calculations

Choice 4: Thursday -> Performing internal calculations

Choice 5: Friday -> Performing internal calculations

Choice 6: Saturday -> Performing internal calculations

Choice 7: Sunday -> Performing internal calculations

State:GetDay

Agent: On what day?

Menu:

Choice 1: Monday -> Performing internal calculations

Choice 2: Tuesday -> Performing internal calculations

Choice 3: Wednesday -> Performing internal calculations

Choice 4: Thursday -> Performing internal calculations

Choice 5: Friday -> Performing internal calculations

Choice 6: Saturday -> Performing internal calculations

Choice 7: Sunday -> Performing internal calculations

State:GetActivity

Agent: And what were you doing at this time?

Text Prompt:

Prompt:What were you doing?

Action: Performing internal calculations

State:GetFeeling

Agent: And how did that make you feel?

Menu:

Choice 1: Angry -> Performing internal calculations

Choice 2: Disgusted -> Performing internal calculations

Choice 3: Fearful -> Performing internal calculations

Choice 4: Happy -> Performing internal calculations

Choice 5: Sad -> Performing internal calculations

Choice 6: Surprised -> Performing internal calculations

State:GetEvidence

Agent: Ok, let's try to take a critical look at this situation, what evidence do you have to support this thought?

Text Prompt:

Prompt: What evidence do you have to support your thought?

Action: Performing internal calculations

State: GetEvidenceAgainst

Agent: And now let's look at it in the opposite direction, what evidence do you have against this thought?

Text Prompt:

Prompt: What evidence do you have against this thought?

Action: Performing internal calculations

State: AskDistortion

Agent: So thinking over this situation, do you think you may have had a cognitive distortion related to your thought?

Menu:

Choice 1: Yes -> GetDistortion

Choice 2: No -> NoDistortion

State: NoDistortion

Agent: Can you think of another situation that you think may have had a distortion?

Menu:

Choice 1: Yes -> GetThought

Choice 2: No -> NoDistortionFollowup

State: NoDistortionFollowup

Agent: That's fine, I know this can be difficult at first, but after some practice it should become easier. In the mean time, let's look at what we have for now.

Whiteboard Display:

Action: Performing internal calculations

State: GetDistortion

Agent: What was the distortion you think you had?

Menu:

Choice 1: Overgeneralizing -> Performing internal calculations

Choice 2: Mental filtering -> Performing internal calculations

Choice 3: Mind Reading -> Performing internal calculations

Choice 4: Discounting the positives -> Performing internal calculations

Choice 5: Catastrophizing -> Performing internal calculations

Choice 6: All-or-Nothing thinking -> Performing internal calculations

Choice 7: Should Statements -> Performing internal calculations

Choice 8: Labeling and Mislabeled -> Performing internal calculations

Choice 9: Not sure -> Performing internal calculations

State:OtherThought

Agent: Now, I want you to take a minute to think over this situation. Can you think of a better thought that could have helped you get through this situation?

Whiteboard Display:

Action: Performing internal calculations

State:NoOther

Agent: That's fine, it is not an easy process to find alternative viewpoints to certain situation, but with a bit of practice I'm sure you will be able to.

Menu:

Choice 1: Ok -> Performing internal calculations

State:GetOtherThought

Agent: What was that thought?

Text Prompt:

Prompt: What was the other thought you could have had?

Action: Performing internal calculations

State:GetNewFeeling

Agent: With this new thought in mind, how do you think you would feel about the situation.

Menu:

Choice 1: Angry -> Performing internal calculations

Choice 2: Disgusted -> Performing internal calculations

Choice 3: Fearful -> Performing internal calculations

Choice 4: Happy -> Performing internal calculations

Choice 5: Sad -> Performing internal calculations

Choice 6: Surprised -> Performing internal calculations

State:ShowChart

Agent: Great, now lets take a look at all of this put together.

Whiteboard Display:

Action: Performing internal calculations

State:ChartFollowup

Agent: As we discussed last time, by writing them out like this, we can start to try and find relationships between our thoughts, feelings, and actions. Also by taking a more critical view of these situations, we can try and learn better ways to think about them in the future.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 27: Session4 Review3

State:Review

Agent: So today I want to switch topics a bit and talk about the importance of having fun. I know that may seem impossible at times, but together we can try to figure out a plan on how to bring some more joy into your life.

Menu:

Choice 1: Ok -> Review1

State:Review1

Agent: Before we dive into that however, I would like us to talk a bit about some of the activities we discussed during our last meeting.

Menu:

Choice 1: Ok -> Review2

Choice 2: Which activities? -> Review2

State:Review2

Agent: Last time we talked about trying to track your thoughts and feelings in certain situations, and the possible distortions related to them. Did you get a chance to write down any of these situations?

Menu:

Choice 1: Yes -> YesHomework

Choice 2: No -> NoHomework

State:NoHomework

Agent: Was there any reason why you didn't track them?

Menu:

Choice 1: I didn't have the time -> NoHomeworkTime

Choice 2: I wasn't interested in doing the activity -> NoHomeworkInterest

Choice 3: I'm not sure -> NoHomeworkGeneric

State:NoHomeworkTime

Agent: I understand. I know it can be time consuming but these tasks can really help to make you feel better in the long run.

Engine: Performing internal calculations

State:NoHomeworkInterest

Agent: I understand some of these activities can be boring, but they can really help to making you feel better in the long run.

Engine: Performing internal calculations

State:NoHomeworkGeneric

Agent: Ok. Well it would be great if you could try and complete these tasks in the future. I know they can feel like a hassle but they can greatly help in making you feel better in the long run.

Engine: Performing internal calculations

State:NoFollowup

Agent: Looking at the connection between your thoughts and feelings is a key component to learning how to feel better.

Menu:

Choice 1: Ok -> AskQuestion

State:YesHomework

Agent: That's great! What did you think about the tracking?

Menu:

Choice 1: I enjoyed doing it -> HomeworkGood

Choice 2: I didn't like it but I know it is important -> HomeworkImportant

Choice 3: It was fine but it didn't feel useful -> HomeworkUseful

Choice 4: It made me kinda sad -> HomeworkSad

Choice 5: It was ok -> HomeworkOk

State:HomeworkGood

Agent: That's great to hear. I'm glad you're enjoying it.

Menu:

Choice 1: Ok -> AskQuestion

State:HomeworkImportant

Agent: I'm sorry to hear that you're not enjoying it, but you are right, in the long run, it can have a really positive impact.

Menu:

Choice 1: Ok -> AskQuestion

State:HomeworkUseful

Agent: That's completely reasonable. You probably won't feel the effects immediately, but, over a long period it will have a really positive effect.

Menu:

Choice 1: Ok -> AskQuestion

State:HomeworkSad

Agent: Sorry to hear that. I know it can be difficult to spend a lot of time reflecting on these issues. In the long run though, it can have really positive effects.

Menu:

Choice 1: Ok -> AskQuestion

State:HomeworkOk

Agent: OK, but remember, keeping track of your feelings and thoughts can help a lot in the long run.

Menu:

Choice 1: Ok -> AskQuestion

State:AskQuestion

Agent: Did you try to use the questions we had discussed last time to help identify these thoughts.

Menu:

Choice 1: Yes -> YesQuestion

Choice 2: I forgot about them -> ForgotQuestion

Choice 3: No -> NoQuestion

State:YesQuestion

Agent: Great! Did you find them useful?

Menu:

Choice 1: Yes I did -> LikeQuestion

Choice 2: Kinda -> DislikeQuestion

Choice 3: Not really -> DislikeQuestion

Choice 4: No -> DislikeQuestion

State:LikeQuestion

Agent: That's great to hear! You should keep using them for as long as they feel helpful.

Menu:

Choice 1: Ok -> Performing internal calculations

State:ForgotQuestion

Agent: That's fine, after today's session feel free to come back and talk to me again. We can review the questions to hopefully help you better identify these thoughts.

Menu:

Choice 1: Ok -> Performing internal calculations

State:NoQuestion

Agent: Oh, was there any reason why?

Menu:

Choice 1: I'm not sure why -> UnsureQuestion

Choice 2: They don't seem very helpful -> DislikeQuestion

State:UnsureQuestion

Agent: That's ok. If you want, we can review them again during the week if you come back to talk to me. I know they can seem weird, but I highly recommend that you try them once or twice. A Lot of people I talk to find them very helpful.

Menu:

Choice 1: Ok -> Performing internal calculations

State:DislikeQuestion

Agent: I know they can seem weird, but I highly recommend that you try them a few times. A lot of people I talk to find them very helpful.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 28: Session5 Checkin

State:Checkin

Agent: <camera zoom=".8"/> Hi! Welcome back for our final session. Before we begin today's session I would like you to fill out two quick questionnaires.

Engine: Performing internal calculations

Menu:

Choice 1: Ok -> PHQ-8

Choice 2: Ok (Debugging Only - Skip Questionnaires) -> Followup

State:PHQ-Return

Agent: Thanks, I have one more questionnaire for you to fill out.

Menu:

Choice 1: Ok -> StateAnxiety

Choice 2: Ok -> StateAnxiety

State:Advance

Agent: Thanks for filling those out.

Engine: Performing internal calculations

State:Followup

Agent: Thanks for filling those out. So how are you doing today?

Menu:

Choice 1: I'm doing great -> Performing internal calculations

Choice 2: I'm doing ok -> Performing internal calculations

Choice 3: Not so great -> Performing internal calculations

Choice 4: I'm pretty down -> Performing internal calculations

State:NeutralContinue

Agent: Ok

Engine: Performing internal calculations

State:GoodEmotion

Agent: That's great to hear!

Engine: Performing internal calculations

State:BadEmotion

Agent: I'm sorry to hear that, hopefully you will feel a bit better after our talk today.

Engine: Performing internal calculations

State:BetterEmotion

Agent: Oh, you seemed to be doing pretty good based on your questionnaires, is everything ok?

Menu:

Choice 1: Not really -> BadEmotion

Choice 2: Actually, I'm doing ok. -> GoodEmotion

State:WorseEmotion

Agent: Oh, I noticed that you seemed a bit down based on your responses to the questionnaires, is everything ok?

Menu:

Choice 1: Yah -> NeutralContinue

Choice 2: Actually, I am a bit down -> BadEmotion

Script 29: Session5 HomeworkPractice

State:Practice

Agent: So, like we did last time, I would really like to take a few minutes to talk about a thought you had over the last week. Take a moment to think about one and let me know when you're ready.

Menu:

Choice 1: I'm ready -> GetThought

Choice 2: What kind of thought? -> WhatThought

State:WhatThought

Agent: Any kind of thought, good or bad, that you have had over the last week and would like to think about a bit more critically.

Menu:

Choice 1: Ok, I have a thought ready -> GetThought

State:GetThought

Agent: Ok, so what was your thought?

Text Prompt:

Prompt:What was your thought?

Action: Performing internal calculations

State:WhereThought

Agent: And where were you when you had this thought?

Menu:

Choice 1: At school -> Performing internal calculations

Choice 2: At work -> Performing internal calculations

Choice 3: Outside -> Performing internal calculations

Choice 4: At home -> Performing internal calculations

State:GetDay

Agent: On what day?

Menu:

Choice 1: Monday -> Performing internal calculations

Choice 2: Tuesday -> Performing internal calculations

Choice 3: Wednesday -> Performing internal calculations

Choice 4: Thursday -> Performing internal calculations

Choice 5: Friday -> Performing internal calculations

Choice 6: Saturday -> Performing internal calculations

Choice 7: Sunday -> Performing internal calculations

State:GetDay

Agent: On what day?

Menu:

Choice 1: Monday -> Performing internal calculations

Choice 2: Tuesday -> Performing internal calculations

Choice 3: Wednesday -> Performing internal calculations

Choice 4: Thursday -> Performing internal calculations

Choice 5: Friday -> Performing internal calculations

Choice 6: Saturday -> Performing internal calculations

Choice 7: Sunday -> Performing internal calculations

State:GetActivity

Agent: And what were you doing at this time?

Text Prompt:

Prompt:What were you doing?

Action: Performing internal calculations

State:GetFeeling

Agent: And how did that make you feel?

Menu:

Choice 1: Angry -> Performing internal calculations

Choice 2: Disgusted -> Performing internal calculations

Choice 3: Fearful -> Performing internal calculations

Choice 4: Happy -> Performing internal calculations

Choice 5: Sad -> Performing internal calculations

Choice 6: Surprised -> Performing internal calculations

State:GetEvidence

Agent: Ok, let's try to take a critical look at this situation, what evidence do you have to support this thought?

Text Prompt:

Prompt: What evidence do you have to support your thought?

Action: Performing internal calculations

State: GetEvidenceAgainst

Agent: And now let's look at it in the opposite direction, what evidence do you have against this thought?

Text Prompt:

Prompt: What evidence do you have against this thought?

Action: Performing internal calculations

State: AskDistortion

Agent: So thinking over this situation, do you think you may have had a cognitive distortion related to your thought?

Menu:

Choice 1: Yes -> GetDistortion

Choice 2: No -> NoDistortion

State: NoDistortion

Agent: Can you think of another situation that you think may have had a distortion?

Menu:

Choice 1: Yes -> GetThought

Choice 2: No -> NoDistortionFollowup

State: NoDistortionFollowup

Agent: That's fine, I know this can be difficult at first, but after some practice it should become easier. In the mean time, let's look at what we have for now.

Whiteboard Display:

Action: Performing internal calculations

State: GetDistortion

Agent: What was the distortion you think you had?

Menu:

Choice 1: Overgeneralizing -> Performing internal calculations

Choice 2: Mental filtering -> Performing internal calculations

Choice 3: Mind Reading -> Performing internal calculations

Choice 4: Discounting the positives -> Performing internal calculations

Choice 5: Catastrophizing -> Performing internal calculations

Choice 6: All-or-Nothing thinking -> Performing internal calculations

Choice 7: Should Statements -> Performing internal calculations

Choice 8: Labeling and Mislabeled -> Performing internal calculations

Choice 9: Not sure -> Performing internal calculations

State:OtherThought

Agent: Now, I want you to take a minute to think over this situation. Can you think of a better thought that could have helped you get through this situation?

Whiteboard Display:

Action: Performing internal calculations

State:NoOther

Agent: That's fine, it is not an easy process to find alternative viewpoints to certain situation, but with a bit of practice I'm sure you will be able to.

Menu:

Choice 1: Ok -> Performing internal calculations

State:GetOtherThought

Agent: What was that thought?

Text Prompt:

Prompt:What was the other thought you could have had?

Action: Performing internal calculations

State:GetNewFeeling

Agent: With this new thought in mind, how do you think you would feel about the situation.

Menu:

Choice 1: Angry -> Performing internal calculations

Choice 2: Disgusted -> Performing internal calculations

Choice 3: Fearful -> Performing internal calculations

Choice 4: Happy -> Performing internal calculations

Choice 5: Sad -> Performing internal calculations

Choice 6: Surprised -> Performing internal calculations

State:ShowChart

Agent: Great, now lets take a look at all of this put together.

Whiteboard Display:

Action: Performing internal calculations

State:ChartFollowup

Agent: As we discussed last time, by writing them out like this, we can start to try and find relationships between our thoughts, feelings, and actions. Also by taking a more critical view of these situations, we can try and learn better ways to think about them in the future.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 30: Session5 Relaxation

State:Intro

Agent: So as I mentioned earlier, Today I want to show you a relaxation technique which will help reduce your anxiety.

Menu:

Choice 1: Ok -> Intro2

State:Intro2

Agent: As you may have noticed, your breathing patterns change based on how you feel.

Menu:

Choice 1: Yes, I've noticed -> Intro3

Choice 2: I guess -> Intro3

Choice 3: Sure -> Intro3

State:Intro3

Agent: When you are anxious, you breathe more rapidly, whereas when you are relaxed you breathe more regularly. By learning to control your breathing, you can help yourself to relax when you are feeling stressed out.

Menu:

Choice 1: Sounds good -> Calm

Choice 2: How? -> Calm

State:Calm

Agent: To learn to control your breathing, I would like to go over a technique called calm breathing. Calm breathing teaches us how to regulate our breathing patterns to relax ourselves. It won't take us very long to go over, and should be a useful tool to help you feel better.

Menu:

Choice 1: Ok -> Calm2

Choice 2: So how do you do it? -> Calm2

State:Calm2

Agent: To do a calm breathing, you should take a slow breath through your nose and count to five in your head. Once you have counted to five, hold your breath for a few seconds and then slowly breathe out through your mouth. Why don't you try one now, slowly breathe in, hold your breath for a few seconds, and then slowly breathe out.

Menu:

Choice 1: That was easy -> Calm3

Choice 2: Is that it? -> Calm3

State:Calm3

Agent: When you are feeling anxious, just do 6 to 8 of those breaths in a row. Be sure to breathe regularly for a few seconds between each so you don't exhaust yourself.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 31: Session5 Review4

State:Review

Agent: So today I want to talk to you a bit about the importance of relaxation, and a few techniques you can use to calm down. I know it can be hard to relax sometimes, but the techniques I will be talking with you about today should help.

Menu:

Choice 1: Ok -> Review1

State:Review1

Agent: Before we dive into that however, I would like us to talk a bit about some of the activities we discussed during our last meeting.

Menu:

Choice 1: Ok -> Review2

Choice 2: Which activities? -> Review2

State:Review2

Agent: Last time we talked, we discussed trying to incorporate a few pleasant activities into your life. Did you get a chance to do any of the activities we agreed upon?

Menu:

Choice 1: Yes -> YesActivity

Choice 2: No -> NoActivity

State:NoActivity

Agent: I know it may seem like a burden to commit to doing these activities, but as we discussed, incorporating pleasant activities into your schedule can greatly help. I highly encourage you to try and incorporate some of these activities into your weekly routine in the future.

Menu:

Choice 1: Ok -> CheckHomework

State:YesActivity

Agent: Great! How did they go?

Menu:

Choice 1: I really enjoyed doing them! -> ActivityGood

Choice 2: They were ok -> ActivityNeutral

Choice 3: They made me feel worse -> ActivityBad

State:ActivityGood

Agent: That's great to hear. Incorporating a few positive activities into your weekly can greatly help with how you feel. If you get a chance, you should try to incorporate more of these activities into your schedule or try some new ones next week.

Menu:

Choice 1: Ok -> CheckHomework

State:ActivityNeutral

Agent: Good to hear. Incorporating a few positive activities into your weekly schedule can greatly help with how you feel. If you get a chance, you should try to incorporate some more pleasant activities into your schedule next week.

Menu:

Choice 1: Ok -> CheckHomework

State:ActivityBad

Agent: I'm sorry to hear that. Incorporating a few positive activities into your weekly can greatly help with how you feel, but it may take some time to find the activity that is right for you. If you get a chance, try to incorporate a few different activities into your schedule next week to see how they work out.

Menu:

Choice 1: Ok -> CheckHomework

State:CheckHomework

Agent: Last session we also talked about trying to continue to track situations in which you may have had thought distortions. Did you get a chance to write down any of these situations?

Menu:

Choice 1: Yes -> YesHomework

Choice 2: No -> NoHomework

State:NoHomework

Agent: Was there any reason why you didn't track them?

Menu:

Choice 1: I didn't have the time -> NoHomeworkTime

Choice 2: I wasn't interested in doing the activity -> NoHomeworkInterest

Choice 3: I'm not sure -> NoHomeworkGeneric

State:NoHomeworkTime

Agent: I understand. I know it can be time consuming but these tasks can really help to make you feel better in the long run.

Engine: Performing internal calculations

State:NoHomeworkInterest

Agent: I understand some of these activities can be boring, but they can really help to making you feel better in the long run.

Engine: Performing internal calculations

State:NoHomeworkGeneric

Agent: Ok. Well it would be great if you could try and complete these tasks in the future. I know they can feel like a hassle but they can greatly help in making you feel better in the long run.

Engine: Performing internal calculations

State:NoFollowup

Agent: Looking at the connection between your thoughts and feelings is a key component to learning how to feel better.

Menu:

Choice 1: Ok -> AskQuestion

State:YesHomework

Agent: That's great! What did you think about the tracking?

Menu:

Choice 1: I enjoyed doing it -> HomeworkGood

Choice 2: I didn't like it but I know it is important -> HomeworkImportant

Choice 3: It was fine but it didn't feel useful -> HomeworkUseful

Choice 4: It made me kinda sad -> HomeworkSad

Choice 5: It was ok -> HomeworkOk

State:HomeworkGood

Agent: That's great to hear. I'm glad you're enjoying it.

Menu:

Choice 1: Ok -> AskQuestion

State:HomeworkImportant

Agent: I'm sorry to hear that you're not enjoying it, but you are right, in the long run, it can have a really positive impact.

Menu:

Choice 1: Ok -> AskQuestion

State:HomeworkUseful

Agent: That's completely reasonable. You probably won't feel the effects immediately, but, over a long period it will have a really positive effect.

Menu:

Choice 1: Ok -> AskQuestion

State:HomeworkSad

Agent: Sorry to hear that. I know it can be difficult to spend a lot of time reflecting on these issues. In the long run though, it can have really positive effects.

Menu:

Choice 1: Ok -> AskQuestion

State:HomeworkOk

Agent: OK, but remember, keeping track of your feelings and thoughts can help a lot in the long run.

Menu:

Choice 1: Ok -> AskQuestion

State:AskQuestion

Agent: Did you try to use the questions we had discussed last time to help identify these thoughts.

Menu:

Choice 1: Yes -> YesQuestion

Choice 2: I forgot about them -> ForgotQuestion

Choice 3: No -> NoQuestion

State:YesQuestion

Agent: Great! Did you find them useful?

Menu:

Choice 1: Yes I did -> LikeQuestion

Choice 2: Kinda -> DislikeQuestion

Choice 3: Not really -> DislikeQuestion

Choice 4: No -> DislikeQuestion

State:LikeQuestion

Agent: That's great to hear! You should keep using them for as long as they feel helpful.

Menu:

Choice 1: Ok -> Performing internal calculations

State:ForgotQuestion

Agent: That's fine, after today's session feel free to come back and talk to me again. We can review the questions to hopefully help you better identify these thoughts.

Menu:

Choice 1: Ok -> Performing internal calculations

State:NoQuestion

Agent: Oh, was there any reason why?

Menu:

Choice 1: I'm not sure why -> UnsureQuestion

Choice 2: They don't seem very helpful -> DislikeQuestion

State:UnsureQuestion

Agent: That's ok. If you want, we can review them again during the week if you come back to talk to me. I know they can seem weird, but I highly recommend that you try them once or twice. A Lot of people I talk to find them very helpful.

Menu:

Choice 1: Ok -> Performing internal calculations

State:DislikeQuestion

Agent: I know they can seem weird, but I highly recommend that you try them a few times. A lot of people I talk to find them very helpful.

Menu:

Choice 1: Ok -> Performing internal calculations

Script 32: Session5 Wrapup

State:Wrapup

Agent: So, I would like to review what we have talked about over the last 5 weeks, and to talk a bit about the progress we have made together.

Menu:

Choice 1: Ok -> Performing internal calculations

State:PHQBetter

Agent: Based on your questionnaires, you seem to be feeling better than you did when we first meet. You should feel proud of what you have accomplished!

Whiteboard Display:

Action: Performing internal calculations

State:PHQWorse

Agent: Based on your questionnaires, it seems like you are still feeling pretty down. I know this can be discouraging, but depression often takes a long time to overcome and the work we did together was important towards ultimately feeling better.

Whiteboard Display:

Action: Performing internal calculations

State:Wrapup2

Agent: To keep getting better, I want you to continue to use the techniques we discussed during our sessions to think about the connections between your thoughts and behaviors. By continuing to use the tools we learnt together, you will start identifying trends in your thinking and ultimately learn how to overcome some of your common thought distortions.

Menu:

Choice 1: Ok -> Wrapup3

State:Wrapup3

Agent: Also, I want you to practice the relaxation technique we tried today, and to try and continue to schedule some fun activities into your weekly schedule.

Menu:

Choice 1: Ok -> Wrapup4

State:Wrapup4

Agent: Sadly, you have learnt all you can from me, and this will be our last meeting. It was a pleasure working with you. Feel free to contact the research assistant to let them know you have completed the study.

Whiteboard Display:

Action: Performing internal calculations

State:End

Agent: Thanks again for working with me. Goodbye!

Menu:

Choice 1: Bye! -> Performing internal calculations

Script 33: StateAnxiety

State:StateAnxiety1

Questionnaire:

Prompt: A number of statements which people have used to describe themselves are given below. Read each statement and then select the statement which best indicates how you feel right now.

Action: Performing internal calculations

State:StateAnxiety2

Questionnaire:

Prompt: A number of statements which people have used to describe themselves are given below. Read each statement and then select the statement which best indicates how you feel right now.

Action: Performing internal calculations

State:StateAnxiety3

Questionnaire:

Prompt: A number of statements which people have used to describe themselves are given below. Read each statement and then select the statement which best indicates how you feel right now.

Action: Performing internal calculations

State:StateAnxiety4

Questionnaire:

Prompt: A number of statements which people have used to describe themselves are given below. Read each statement and then select the statement which best indicates how you feel right now.

Action: Performing internal calculations

State:StateAnxiety5

Questionnaire:

Prompt: A number of statements which people have used to describe themselves are given below. Read each statement and then select the statement which best indicates how you feel right now.

Action: Performing internal calculations

Script 34: TimeoutMenu

State:Timeout

Agent: Hey, are you still there? Let me know when you are ready to continue.

Menu:

Choice 1: I'm back -> Performing internal calculations

Choice 2: I have to go. -> Leave

State:Leave

Agent: No problem, when you are free come back and we can continue.

Menu:

Choice 1: Bye -> Performing internal calculations

Choice 2: Actually, I have time to continue. -> Performing internal calculations

Script 35: Top

State:CheckIntro

Engine: Performing internal calculations

State:ClearAndCheck

Action:

Hide Text Display

Engine: Performing internal calculations

State:Lockout

Action:

Hide Text Display

Agent: Engine Generated Response

Menu:

Choice 1: Ok -> Performing internal calculations

Choice 2: Bye -> Performing internal calculations

State:IntroEditor

Action:

Hide Text Display

Agent: <gaze dir="towards"/>Hello, which project do you wish to test?

Menu:

Choice 1: Check for next script -> Performing internal calculations

Choice 2: Thesis - Start from Beginning -> QuestionnairePrompt

Choice 3: Thesis - Start Session 2 -> Session2.Checkin

Choice 4: Thesis - Start Session 3 -> Session3.Checkin

Choice 5: Thesis - Start Session 4 -> Session4.Checkin

Choice 6: Thesis - Start Session 5 -> Session5.Checkin

Choice 7: Thesis - Script Selection -> Menu

State:QuestionnairePrompt

Agent: To simulate the real study, please complete the questionnaire that will be given at intake.

Engine: Performing internal calculations

Menu:

Choice 1: Do Intake Questionnaire -> PHQ-8

Choice 2: Skip Questionnaire -> Session1.Tutorial

Appendix B: Questionnaires for Longitudinal Evaluation Study

PHQ-8

Reference: [64]

Administered in person at intake and debrief, and by the system at the start of each session.

Over the **last 2 weeks**, how often have you been bothered by any of the following problems?

Use a checkmark in indicate your answer

	<u>Not at all</u>	<u>Several days</u>	<u>More than half the days</u>	<u>Nearly every day</u>
<i>Little interest or pleasure in doing things</i>				
<i>Feeling down, depressed, or hopeless</i>				
<i>Trouble falling or staying asleep, or sleeping too much</i>				
<i>Feeling tired or having little energy</i>				
<i>Poor appetite or overeating</i>				
<i>Feeling bad about yourself — or that you are a failure or have let yourself or your family down</i>				
<i>Trouble concentrating on things, such as reading the newspaper or watching television</i>				

Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual

--	--	--	--	--

State Anxiety

Reference: [92]

Administered in person at intake and debrief, and by the system at the start of each session.

A number of statements which people have used to describe themselves are given below. Reach each statement and then circle the appropriate number to the below the statement to indicate how you feel *right now*, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

I feel calm

Not at all.....SomewhatModerately So.....Very much So

I feel secure

Not at all.....SomewhatModerately So.....Very much So

I feel tense

Not at all.....SomewhatModerately So.....Very much So

I feel strained

Not at all.....SomewhatModerately So.....Very much So

I feel at ease

Not at all.....SomewhatModerately So.....Very much So

I feel upset

Not at all.....SomewhatModerately So.....Very much So

I am presently worrying over possible misfortunes

Not at all.....SomewhatModerately So.....Very much So

I feel satisfied

Not at all.....SomewhatModerately So.....Very much So

I feel frightened

Not at all.....SomewhatModerately So.....Very much So

I feel comfortable

Not at all.....SomewhatModerately So.....Very much So

I feel self-confident

Not at all.....SomewhatModerately So.....Very much So

I feel nervous

Not at all.....SomewhatModerately So.....Very much So

I feel jittery

Not at all.....SomewhatModerately So.....Very much So

I feel indecisive

Not at all.....SomewhatModerately So.....Very much So

I feel relaxed

Not at all.....SomewhatModerately So.....Very much So

I feel content

Not at all.....SomewhatModerately So.....Very much So

I feel worried

Not at all.....SomewhatModerately So.....Very much So

I feel confused

Not at all.....SomewhatModerately So.....Very much So

I feel steady

Not at all.....SomewhatModerately So.....Very much So

I feel pleasant

Not at all.....SomewhatModerately So.....Very much So

How much do you feel that Tanya cares about you?

not at all • • • • • • • very much

How much do you feel that you and Tanya understand each other?

not at all • • • • • • • very much

How much do you feel that Tanya was honest about her feelings towards you?
not honest • • • • • • • very honest

Working Alliance

Reference: [67]

Administered in person at debrief.

Score the degree to which you agree with each statement, from
1 = "not at all" to 7 = "completely"

- (1). I feel uncomfortable with Tanya.
- (2). Tanya and I agree about the things I will need to do in therapy to help improve my situation.
- (3). I am worried about the outcome of these sessions.
- (4). What I am doing in therapy gives me new ways of looking at my problem.
- (5). Tanya and I understand each other.
- (6). Tanya perceives accurately what my goals are.
- (7). I find what I am doing in therapy confusing.
- (8). I believe Tanya likes me.
- (9). I wish Tanya and I could clarify the purpose of our sessions.
- (10). I disagree with Tanya about what I ought to get out of therapy.
- (11). I believe the time Tanya and I are spending together is not spent efficiently.
- (12). Tanya does not understand what I am trying to accomplish in therapy.
- (13). I am clear on what my responsibilities are in therapy.
- (14). The goals of these sessions are important for me.
- (15). I find what Tanya and I are doing in therapy is unrelated to my concerns.
- (16). I feel that the things I do in therapy will help me to accomplish the changes that I want.
- (17). I believe Tanya is genuinely concerned for my welfare.
- (18). I am clear as to what Tanya wants me to do in these sessions.
- (19). Tanya and I respect each other.
- (20). I feel that Tanya is not totally honest about his/her feelings toward me.
- (21). I am confident in Tanya's ability to help me.
- (22). Tanya and I are working towards mutually agreed upon goals.
- (23). I feel that Tanya appreciates me.
- (24). We agree on what is important for me to work on.

- (25). As a result of these sessions I am clearer as to how I might be able to change.
- (26). Tanya and I trust one another.
- (27). Tanya and I have different ideas on what my problems are.
- (28). My relationship with Tanya is very important to me.
- (29). I have the feeling that if I say or do the wrong things, Tanya will stop working with me.
- (30). Tanya and I collaborate on setting goals for my therapy.
- (31). I am frustrated by the things I am doing in therapy.
- (32). We have established a good understanding of the kind of changes that would be good for me.
- (33). The things that Tanya is asking me to do don't make sense.
- (34). I don't know what to expect as the result of my therapy.
- (35). I believe the way we are working with my problem is correct.
- (36). I feel Tanya cares about me even when I do things that he/she does not approve of.

Appendix C: Interview Questions for Longitudinal Evaluation Study

Administered in person at debrief.

For All Conditions:

1. How was your experience with the system?
2. Do you feel your depressive symptoms have changed over the past five weeks?
3. Did you ever feel emotional during your interaction with the program?
 - a. If Yes, Do you remember why/what were you talking about?
 - b. If Yes, Did the system respond to your emotions? Where these responses appropriate?
4. Would you use a program like this again in the future?
 - a. Why or Why not?

For Character Conditions

1. What was it like to talk about with the computer character about depression?
2. Did you find the system engaging?
 - a. Why or Why not?
3. Do you think the computer character listened to you? Understood you?
 - a. Why or Why not?
 - b. If Yes, was there a specific instance that you can think of?
4. Do you feel the computer character understood your emotions?
 - a. Why or Why not? How did the character express its understanding?
 - b. If Yes, Did the system ever respond incorrectly to how you were feeling?
5. Did you trust the computer character?
 - a. Why or Why not?
6. How often did you talk to the computer character?
 - a. Did you stick to a schedule? Was it when you felt X, etc.?
7. Did you ever stop using the system during the five-weeks period?
 - a. Why or Why not? What prevented you from using the system?
8. Have you ever talked to a therapist about depression?

- a. If Yes, How was the interaction with the program different?
9. How did you feel about completing your session? Was it something you looked forward to, was it a chore, etc?
10. What was your favorite part of the system?
11. What was your least favorite part of the system?
12. Did you feel like the five interactions with the system was enough, too much, or just right?
 - a. If not just right, Why/Why not?
13. Is there anything you would want to change/add to the program?
14. Would you have preferred to talk with a real person either in person or via a video conference instead of the character?
15. Would you recommend this system to others?

Appendix D: Sample Therapy Transcript with Section Annotation

Transcript from one of the four APA videos [49] illustrating where the therapeutic techniques outlined in Chapter 3 and 5 are used in practice. Relevant textual cues are bolded.

Transcribed Text	Section notes and therapeutic techniques
<p>[C]ounselor: Ok [Name] let's start today. I want to check in and see how you are feeling today and how things have gone since last week and then we want to set an agenda for today and one of the things we want to be sure to put on the agenda is the HW that you did this past week.</p>	<p><i>Section: Orientation</i></p>
<p>[P]atient: Ok, yeah, I brought my measures</p> <p>[C]: Ok, terrific, let me take a look</p> <p>[P]: The scores look pretty much the same from last week even though I'm feeling better about the social stuff we have been working on.</p> <p>[C]: Good</p> <p>[P]: Even though it's been a really stressful week at work, so the scores are looking the same</p> <p>[C]: Ok, I'm noting one of the items here, that you still have some suicidal thoughts, but no plans?</p> <p>[P]: Yah, no plan at all</p>	<p><i>Section: Checkin</i></p> <p>The counselor notices a discrepancy between the patients reported symptoms and what they are verbally saying, and alerts the patient of the difference to ensure they are correctly assessing their feelings.</p>
<p>[C]: Ok, so it sounds like we don't have to put that on the agenda.</p> <p>[C]: Ok, you started to say you had a social thing, went well, but you've had a stressful week at work</p> <p>[P]: Yah, I have these deadlines that come up, and its crunch time right and I have this huge project I</p>	<p><i>Section: Agenda Setting</i></p> <p>The counselor identifies a possible agenda item to discuss during the session and asks the patient if they want to put it on their agenda for the day.</p>

<p>need to get done. I just get really overwhelmed when I think about I'll never be able to get it done and I'm such a loser and I shouldn't have taken it on because it's too big and there's no way I can do it.</p> <p>[C]: So this sounds like an agenda item, it's very stressful for you and is raising lots of thoughts.</p> <p>[P]: Yes, I have all kinds of negative thoughts about how I can't get it done and I just shouldn't have taken it in the first place.</p> <p>[C]: Ok, so definitely put this one on the agenda</p>	
<p>[P]: Yah for example this project I have to get done it's..., I have to get it done, like this week I have to get it done, umm, and there is so much left that I have to do, so umm, I don't know what I'm gonna do.</p> <p>[C]: Ok, so let me interrupt you for a moment, if I can. So it sounds like we are starting to move into this agenda item right now and I want to make sure we take time to set an agenda for the whole session and its clear this seems to be a priority.</p> <p>[P]: Yes</p> <p>[C]: Agenda item, but before we get into that let's take a look at what else we might want to put on the agenda, let's be sure we cover everything we are sure we want to cover today. So, is there anything else that you want to make sure we put on the agenda for today?</p> <p>[P]: Yah, um, I would really like to keep working on the social stuff because I think that's going well, just like having two or three things I'm suppose to do every week instead of having something to do every day, I have got all overwhelmed and think about how I should be doing something and I go around feeling guilty that I'm not, so it's very helpful to</p>	<p><i>Section: Agenda Setting</i></p> <p>The counselor alerts the patient that they are trying to skip straight into the main agenda before they have finished setting their agenda for the whole session. This is done to ensure no other important topics are missed by skipping ahead.</p>

<p>have just a couple of things.</p> <p>[C]: This was the homework plan that we made last week so it's a really important agenda item to follow up, on the homework plan that we made and the social things were working on setting concrete and fewer goals to work on. Ok so we definitely want to put that on there for today.</p> <p>[P]: Uh huh</p> <p>[C]: Ok, good so we got two things, let me check, anything else that you wanted to be sure we cover today?</p>	
<p>[P]: Um, I kinda like to talk, my parents are coming to town next weekend and it's kinda something I do want to talk about at some point because its anxious about it I guess.</p> <p>[C]: Kinda anxious, your parents, are coming over, coming next week, ok so this is an agenda item that we might want to take up too. Sounds like we got three agenda items, what's going on with work and stress you're feeling and also following up on your homework and the social goals we have been working on and your parents coming over to visit.</p>	<p><i>Section: Agenda Setting</i></p> <p>Counselor uses reflective dialogue to communicate emotional understanding to the participant and to ensure they are interpreting the situation correctly.</p>
<p>Now I'm wondering, three items this might be too much to cover in the time we have today, we might want to keep it to just a couple, what would you say would be the priorities that we make sure we get too.</p> <p>[P]: Well, um, I could spend the whole session talking about work, so I definitely want to talk about work and um, the social stuff, and I guess I'll deal with my parents, I can deal with that.</p> <p>[C]: Does that feel less of a priority than the other two?</p> <p>[P]: Yah, definitely the work and the social</p>	<p><i>Section: Agenda Setting</i></p> <p>Due to the time limited nature of human-human therapy sessions, the counselor alerts the patient that they may not have enough time to cover all of the patient's topics.</p>

<p>[C]: Ok, ok great, so we will focus on those two today, and from what you are telling me, we can spend pretty much the whole session on work and what's happening so what I would suggest is we do the homework check-in and follow up on the homework that you did for the past week. So we be sure to get to that so we don't end up using up the session and not have time to follow up.</p> <p>[P]: Ok</p> <p>[C]: How does that sound?</p> <p>[P]: Good, that makes sense</p> <p>[C]: Ok great.</p>	
<p><i>Break in video</i></p>	<p><i>Section: Main Agenda</i></p> <p>To ensure patient confidentiality, discussions that occurred during the main agenda was not included in the sample videos.</p>
<p>[C]: Ok [Name], we covered a lot here today and I noticed we are getting near the end of our time together and I want to be sure we have enough time to make a good homework plan. So why don't we stop for a moment and summarize?</p>	<p><i>Section: End of Main Agenda</i></p> <p>Time is again brought up by the counselor since there session is about to come to an end.</p>
<p>[P]: That would be helpful, because we have covered a lot and it all gets kind of mixed up in my head</p> <p>[C]: Yah, we did just cover a lot just now so why don't we stop for a moment and summarize what we have done here today?</p> <p>[P]: Ok</p> <p>[C]: Ok, we started by just checking on your homework and it went really well, having three things to focus on this week made a big difference rather than everyday thing thinking you should be</p>	<p><i>Section: End of Main Agenda</i></p> <p>The counselor recaps the topics covered during today's session as a lead in to the homework assigning process. As part of this recap, they remind the patient of any homework assignments they discussed during the main agenda discussion.</p>

doing something social. You picked three concrete things and that was key because you were able to do those three things and not feel so guilty which worked really well.

[P]: Yes

[C]: We decided to continue with that plan for the week and we picked three things, right? You're going to have a work party coming up and you are going to get together with [X] for lunch and you will get together with [Y] coming up and it sounds like you have some good ideas for backup plans just in case any of those plans fall through.

Then we spent most of the session really focusing on work issues and what happens, you start to procrastinate and avoid your work because you feel really overwhelmed and we used a thought record today to identify a specific time you felt really overwhelmed and we learnt a lot about the automatic thoughts you get and how this leads to wanting to avoid and procrastinate and we came up with some ideas based on this thinking and learned it would be helpful to have some concrete specific goals to work on every day

[P]: Yah, I think it will be really helpful to have just like two or three goals per day.

[C]: Right, ok, so let's make a homework plan

[P]: Ok

[C]: About those two to three goals and see if we can get that more specific

[P]: Ok

[C]: Ok, so we are thinking of what, two or three goals each day

Section: Assigning Homework

As part of the counseling session, the patient and counselor had discussed trying to lay out a work schedule for the patient. The counselor re-iterates this idea to the patient, and works with them to set realistic goals.

[P]: Right

[C]: Ok, any ideas, let's see if we can get them a little more concrete

[P]: Ok

[C]: Any ideas?

[P]: Um, well like for tomorrow, I was thinking I should get this editing project done

[C]: Uh huh

[P]: So that would be one goal

[C]: editing project

[P]: Yah

[C]: Ok, what's involved in the editing project

[P]: Um, well I have this, um, manual that I translated and so it's got 200 pages or so of translation I have to go through and edit and um make sure that it, um, makes sense and that there's no typos and all of that

[C]: Ok, so you think that like for tomorrow, one concrete goal would be to do that editing?

[P]: Yah, and get it done

[C]: And get it done?

[P]: Yes

[C]: Let me just check in about realistic planning, how, you said 200 pages?

[P]: Yah

[C]: I don't know much about how long that would take, how long would you estimate that would take?

[P]: Um, I can do about 25 pages an hour at this stage so like 8 hours to get it done

[C]: 8 hours, to finish the editing project?

[P]: Yes

[C]: This seems like a big goal, this is one goal for tomorrow?

[P]: Yah, yah your right, it's kinda a lot isn't it, no I guess I can't get that done tomorrow

[C]: Ok, well this is good, im glad we are going over this, looking at what to do

[P]: Right

[C]: So let's see if we can break that down into something more manageable and realistic and nice and concrete and specific for tomorrow

[P]: Ok

[C]: So that takes 8 hours, that's too much

[P]: Yah, and then I also have to, um, answer my emails and telephone calls and I have to do that every day

[C]: Ok, that's important, how long does that take?

[P]: Um, an hour, sometimes more

[C]: An hour, or more, ok so an hour or more for emails and phone calls, ok

[P]: And then, I have this letter that I must write it and I have to get that done, so um, so that's something else I need to put on the list for tomorrow

[C]: A letter, ok, lets stop for a moment, how long should this letter take, do you think?

[P]: Um, well I would say probably an hour but maybe I should allow one and a half to two hours, just incase I have trouble coming up with what to say

[C]: Good, so that sounds smart to give yourself a little room incase it

[P]: Time management is one of my issues

[C]: Ok, so we get one to two hours for this letter, an

hour or so for emails and phone calls

[P]: And then I have, um, this billing thing that I, um, one of my agencies has been calling me repeatedly about this bill, so I need to get that done and um, it really should only take fifteen minutes because all I have to do is go, pull the file and look and see the bill was paused or not so and just dash off a quick email about that so, but to be generous about time lets say 30 to 45 minutes to be sure that I get it done

[C]: Ok, for this bill, let me just check in on the priorities for tomorrow

[P]: Ok, so tomorrow I'm gonna answer my emails and telephone calls, and then ill um, set in on my goals of working on the letter and working on that billing problem and that should take me to about lunch

[C]: Ok

[P]: So then I can take a lunch break and it will also be like a nice little motivator for me

[C]: Good

[P]: And then I'll, I can come back from lunch and I'll just spend the rest of the afternoon just trying to make some progress on my editing job

[C]: Ok, good, some progress, on the editing job

[P]: Ok, right

[C]: Ok, this is sounding a little more realistic

[P]: Yes, I'm feeling much better about it all

[C]: Ok, good

[P]: Yah, like this is really helping to just make finite, just like we did with the social thing and having just three things and I'll do that for each day and I'll try to be very realistic about what those things are and what I'll get done

[C]: Ok, great, so let's think ahead if we can and just plan ahead for any obstacles that might come up, what about for tomorrow, we made a plan for tomorrow that's sounding pretty concrete and specific, get two or three goals and I've allowed for all the other things, anything that we can anticipate might come up tomorrow that might be an obstacle?

[P]: Um, not that I can think of

[C]: Ok, what about the next day, or the next day?

[P]: Um, I think the biggest thing is just for me to be realistic about it is I am setting as a goal, like earlier when I said one of my goals for tomorrow would be finishing the project

[C]: Exactly

[P]: So trying to be very concrete and realistic about what those goals are

[C]: Ok, anything you can think of that will help you be more realistic? About how much you can do in one day?

[P]: Well, making those time estimates, because I do, because when I think about it I'm pretty good, I know how much time it takes to edit that stuff, um so, so I think doing time

[C]: Time, ok, good, anything else that we can think about now that will help you with this?

[P]: I don't think so

[C]: Ok, good, this is sounding like a good plan. **What I would suggest is when you write those goals down for each day, what if you bring that in next week?**

[P]: Oh, that's a good idea, and then you could help me troubleshoot, yah that would be great

[C]: Yah, so we can learn, let's use this an opportunity

Section: Assigning Homework

To end the session, the counselor re-iterates the patient's homework assignments and ties it into the topics they will theoretically talk about during their next session.

to learn what works and what doesn't, you know when does it go well, when do you get into some trouble and then you and I can get into some problem solving or review what's going on.

[P]: So we put my daily agendas on my homework list?

[C]: Yah, that sounds?

[P]: Good

References

1. D. Aderman. 1972. Elation, depression, and helping behavior. *Journal of personality and social psychology* 24, 1: 91–101.
2. American Psychiatric Association. 2013. *Diagnostic and Statistical Manual of Mental Disorders (DSM-5®)*. American Psychiatric Pub.
3. D. Bates, M. Maechler, and B. Bolker. 2012. lme4: linear mixed-effects models using Eigen and Eigenfish. R package version 0.999375-42. 2011. *Google Scholar*.
4. Timothy Bickmore and Toni Giorgino. 2006. Health dialog systems for patients and consumers. *Journal of biomedical informatics* 39, 5: 556–571.
5. Timothy Bickmore, Amanda Gruber, and Rosalind Picard. 2005. Establishing the computer-patient working alliance in automated health behavior change interventions. *Patient education and counseling* 59, 1: 21–30.
6. Timothy Bickmore and Daniel Schulman. 2007. Practical approaches to comforting users with relational agents. In *CHI '07 extended abstracts on Human factors in computing systems - CHI '07*. <https://doi.org/10.1145/1240866.1240996>
7. Timothy Bickmore and Daniel Schulman. 2009. A virtual laboratory for studying long-term relationships between humans and virtual agents. In *Proceedings of The 8th International Conference on Autonomous Agents and Multiagent Systems - Volume 1 (AAMAS '09)*, 297–304.
8. Timothy Bickmore, Daniel Schulman, and Langxuan Yin. 2010. Maintaining Engagement in Long-term Interventions with Relational Agents. *Applied artificial intelligence: AAI* 24, 6: 648–666.
9. Margaret M. Bradley and Peter J. Lang. 1999. *Affective norms for English words (ANEW): Instruction manual and affective ratings*. Technical report C-1, the center for research in psychophysiology, University of Florida. Retrieved from <http://www.uvm.edu/~pdodds/teaching/courses/2009-08UVM-300/docs/others/everything/bradley1999a.pdf>
10. Scott Brave, Clifford Nass, and Kevin Hutchinson. 2005. Computers that care: investigating the effects of orientation of emotion exhibited by an embodied computer agent. *International journal of human-computer studies* 62, 2: 161–178.
11. Felix Burkhardt, Jitendra Ajmera, Roman Englert, Joachim Stegmann, and Winslow Burleson. 2006. Detecting anger in automated voice portal dialogs. In *Ninth International Conference on Spoken Language Processing*. Retrieved from <https://pdfs.semanticscholar.org/be51/101144377238b26d8d24141dc6415f6d56e3.pdf>
12. Winslow Burleson. 2006. Affective learning companions : strategies for empathetic agents with real-time multimodal affective sensing to foster meta-cognitive and meta-affective approaches to learning, motivation, and perseverance. Massachusetts Institute of Technology. Retrieved September 11, 2017 from <https://dspace.mit.edu/handle/1721.1/37404?show=full?show=full>
13. Winslow Burleson, R. W. Picard, Ken Perlin, and Jon Lippincott. 2004. A platform for affective agent research. In *Workshop on Empathetic Agents, International Conference on Autonomous Agents and Multiagent Systems, Columbia University, New York, NY*. Retrieved from <https://pdfs.semanticscholar.org/a303/aebc0be81f1865ae4e6ae2470c9b17924052.pdf>
14. David D. Burns. 1989. *The feeling good handbook: Using the new mood therapy in everyday life*. William Morrow & Co.
15. D. D. Burns and S. Nolen-Hoeksema. 1992. Therapeutic empathy and recovery from depression in cognitive-behavioral therapy: a structural equation model. *Journal of consulting and clinical psychology* 60, 3: 441–449.
16. James R. Carpenter, Harvey Goldstein, and Jon Rasbash. 2003. A novel bootstrap procedure for assessing the relationship between class size and achievement. *Journal of the Royal Statistical Society. Series C, Applied statistics* 52, 4: 431–443.
17. James R. Carpenter, Harvey Goldstein, and Jon Rasbash. 2003. A novel bootstrap procedure for

- assessing the relationship between class size and achievement. *Journal of the Royal Statistical Society. Series C, Applied statistics* 52, 4: 431–443.
18. Justine Cassell. 1999. Embodied conversational agents: a new paradigm for the study of gesture and for human—computer interface. In *Gesture, Speech, and Sign*. 203–222.
 19. Justine Cassell, Hannes Högni Vilhjálmsón, and Timothy Bickmore. 2004. BEAT: the Behavior Expression Animation Toolkit. In *Cognitive Technologies*. 163–185.
 20. Bruce G. Charlton. 1994. Empathy and the Practice of Medicine: Beyond Pills and the Scalpel. Edited by H. M. Spiro, M. G. McC. Curnen, E. Peschel and D. St James. (Pp. 208; £14.95.) Yale University Press: Connecticut. 1993. *Psychological medicine* 24, 03: 797.
 21. Helen Christensen, Kathleen M. Griffiths, and Anthony F. Jorm. 2004. Delivering interventions for depression by using the internet: randomised controlled trial. *BMJ* 328, 7434: 265.
 22. Helen Christensen, Kathleen M. Griffiths, and Anthony F. Jorm. 2004. Delivering interventions for depression by using the internet: randomised controlled trial. *BMJ* 328, 7434: 265.
 23. J. F. Cohn, T. S. Kruez, I. Matthews, Y. Yang, M. H. Nguyen, M. T. Padilla, F. Zhou, and F. De la Torre. 2009. Detecting depression from facial actions and vocal prosody. In *2009 3rd International Conference on Affective Computing and Intelligent Interaction and Workshops*, 1–7.
 24. Mark Coulson. 2004. Attributing Emotion to Static Body Postures: Recognition Accuracy, Confusions, and Viewpoint Dependence. *Journal of nonverbal behavior* 28, 2: 117–139.
 25. Mark H. Davis and H. Alan Oathout. 1987. Maintenance of satisfaction in romantic relationships: Empathy and relational competence. *Journal of personality and social psychology* 53, 2: 397–410.
 26. Ap Dijksterhuis and Pamela K. Smith. 2002. Affective habituation: subliminal exposure to extreme stimuli decreases their extremity. *Emotion* 2, 3: 203–214.
 27. Sidney K. D’Mello and Arthur Graesser. 2010. Multimodal semi-automated affect detection from conversational cues, gross body language, and facial features. *User modeling and user-adapted interaction* 20, 2: 147–187.
 28. Sidney D’Mello, Rosalind W. Picard, and Arthur Graesser. 2007. Toward an Affect-Sensitive AutoTutor. *IEEE intelligent systems* 22, 4: 53–61.
 29. Paul Ekman. 1992. An argument for basic emotions. *Cognition & emotion* 6, 3: 169–200.
 30. Florian Eyben, Martin Wöllmer, and Björn Schuller. 2010. Opensmile. In *Proceedings of the international conference on Multimedia - MM '10*. <https://doi.org/10.1145/1873951.1874246>
 31. Ethan Fast, Binbin Chen, and Michael S. Bernstein. 2016. Empath. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI '16*. <https://doi.org/10.1145/2858036.2858535>
 32. Candi P. Feller and R. Rocco Cottone. 2003. The Importance of Empathy in the Therapeutic Alliance. *The Journal of Humanistic Counseling, Education and Development* 42, 1: 53–61.
 33. Hany Ferdinando, Liang Ye, Tapio Seppänen, and Esko Alasaarela. 2014. Emotion Recognition by Heart Rate Variability. In *Emotion Recognition by Heart Rate Variability*. repository.petra.ac.id, 50–55.
 34. Evan M. Forman, James D. Herbert, Ethan Moitra, Peter D. Yeomans, and Pamela A. Geller. 2007. A randomized controlled effectiveness trial of acceptance and commitment therapy and cognitive therapy for anxiety and depression. *Behavior modification* 31, 6: 772–799.
 35. Richard M. Frankel. 1995. Emotion and the physician-patient relationship. *Motivation and emotion* 19, 3: 163–173.
 36. Barbara L. Fredrickson. 2001. The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *The American psychologist* 56, 3: 218–226.
 37. Sigmund Freud and Josef Breuer. Studies on Hysteria (1893-1895). Chapter I. On the psychical mechanism of hysterical phenomena: Preliminary communication (1893) (Breuer and Freud). *PsycEXTRA Dataset*. <https://doi.org/10.1037/e417472005-070>
 38. Paula Gardiner, Megan B. Hempstead, Lazlo Ring, Timothy Bickmore, Leanne Yinusa-Nyahkoon, Huong Tran, Michael Paasche-Orlow, Karla Damus, and Brian Jack. 2013. Reaching women through health information technology: the Gabby preconception care system. *American journal of*

- health promotion: AJHP* 27, 3 Suppl: eS11–20.
39. Maria Gendron, Debi Roberson, Jacoba Marietta van der Vyver, and Lisa Feldman Barrett. 2014. Perceptions of emotion from facial expressions are not culturally universal: Evidence from a remote culture. *Emotion* 14, 2: 251–262.
 40. Leslie S. Greenberg. 1990. *Emotion in Psychotherapy*. Guilford Press.
 41. Leslie S. Greenberg. 2007. *Emotion-Focused Therapy for Depression*. American Psychological Association, United States.
 42. Leslie S. Greenberg and Sandra C. Paivio. 2003. *Working with Emotions in Psychotherapy*. Guilford Press.
 43. Andreas Haag, Silke Goronzy, Peter Schaich, and Jason Williams. 2004. Emotion Recognition Using Bio-sensors: First Steps towards an Automatic System. In *Lecture Notes in Computer Science*. 36–48.
 44. Nancy A. Hamilton, Alex J. Zautra, and John W. Reich. 2005. Affect and pain in rheumatoid arthritis: Do individual differences in affective regulation and affective intensity predict emotional recovery from pain? *Annals of behavioral medicine: a publication of the Society of Behavioral Medicine* 29, 3: 216–224.
 45. Adam O. Horvath and B. Dianne Symonds. 1991. Relation between working alliance and outcome in psychotherapy: A meta-analysis. *Journal of counseling psychology* 38, 2: 139–149.
 46. D. Huggins-Daines, M. Kumar, A. Chan, A. W. Black, M. Ravishankar, and A. I. Rudnicky. Pocketsphinx: A Free, Real-Time Continuous Speech Recognition System for Hand-Held Devices. In *2006 IEEE International Conference on Acoustics Speed and Signal Processing Proceedings*. <https://doi.org/10.1109/icassp.2006.1659988>
 47. S. Iwakabe, K. Rogan, and A. Stalikas. 2000. The relationship between client emotional expressions, therapist interventions, and the working alliance: An exploration of eight emotional expression events. *Journal of psychotherapy integration*. Retrieved from <http://psycnet.apa.org/journals/int/10/4/375/>
 48. Rachael E. Jack, Oliver G. B. Garrod, Hui Yu, Roberto Caldara, and Philippe G. Schyns. 2012. Facial expressions of emotion are not culturally universal. *Proceedings of the National Academy of Sciences of the United States of America* 109, 19: 7241–7244.
 49. Joan Davidson, PhD, Jacqueline B. Persons, PhD, Michael A. Tompkins. 2007. *Structure of the Therapy Session*. American Psychological Association, United States.
 50. Joan Davidson, PhD, Jacqueline B. Persons, PhD, Michael A. Tompkins. 2007. *Individualized Case Formulation and Treatment Planning*. American Psychological Association, United States.
 51. Joan Davidson, PhD, Jacqueline B. Persons, PhD, Michael A. Tompkins. 2007. *Using the Thought Record*. American Psychological Association, United States.
 52. Eva Kaltenthaler, Glenys Parry, Catherine Beverley, and Michael Ferriter. 2008. Computerised cognitive-behavioural therapy for depression: systematic review. *The British journal of psychiatry: the journal of mental science* 193, 3: 181–184.
 53. Mary Kayyal, Sherri Widen, and James A. Russell. 2015. Context is more powerful than we think: contextual cues override facial cues even for valence. *Emotion* 15, 3: 287–291.
 54. Ronald C. Kessler, Wai Tat Chiu, Olga Demler, Kathleen R. Merikangas, and Ellen E. Walters. 2005. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of general psychiatry* 62, 6: 617–627.
 55. Blair Kidwell, David M. Hardesty, Brian R. Murtha, and Shubin Sheng. 2011. Emotional Intelligence in Marketing Exchanges. *Journal of marketing* 75, 1: 78–95.
 56. K. H. Kim, S. W. Bang, and S. R. Kim. 2004. Emotion recognition system using short-term monitoring of physiological signals. *Medical & biological engineering & computing* 42, 3: 419–427.
 57. J. Klein, Y. Moon, and R. W. Picard. 2002. This computer responds to user frustration: *Interacting with computers* 14, 2: 119–140.
 58. A. Kleinsmith, N. Bianchi-Berthouze, and A. Steed. 2011. Automatic Recognition of Non-Acted Affective Postures. *IEEE transactions on systems, man, and cybernetics. Part B, Cybernetics: a*

- publication of the *IEEE Systems, Man, and Cybernetics Society* 41, 4: 1027–1038.
59. C. G. Kohler, W. Bilker, M. Hagendoorn, R. E. Gur, and R. C. Gur. 2000. Emotion recognition deficit in schizophrenia: association with symptomatology and cognition. *Biological psychiatry* 48, 2: 127–136.
 60. Gordon T. Kraft-Todd, Diego A. Reinero, John M. Kelley, Andrea S. Heberlein, Lee Baer, and Helen Riess. 2017. Empathic nonverbal behavior increases ratings of both warmth and competence in a medical context. *PloS one* 12, 5: e0177758.
 61. Paul Krebs, James O. Prochaska, and Joseph S. Rossi. 2010. A meta-analysis of computer-tailored interventions for health behavior change. *Preventive medicine* 51, 3-4: 214–221.
 62. Ann M. Kring, Sandra L. Kerr, David A. Smith, and John M. Neale. 1993. Flat affect in schizophrenia does not reflect diminished subjective experience of emotion. *Journal of abnormal psychology* 102, 4: 507.
 63. K. Kroenke, R. L. Spitzer, and J. B. Williams. 2001. The PHQ-9: validity of a brief depression severity measure. *Journal of general internal medicine* 16, 9: 606–613.
 64. Kurt Kroenke, Tara W. Strine, Robert L. Spitzer, Janet B. W. Williams, Joyce T. Berry, and Ali H. Mokdad. 2009. The PHQ-8 as a measure of current depression in the general population. *Journal of affective disorders* 114, 1: 163–173.
 65. M. Liberman and Others. Emotional Prosody Speech and Transcripts, Linguistic Data Consortium, 2002, Philadelphia.
 66. Marsha M. Linehan, Bryan N. Cochran, Corinne M. Mar, Eric R. Levensky, and Katherine Anne Comtois. 2000. Therapeutic burnout among borderline personality disordered clients and their therapists: Development and evaluation of two adaptations of the maslach burnout inventory. *Cognitive and behavioral practice* 7, 3: 329–337.
 67. Jeffrey Longhofer. 2015. Working alliance/Therapeutic alliance. In *A-Z of Psychodynamic Practice*. 180–183.
 68. Stacy Marsella and Jonathan Gratch. 2014. Computationally modeling human emotion. *Communications of the ACM* 57, 12: 56–67.
 69. Daniel McDuff, Rana el Kaliouby, Thibaud Senechal, May Amr, Jeffrey F. Cohn, and Rosalind Picard. 2013. Affective-MIT Facial Expression Dataset (AM-FED): Naturalistic and Spontaneous Facial Expressions Collected “In-the-Wild.” In *2013 IEEE Conference on Computer Vision and Pattern Recognition Workshops*. <https://doi.org/10.1109/cvprw.2013.130>
 70. Celso M. de Melo, Peter Carnevale, and Jonathan Gratch. 2011. The effect of expression of anger and happiness in computer agents on negotiations with humans. In *The 10th International Conference on Autonomous Agents and Multiagent Systems - Volume 3 (AAMAS '11)*, 937–944.
 71. R. Mojtabai, M. Olfson, and B. Han. 2016. National Trends in the Prevalence and Treatment of Depression in Adolescents and Young Adults. *Pediatrics* 138, 6: e20161878–e20161878.
 72. Rosalind W. Picard. *Affective Computing*. MIT Press. Retrieved July 31, 2017 from <https://mitpress.mit.edu/books/affective-computing>
 73. Laura A. Pratt and Debra J. Brody. 2014. *Depression in the U.S. Household Population, 2009-2012*.
 74. Helmut Prendinger and Mitsuru Ishizuka. 2013. *Life-Like Characters: Tools, Affective Functions, and Applications*. Springer Science & Business Media.
 75. Kenneth M. Prkachin, Rhonda M. Williams-Avery, Caroline Zwaal, and David E. Mills. 1999. Cardiovascular changes during induced emotion. *Journal of psychosomatic research* 47, 3: 255–267.
 76. S. D. Pugh. 2001. SERVICE WITH A SMILE: EMOTIONAL CONTAGION IN THE SERVICE ENCOUNTER. *Academy of Management journal. Academy of Management* 44, 5: 1018–1027.
 77. Suzanne M. Retzinger. 1995. Identifying Shame and Anger in Discourse. *The American behavioral scientist* 38, 8: 1104–1113.
 78. Renee H. Rhodes, Clara E. Hill, Barbara J. Thompson, and Robert Elliott. 1994. Client retrospective recall of resolved and unresolved misunderstanding events. *Journal of counseling psychology* 41, 4: 473.
 79. Charles Rich and Candace L. Sidner. 1998. COLLAGEN: A Collaboration Manager for Software

- Interface Agents. In *Computational Models of Mixed-Initiative Interaction*. 149–184.
80. Lazlo Ring, Barbara Barry, Kathleen Totzke, and Timothy Bickmore. 2013. Addressing Loneliness and Isolation in Older Adults: Proactive Affective Agents Provide Better Support. In *2013 Humaine Association Conference on Affective Computing and Intelligent Interaction*.
<https://doi.org/10.1109/acii.2013.17>
 81. Lazlo Ring, Timothy Bickmore, and Paola Pedrelli. 2016. Real-Time Tailoring of Depression Counseling by Conversational Agent. *Iproceedings 2*, 1: e27.
 82. Lazlo Ring, Timothy Bickmore, and Daniel Schulman. 2012. Longitudinal Affective Computing. In *Lecture Notes in Computer Science*. 89–96.
 83. Lazlo Ring, Lin Shi, Kathleen Totzke, and Timothy Bickmore. 2014. Social support agents for older adults: longitudinal affective computing in the home. *Journal on Multimodal User Interfaces 9*, 1: 79–88.
 84. Linda Rueckert and Nicolette Naybar. 2008. Gender differences in empathy: the role of the right hemisphere. *Brain and cognition 67*, 2: 162–167.
 85. James A. Russell, Anna Weiss, and Gerald A. Mendelsohn. 1989. Affect Grid: A single-item scale of pleasure and arousal. *Journal of personality and social psychology 57*, 3: 493–502.
 86. Shekhar Saxena, Graham Thornicroft, Martin Knapp, and Harvey Whiteford. 2007. Resources for mental health: scarcity, inequity, and inefficiency. *The Lancet 370*, 9590: 878–889.
 87. Marc Schröder. 2010. The SEMAINE API: Towards a Standards-Based Framework for Building Emotion-Oriented Systems. *Advances in Human-Computer Interaction 2010*: 1–21.
 88. Daniel Schulman and Timothy Bickmore. 2009. Persuading users through counseling dialogue with a conversational agent. In *Proceedings of the 4th International Conference on Persuasive Technology - Persuasive '09*. <https://doi.org/10.1145/1541948.1541983>
 89. D. A. Shapiro, M. Barkham, A. Rees, G. E. Hardy, S. Reynolds, and M. Startup. 1994. Effects of treatment duration and severity of depression on the effectiveness of cognitive-behavioral and psychodynamic-interpersonal psychotherapy. *Journal of consulting and clinical psychology 62*, 3: 522–534.
 90. Cleveland G. Shields, Ronald M. Epstein, Peter Franks, Kevin Fiscella, Paul Duberstein, Susan H. McDaniel, and Sean Meldrum. 2005. Emotion language in primary care encounters: reliability and validity of an emotion word count coding system. *Patient education and counseling 57*, 2: 232–238.
 91. Gabriel Skantze. 2005. Exploring human error recovery strategies: Implications for spoken dialogue systems. *Speech communication 45*, 3: 325–341.
 92. Charles D. Spielberger. 2010. State-Trait Anxiety Inventory. In *The Corsini Encyclopedia of Psychology*.
 93. Anthony L. Suchman. 1997. A Model of Empathic Communication in the Medical Interview. *JAMA: the journal of the American Medical Association 277*, 8: 678.
 94. Marie Tahon, Gilles Degottex, and Laurence Devillers. 2012. Usual voice quality features and glottal features for emotional valence detection. In *Speech Prosody 2012*. Retrieved from <https://pdfs.semanticscholar.org/a656/8f1c1ca3474e5ea326b44fc73907ec24a766.pdf>
 95. Rdc Team. 2011. R Development Core Team: R: a language and environment for statistical computing. Vienna: R Foundation for Statistical Computing; 2011.
 96. Edward Bradford Titchener. 1909. *Lectures on the Elementary Psychology of Feeling and Attention*. Macmillan.
 97. Fabien Trémeau, Dolores Malaspina, Fabrice Duval, Humberto Corrêa, Michaela Hager-Budny, Laura Coin-Bariou, Jean-Paul Macher, and Jack M. Gorman. 2005. Facial expressiveness in patients with schizophrenia compared to depressed patients and nonpatient comparison subjects. *The American journal of psychiatry 162*, 1: 92–101.
 98. Laura Pfeifer Vardoulakis, Lazlo Ring, Barbara Barry, Candace L. Sidner, and Timothy Bickmore. 2012. Designing Relational Agents as Long Term Social Companions for Older Adults. In *Lecture Notes in Computer Science*. 289–302.
 99. Ning Wang, W. Lewis Johnson, Richard E. Mayer, Paola Rizzo, Erin Shaw, and Heather Collins.

2008. The politeness effect: Pedagogical agents and learning outcomes. *International journal of human-computer studies* 66, 2: 98–112.
100. Xinyu Wang, Chunhong Zhang, Yang Ji, Li Sun, Leijia Wu, and Zhana Bao. 2013. A Depression Detection Model Based on Sentiment Analysis in Micro-blog Social Network. In *Lecture Notes in Computer Science*. 201–213.
101. Bernard Weiner. 1980. The Role of Affect in Rational (Attributional) Approaches to Human Motivation. *Educational researcher* 9, 7: 4.
102. K. B. Wells, M. C. Benson, and P. Hoff. 1985. A model for teaching the brief psychosocial interview. *Journal of medical education* 60, 3: 181–188.
103. David M. Williams, Shira Dunsiger, Ernestine G. Jennings, and Bess H. Marcus. 2012. Does affective valence during and immediately following a 10-min walk predict concurrent and future physical activity? *Annals of behavioral medicine: a publication of the Society of Behavioral Medicine* 44, 1: 43–51.
104. Jing Zhai and A. Barreto. 2006. Stress detection in computer users based on digital signal processing of noninvasive physiological variables. *Conference proceedings: ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Conference* 1: 1355–1358.
105. Mingmin Zhao, Fadel Adib, and Dina Katabi. 2016. Emotion recognition using wireless signals. In *Proceedings of the 22nd Annual International Conference on Mobile Computing and Networking - MobiCom '16*. <https://doi.org/10.1145/2973750.2973762>
106. moodgym CBT training program. Retrieved July 31, 2017 from <https://moodgym.com.au/>
107. Beating the Blues USTM - Computerized cognitive behavioral therapy (CBT) program from U2 Interactive. Retrieved July 31, 2017 from <https://www.beatingthebluesus.com/>