Leveraging Adaptive Sessions Based on Therapeutic Empathy Through a Virtual Agent

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1 STAGE OF THE RESEARCH

This document describes the work under development as part of a PhD Thesis carried out in the context of the European Project "**Help4Mood – A Distributed System to Support the Treatment of Patients with Major Depression**" (www.help4mood.info) [FP7-ICT-2009-4; 248765]. Help4Mood aims to support the treatment of patients with Major Depression using Information and Communications Technology (ICT). The resultant Personal Health System (PHS) of Help4Mood uses a set of activity sensors (such as wrist watch, key ring, or under-mattress sensor) that gather information about the daily physical and sleep activities from the patient. This information and other data obtained through standardized questionnaires are analysed in order to infer some recommendations (or alerts) and offer adaptive and tailored tasks as part of the treatment in the form of daily interactive sessions provided by a Virtual Agent (VA).

The initial developed work for the project resulted in the MSc Thesis entitled "**Generic Data Processing & Analysis Architecture of a Personal Health System to Manage Daily Interactive Sessions in Patients with Major Depression**" (Bresó, 2013) within the Artificial Intelligence, Pattern Recognition and Digital Imaging MSc program at the Technical University of Valencia. In this MSc Thesis, the author describes the design and the implementation of the Data Processing & Analysis layer of the Help4Mood's PHS. It had been conceived as the module responsible to analyse relevant patient's data, plan the daily interactive sessions and recommend a set of tailored activities configured by clinicians that help in the recovery of the patient. Additionally, this system included an initial cognitive-emotional module aimed to infer the specific set of emotions to be displayed by the VA during the interaction

The research work presented in this document is an extension of the work done in the MSc's Thesis. The proposed extension will allow a deeper research on how to improve current Human-Agent Interactions particularly addressed to users that are under treatment of Major Depression. Some theories in the areas of psychology and cognitive science will be the basis of a computational model that is expected to improve the production of the daily session's content and the adequate –emotional– fashion for a better engagement of the users promoting the long-term use of the system.

2 OUTLINE OF OBJECTIVES

The proposed research work is focused on the improvement of the treatment adherence and the user acceptability through two main contributions in the computer-based psychotherapy:

1. Get a modular and flexible computational architecture to improve Human-Agent Interactions during the daily sessions provided as part of treatment to patients with Major Depression.
2. Encourage the system's realism and reliability through the generation of VA's empathic responses based on a modelling of Therapeutic Empathy.

3 RESEARCH PROBLEM

Depression is expected to be the disorder with the highest disease burden in high-income countries by the year 2030 (WHO, 2012). Patients with Major Depression should follow a specific and continued treatment based on therapeutic sessions (and/or drugs) and evaluations to treat the illness and achieving recovery and prevent future relapse (Vittengl, 2007). The lengthening of treatment and relapses increases the healthcare resources and the healthcare costs, and reduces the quality of life in the patients.

The magnitude of the lack of therapeutic adherence is estimated close to 50% in patients with chronic diseases (Sabatâe, 2003). In particular, non-adherence in psychiatric disorders is 75% (Rigueira, 2001). The benefits of the therapy are drastically diminished due to the lack of adherence (Sotoca-Momblona, 2006). Despite the wide range of studies on interventions to improve adherence to treatment (DiMatteo, 1993; Dulmen, 2007; Sabatâe, 2003; Coombs, 2003; Katon, 1996; Thompson, 2012), there is no clear evidence on the effect to promote compliance or clinical parameters (Márquez, 2001; Rigueira, 2001).

Currently, the use of ICT in mental health is fairly new and there are open questions and challenges to effectively apply it. In particular, patients with Major Depression often have associated a distorted and negative thinking which makes them prone to suffer anxiety when interacting with computer systems (Safford, 1999). Much effort is needed to develop systems that can be widely accepted and improve the adherence to computer-based psychotherapy.

4 STATE OF THE ART

4.1 Human-Agent Interaction in Mental Health

The development of Human-Agent Interactions (HAI) applied to Mental Health is a difficult task because many of the content in therapeutic sessions are related with personal issues (e.g. thoughts, emotions and feelings). Therefore, a feasible computer-based psychotherapy must gain an acceptable level of trust from the patient. Particularly important is the content of the message disclosed to the patient, and the way in which the VA displays the message.

Systems based on VA have evolved greatly over the past two decades, improving the interactions with users. Many studies have demonstrate the utility of using VAs for training and learning purposes (Core, 2006; Martínez-Miranda, 2008; Castellano, 2013), and games (Gebhard, 2008; Mateas and Stern, 2003; Andrist, 2013).

Regarding the health context, we can find systems that train clinicians (Raij, 2007; Kenny, 2007), control patient adherence to medication (Bickmore and Pfeifer, 2008), and promote physical exercise (Bickmore, 2006). There are also works applied to mental health, as the system that support patients with phobias (Krijn, 2004; Brinkman, 2008), post-traumatic stress disorder (Rizzo and Josep, 2011), systems aimed at children with autism (Tartaro and Casell, 2008; Bernardini, 2013), support interventions to reduce alcohol consumption (Yasavur, 2013) or systems that implements standardized questionnaires in order to treat depression (Pontier and Siddiqui, 2008).

Although initial results are promising, much effort is still needed to develop systems in which human-agent interactions are widely accepted for its use in computer-based psychotherapeutic interventions. Initiatives such as the developed in the project Help4Mood would never be able to replace psychotherapists with the same level of competences, but may become essential tools to offer personalized and remote support on daily basis during the treatment. The key lines of research in Help4Mood include the mechanism for the planning of the daily sessions, the generation of the verbal and nonverbal behaviour in the VA, and the continuous collection of physical and sleep activities from the patient through a monitoring system. Taking the particular characteristics of the addressed users, the Human-Agent ·Interactions need to be carefully designed to avoid counter-productive effects in the target users.

Our proposal, as part of the PhD Thesis is the construction of a computational model that improve the current developed system through the generation of better adaptive sessions regarding to patient's condition and the production of an adequate emotional behaviour in the VA that simulates therapeutic empathy reactions during the interaction with the user.

4.2 Treatment Adherence

Treatment adherence was defined by World Health Organization (WHO) in 2001 as "*the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider*".

Accurate assessment of adherence behaviour is necessary for effective and efficient treatment planning, and for ensuring that changes in health outcomes can be attributed to the recommended regimen. Adherence may be measured using either process-oriented or outcome-oriented definitions. Outcome-oriented definitions use the end-result of treatment, e.g. cure rate, as an indicator of success.

Process-oriented indicators make use of intermediate variables such as appointment-keeping or pill counts to measure adherence.

There are some variables which researchers are studying in order to determine if they are influencing the treatment adherence. Neil et al. (Neil, 2009) investigated personal predictors of adherence in people who use a Cognitive Behaviour Therapy website. Neil et al. (Neil, 2009) found to be associated with increased adherence were lower baseline rates of depression, younger age, female gender, and less knowledge of psychological treatments. Regarding the factors that an ICT solutions can influence in the treatment adherence, we can found reviews on treatment adherence based on "***Interventions on technical solutions***" (Yildiz, 2004) which are aimed at simplifying the medication regimen in order to improve the adherence. Other are based on "***Educational interventions***" (Vergouwen, 2003) which are aimed at informing the patient about the disease and the treatment in order to empower him to take a more active participation in disease management. Some others are based on "***Behavioral interventions***" (Yildiz, 2004; Pampallona, 2002) such as alerts and reminders to improve adherence.

Regarding the interventions on technical solutions, the treatment complexity has been identified as a cause of poor adherence. It may be considered therefore reasonable to think that interventions aimed at simplification would improve compliance (Orueta, 2005). Therefore, treatment must be customized and adapted to the daily needs of the patient and should be less invasive as possible.

The educational interventions strategies that increase knowledge about the disease and treatment seem necessary, but not sufficient to change behaviour regarding adherence (Orueta, 2005). However, other studies focused on schizophrenia claim that psycho-educational interventions have no effect on adherence (Dolder, 2003; Zygmunt, 2002; Lincoln, 2007). In depression studies are less numerous and with inconclusive results.

Additionally, the systems which provide information and education about the disease, get empower patients. The most relevant for obtain the expected therapeutic results factor is the quality of the doctor-patient communication (Márquez, 2001; Donovan, 1997; Thompson, 2012). In the psychological domain, good communication is achieved through active listening and **therapeutic empathy**.

Health care providers must understand behaviour change as part of an interpersonal process. Effective behavioural interventions involve the actions that help the patients to become responsible for their own decisions and self-care behaviours. This behaviour change can be reflected into an increment of treatment adherence. ICT solutions can contribute to this change through reminders, alerts, recommendations, self-reflection, or the planning of routines (Delamater, 2006). Specifically, in the treatment of major depressive disorders, psychologists use several tools such as self-reflection techniques that may improve psychological outcomes (Delamater, 2006).

It is easier to make assessments of adherence when drug treatment is performed (e.g. by applying, Directly-Observed Therapy (DOT)). But when treatment involves psychotherapeutic sessions, the assessment is often made through comparisons about Treatment Adherence Therapy (TAT) (Staring, 2006) versus Treatment As Usual (TAU) as control group (Staring, 2010; Gilden, 2011) or using questionnaires (Titov, 2013; Lin, 2012).

5 METHODOLOGY

The main hypothesis under research in this thesis is that "T*he use of a computational model that plans personalized daily sessions and generates appropriate empathic responses will improve the adherence in depressed patients avoiding an early discontinuation of the treatment, which can result in new episodes or relapses into major depression*".

The following sections outline the proposed experiments and methodologies designed to address the proposed hypothesis.

5.1 Adaptive and Flexible Daily Session Planning

We are extending the generic and flexible session planner implemented in the previous MSc. Thesis (Bresó, 2013). The session planner is able to process and analyse data from different sources (activity sensors, demographical data, questionnaire scores, etc.) in order to infer the patient's condition and generate an appropriate set of more than 10 tasks (such as the collection of speech patterns, the negative thoughts reflexion activity, sleep questionnaire, or daily mood check questionnaire) as part of the treatment. For instance, when the patient answers the Patient Health Questionnaire (PHQ-9), the system infers and updates the patient's depression level. If the system detects a health deterioration compared to historical values, the system will provide a message for the patient to contact clinical staff and switch the system to the "*emergency mode*". In this mode the system will plan only a basic set of essential tasks specified by the clinicians. A complementary example is when the system detects a critical situation such as suicidal risks. This situation can be inferred from different questionnaires. When it is inferred, the planning of the system is stopped and only one task will be planned: "*crisis plan*" task, which will try to calm and inform the patient about local emergency telephones to contact for assistance.

All defined tasks are managed in order to generate an adaptive daily session which is used by the VA as the core content to communicate with the users. In this sense, we are working to improve the treatment adherence as follows:

- **Interventions based on improved technical solutions:** Future sessions may be more personalized and suitable to patient's condition in order to reduce the complexity of the treatment. This personalization will be carried out by improving the analysis of patient activity data for the patient to estimate objectively the patient's condition and expanding the set of activities available to make more suitable recommendations. The more tasks we add to the system, more variability and more personalization can be done. For instance, the system should be able to automatically adjust the length of the session to patient stamina level in order to the patient does not get tired. Currently we are obtaining the patient stamina level subjectively through a direct question: "*What length of session you prefer (short/medium/long)?*". We are working in order to infer the stamina level from the trend of the past sessions and from gathering activity data.
- **Educational interventions:** The system provides a full weekly report which contains the patient progress and the highlights values. We would add some psycho-educational tasks such as those used to inform the patient about recommendations on good habits. For instance, if the system analyses the data acquired from mattress sensor device and from sleep questionnaire and it detects a disturbance in sleep, the system should provide information related to healthy rest and sleep tips.
- **Behavioural interventions:** Currently, the system alerts the patient when he/she is not using the system or the sensors devices. We plan to generate more sessions with content-related alerts or recommendations such as "*You reject this suggested activity twice, are you sure that you want to reject it again?*" Additionally, we are defining a behaviour activation task in order to suggest (and check its execution) the patient with a set recommended activities such as walking or socializing. Other interesting task that we are implementing is the relaxation task, in which the patient listen a set of relaxing exercises in order to facilitate relaxation and self-reflection.

Currently, some of the tasks defined in the system are based on Cognitive Behaviour Therapy (CBT) (Gray et al., 2002), which have demonstrated high adherence because it uses effective cognitive and behavioural strategies to motivate patients to complete homework, modify their maladaptive thinking and behaviour, and solve problems on their own (Safren, 2012).

Clinicians can configure the available set of tasks, their frequency, constrains and priorities in order to customize the system to different clinical centres, patients or different stages of the treatment. This Planner is implemented using a (1) Rule Based System (RBS) running with the JESS engine (http://herzberg.ca.sandia.gov/) and a (2) planning algorithm that we have developed.

The rule based system allows to generate the inference of a clinically adequate set of suggested tasks. The easy replacement of the set of rules gives the flexibility to adapt the planner to different clinical domains such as other mental disorders (anxiety, phobias, panic, or bipolar). The current rules are codding the clinical preferences of the clinician staff involved in the project but it is also able to code rules from clinical guidelines. Finally, our designed architecture infers clinical concepts (using SNOMED-CT terminology) in order to store valuable information for clinical research purposes. Most of these concepts have been inferred from the analysis of the activity sensor data (e.g. "*Restless*" and "*Activity Sleep Time*").

Regarding the planning algorithm, it is in charge of planning a personalised daily patient session based on clinical specifications (frequencies, constrains, etc.), historical tasks executions, currently user responses, and the level of stamina.

5.2 Therapeutic Empathy Responses

The modelling of *emotional competence* in virtual agents is an active research area where theoretical, technical, and ethical considerations need to be addressed. There are currently some computational models of emotion developed to cover specific components of the emotional phenomenon.

The selection of a specific emotion theory as the basis of a computational model depends on the aspects of emotion that the computational model tries to represent. From the current existent theories of emotion, the one that predominates above the others in the efforts dedicated to implement computational models of emotions is the cognitive appraisal theory of emotions (Lazarus, 1991; Scherer, 2001). The core concept of appraisal theories refer that the events in a person's environment are constantly identified and evaluated by the individual. This cognitive evaluation (or appraisal) process leads to an emotional response (according to the event's relevance for the person) which in turn generates a specific behaviour to cope with the appraised events.

In the context of the Help4Mood project and in the subsequent MSc's Thesis (Bresó, 2013), we developed a Cognitive-Emotional module which is responsible to produce emotional responses in the VA during the interaction with the user. This module has been developed as a stand-alone Java application which makes use of the FAtiMA (FearNot Affective Mind Architecture) software libraries (http://sourceforge.net/projects/fatima-modular/) (Dias, 2011). FAtiMA is one of the existent (appraisal theory based) computational architecture of emotions which its initial objective was the creation of empathic agents interacting in a virtual environment to tackle and eventually help to reduce bullying problems in schools.

With the use of FAtiMA, the emotional behaviour of a virtual agent has been generated through the authoring (in a XML-based format) of their *emotional reactions*, *action tendencies*, *goals* and *actions* based on the detection and appraisal of the events occurred in the agent's environment. The environment of the VA in Help4Mood is basically composed from all the data received (directly and indirectly) from the user. These data include the objective user's information collected through the sensor devices (i.e. actigraphs to identify sleep and physical activity patterns) and the subjective self-reported information through standardised questionnaires. All this information is interpreted and transformed into the specific events used as the input to the cognitive emotional module. The received events will produce the specific VA's emotional behaviour during the interaction with the user according to the specific goals, emotional reactions and action tendencies defined as the internal state of the VA.

The detection and appraisal of the events produced in the VA's environment lead to the selection of specific dialogues which are jointly used with some facial expressions to display the emotional behaviour in the VA. When an event is appraised as desirable for the VA (e.g. the daily logging of the user into the system facilitating the VA's goal related to maintain a good level of adherence in the patient) or desirable for the patient's well-being (e.g. good self-reports about moods or thoughts) positive emotions are generated in the VA. These emotions will disclose specific utterances that complement the VA's feedback dialogues such as "*Thanks for logging in today, I am happy to see you again*" or "*Great! I'm glad to hear that*". Negative emotions are produced when the detected events are appraised as not desirable for the VA or the patient, which in turn produce feedback such as "*I'm sorry to know that"* or "*That's not really good"*.

The displaying of negative emotions when interacting with people recovering from depression should be addressed carefully. In this sense, one of the research lines proposed in this PhD is an extension of the current implemented cognitive-emotional module to better cope with the negative situations reported or detected in the patient. A key difference in the empathic behaviour of the Help4Mood's VA regarding the original application of FAtiMA is that the empathic responses (aimed to be displayed through the dialogue content and some facial expressions) needs to be modulated according to the special characteristics of the target users. Our VA must not display a "*pure emotional*" empathic behaviours by adopting the same typically negative mood of the patient. The disadvantage is that these behaviours can be interpreted as sympathetic expressions of condolence that may imply a sense of unintended agreement with the patients (negative) views (Clark, 2007). What is most beneficial from a clinical perspective is not to produce *"only"* natural empathic reactions as response to the patient's input, but to generate *therapeutic-empathy* responses in the agent.

It is important to distinguish natural empathy (experienced by people in everyday situations) from therapeutic empathy in order to provide the patients with useful feedback for their particular condition. One of the differences between natural and therapeutic empathy is the "*addition of the cognitive perspective-taking component to the emotional one; the cognitive component helps the therapist to conceptualize the client's distress in cognitive terms*" (Thwaites, 2007). That means that a therapist should "*assume both the role of an emotional involvement in an interview with a patient and an* *emotional detachment that allows for a more objective appraisal*" (Clark, 2007).

The extension proposed for the VA's cognitive-emotional module is focused in the modelling of a perspective-taking component aimed to produce in the VA the required emotional detachment or emotional distance at specific stages of the interaction with patients with major depression. The main idea is the implementation of some strategies for emotion regulation as defined in (Gross, 2007). One of these strategies is the cognitive change (through the re-appraisal process) used to assess with a different (more positive) perspective a particular event. This reappraisal mechanism will be integrated as an extension of the FAtiMA architecture.

When a new event is received from the environment a prospective appraisal will be executed to assess if the event derives from a desirable or undesirable situation in terms of the VA's goals. The result of this prospective appraisal is the projection of the potential emotional state produced by this event. In other words, our model "simulates" the appraisal and affect derivation processes to analyse the emotional consequences of the current situation, but without producing the full-blown emotional responses. If the projected emotional state includes the activation of a negative emotion with intensity greater than a pre-defined maximum threshold, the corresponding pre-defined alternative event(s) is selected for reappraisal which would construct a more positive meaning of the original situation.

An example of this process is when the patient is reporting a *low mood* during the today session. The VA can appraise this event as highly undesirable for the patient's condition generating a strong negative emotion. The new reappraisal component can change the meaning of this situation using an alternative view. In the example, the VA can analyse the results obtained in the mood questionnaire during previous sessions (stored in the model of the patient) and check whether these results show a positive tendency in the patient's condition during the past days. If a positive tendency is found, the original event would be reappraised as "not much undesirable" to the patient (thought the current level of patient's mood is not the optimal). This reappraisal can change the emotional state or the emotion's intensity in the VA which is reflected in the feedback provided to the patient, something like "*Ok, it seems that your current mood is not very good, but in general terms you are making good progresses in the last days*".

This proposed extension of the emotional responses is expected to improve the VA-patient interaction and increase the patient engagement, and therefore contribute with the adherence to the treatment.

5.3 Clinical Pilots

There are planned 3 incremental pilots (see Table 1) to evaluate the Help4Mood system in three European clinical centres: (1) The Clinical Centre of Psychology and Psychotherapy at the University of Babes-Bolyai (Cluj-Napoca), (2) the Health Foundation of Sant Joan de Deu (Llobregat, Bacelona), and (3) the Centre for Population Health Sciences, University of Edinburgh (Edinburgh, UK).

Table 1: Help4Mood pilots.

Pilot	Country	Patients	Tasks	Days
1	Edinburgh	5	1	7
2	Cluj-Napoca	4	5	15
3	Catalonia	>10	>5	>15
3	Edinburgh	>10	>5	>15
3	Cluj-Napoca	>10	>5	>15

The first and second one has already been performed, the third one is under development and it is planned the first semester of 2014. The last pilot will include the new developments that are described in this paper. So the final testing results will evaluate the work carry out in this PhD Thesis.

At the end of each pilot the clinicians administer a personal interview to the patients in order to obtain data about acceptability for each of the system's components.

5.4 Statistical Analyses

The gathering data from all these pilots will be analysed to test our main hypothesis and study 3 factors: (1) **system usage**, (2) **system engagement**, and (3) **adherence to the treatment.** .

A clinical requirement is that the system must be used daily, so we can check in system logs the patient logins in order to obtain the system usage. Additionally, clinicians set the minimal and maximal executions of each task to be offered to the user. In the first pilot, only one task was configured, which should be performed once per day during the seven days of the system's use. In the second pilot, clinicians establish 5 tasks (see Table 2). In order to obtain the adherence to the treatment, we calculated the ratio between the maximal executions established by clinicians with the number of tasks completed by the user using the system.

Table 2: Minimum and Maximum number of weekly executions in each task during the second pilot.

Task	Minimum number of executions per week	Maximum number of executions per week
Daily Mood Check Questionnaire	7	7
Speech Activity	3	5
Patient Health Questionnaire (PHQ-9)	1	1
Sleep Questionnaire	0	7
Negative Thought Questionnaire	3	7
Total	**14**	**27**

System engagement is measured based in the length (Long, Medium, Short) of the daily session selected by the patient. The choice of long sessions suggests greater involvement and motivation. On the other hand, the selection of short sessions suggested little engagement and commitment.

5.5 Initial Outcomes

The system was tested in two incremental pilots. The first one was carried out in Edinburg during 7 days with 5 patients in 2013. In this version, the system only offered a Daily Mood Check questionnaire.

The results of this first pilot (see Table 3) showed a 100% of system usage and treatment adherence in 4 patients, and 71% in one patient. The results related with the treatment adherence are the same than the results of system usage due that only one task was possible to be used. If the patient accessed the system, he performed the activity. If not, he could not do the task and he could not get it back another day. In this first pilot it was not possible to clearly measure the patient engagement due to the same reason that only one task was proposed every day, so the patient was not offered with the selection of the session's length.

Table 3: Assessment of the patient system usage (%) and adherence to the treatment (%) in pilot 1.

	P1	P2	P3	P4	P5	AVG
System usage	1	0.71	1	1	1	0.942
Treatment Adherence	1	0.71	1	1	1	0.942

The second pilot was carried out in Cluj-Napoca during 15 days with 4 patients in 2013. This version was more complete. The system could plan 5 different tasks and allow the user to select the length of the sessions. The results for the second pilot are showed in the following tables:

Table 4: Assessment of the patient system usage (%) and adherence to the treatment (%) in pilot 2.

	P1	P2	P3	P4	AVG
System usage	1	0.6	1	0.87	0.87
Treatment Adherence	0.77	0.51	0.88	0.72	0.72

In the second pilot, the treatment adherence is lower than in pilot 1. Patients were requested to perform a minimum of 28 activities in 15 days and a maximum of 54 (optimal result that we take as a reference to calculate the treatment adherence). Additionally, patients could select the length of the session that allows us to analyse the patient engagement to the system (see Table 5). Patient P2 had a low system usage (60%), so adherence was also low (35%). The patients P1 and P3 got a 100% use of the system. Regarding adherence, they presented different results. This is due to the selection of each patient in the length of the conducted sessions. P1 selected mainly short sessions, while P3 selected long sessions. Similarly, P4 has less system usage than P1 but has almost the same treatment adherence. That is because P4 has made many more long sessions than P1, so P4 was able to complete more tasks.

Table 5: Assessment of the patient engagement (%) in pilot 2, based on type session selection (long, medium, or short).

	P1	P2	P3	P4	AVG
Long selection	0.13	0.625	0.7	0.45	0.48
Medium selection	0.2	0.125	0.2	0.0	0.13
Short selection	0.66	0.25	0.1	0.54	0.39

The results obtained from these two pilots inform us about the trends of the use of the system, the treatment adherence, and patient engagement. The low number of patients evaluated has been a limitation of the study. In any case we started to analyse the correlation between system usage, treatment adherence and patient engagement. We expect that the patient engagement can be improved in order to obtain better results than the results presented in Table 5 through the new contributions described in this document. This improvement could affect in the treatment adherence even when the system usage remains low.

Regarding the exit interview of the patient with the clinician, the results obtained showed different results. Some patients thought that the system plans too long sessions, other described that sessions are appropriate and others that there are too short sessions.

Additionally, the patients of the pilot 2 were asked about how much empathic was the virtual agent. Two patients thought that the VA was empathic and correct. In contrast, the third patient answered that sometimes the VA was not really empathic.

6 EXPECTED OUTCOME

The new contributions described in this document (extension of the Session Planner and Cognitive-Emotional module) will be implemented and evaluated in the final pilot. We expect to obtain more data that allow us to asset better conclusions about the patient engagement and adherence regarding our developed system.

In the long run, future pilots should include patients control groups in order to compare the obtained results between those patients that used the system and those patients with the treatment that does not include the use of the system. This would help to conclude whether the use of our system influenced and improved the adherence to the treatment.

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