



# MHeVA - Mental Health Virtual Assistant for High Education Students

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## ABSTRACT

Current Higher Education Institutions' mental health support systems lack the capabilities to cope with the growing need and demand for mental health support from students. We introduce MHeVA – Mental Health Virtual Assistant – which was designed with the goal of creating an intelligent virtual agent that could serve as a first-line diagnostic-aid tool for mental health services across universities and faculties. Students interact with the agent which attempts to establish rapport and promotes disclosure through mental health state evaluation questions. In addition to this, MHeVA has the ability to assess self-reported anxiety levels, provide health improvement tips and flag the most severe cases.

In order to evaluate the agent's effectiveness, a user study was conducted that measured self-disclosure, rapport building, anxiety levels and stigma mitigation. Our findings suggest that MHeVA was able to elicit self-disclosure in higher education students and achieved high levels of acceptance and engagement.

The work presented further supports the potential benefits of using IVAs to encourage self-disclosure and to be integrated into existing mental health care systems.

## KEYWORDS

Virtual Agents, Rapport, Disclosure, Mental Health

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## 1 INTRODUCTION

Mental health organizations around the globe have reported that High Education Institutions (HEIs) are facing higher and higher rates of mental health issues in their students [1–3]. These issues are aggravated by the fact that the demand far exceeds the resources available. Support services on campus are simply unable to provide quick and consistent access to professional psychologists for every student [4]. Furthermore, the stigma that is associated with somebody seeking psychological help, which is particularly present within the student community, further exacerbates this issue, leading students to avoid seeking professional help, due to fear of judgement from their peers [5].

Numerous studies have shown that digital mental health tools, such as chatbots, social agents, serious games and mobile apps can be effective methods to mitigate depression and anxiety issues, particularly in low-resource settings [6, 7]. *Woebot* and *Wysa* are examples of automated conversational agents designed to deliver cognitive-behavioural therapy to individuals experiencing mild-to-moderate mental health issues. Recent years have seen the market become over-saturated with these types of applications. In 2014, the World Health Organization [8] estimated that one-fourth of over 15,000 mobile health (mHealth) apps were focused on mental health issues such as anxiety, schizophrenia, post-traumatic stress disorder (PTSD), eating disorders and addictions. However, very few of those have actually been tested or validated [9].

In this work we present a mental-health-focused intelligent virtual agent, developed in collaboration with the mental health experts of Instituto Superior Técnico<sup>1</sup>, that is designed to be used in a High Education Institution context. Its objective is not to replace clinicians or mental health providers but to be used as a tool for mental health offices within universities to use. In addition, a user study was conducted to evaluate its efficacy in developing rapport and promoting self-disclosure.

## 2 MENTAL HEALTH VIRTUAL ASSISTANT

MHeVA is designed to be an easy-to-access, intelligent social agent that is capable of interacting with students at any time and at any

<sup>1</sup><https://tecnico.ulisboa.pt/en/>

place. The agent strives to identify possible mental health issues, advises students on how to best deal with them and signals mental health support infrastructures in severe cases.

The agent's reasoning and decision-making were created using FAtiMA-Toolkit<sup>2</sup>, a collection of tools designed to be used in tandem for the creation of cognitive agents with socio-emotional skills [10]. MHeVA was designed to behave around two different strategies with distinct objectives:

- **Creating Rapport:** With the objective of developing a therapeutic relationship with patients, therapists employ a collaborative model of communication which establishes rapport and the sharing of personal experiences [11]. When employed, this strategy influences MHeVA to use two different types of exchanges that have proven to be effective [12]; courteous conduct (honesty, civility, empathy) and information-sharing behaviour (offering advice, sharing knowledge, asking questions). For example, the agent tries to exchange names at the start of the interaction so that it can refer to the student by their name throughout the course of the interaction. This is a factor that can have a positive effect on the user's perception of an agent. This process is believed to be essential for a successful intervention [13].
- **Obtaining Self-Disclosure:** When dealing with mental health issues, psychologists strive to obtain truthful information from their patients, to better understand the problems that affect them. Eliciting self-disclosure is a challenge itself due to a wide array of factors such as fear of self-disclosure, fear of judgement and privacy concerns [14]. When employed, this strategy focuses on using dialogue that meets three requirements that promote this capacity in IVAs [15]: Trust, Credibility, and Listening and Reaction Skills.

## 2.1 Dialogue

The interaction between MHeVA and students was designed to be a one-on-one interview, where MHeVA acts as an interviewer. The sensitive subject matter led to an intended limitation of the variety of answers. Human interactors reply to MHeVA's questions by selecting from a range of options presented to them, except in a few sets of open questions. This approach was guided by mental health experts and maximised control and allows for a more systematic diagnostic system. To achieve our goals a dialogue tree was created.

For each question, interactors are presented with a representative range of options that strive to be the most truthful and honest. Additionally, for each prompt, throughout the whole interaction, students may choose to not answer it, replying with, for example, "I don't feel comfortable answering this question". Mental health interviews should never "force" an answer from the interviewee, patients should only disclose information of their own accord [16].

With the objective of increasing the variety, range and adaptability of the student's answers, the dialogue tree gained a number of ramifications, sub-trees. Each is designed to provide the agent with the ability to navigate through different subjects of conversation and avoid abrupt topic changes or jumps to previously established socially sanctioned topics [17]. Each sub-trees revolves around a

main topic but also contains follow-up questions, reactive responses and informative feedback about mental health.

In total, 9 different dialogue trees were created, with 400 different utterances. It is important to note that when each sub-tree was completed, MHeVA reevaluates its goals and readjusts its strategy. There are three types of sub-tree, excluding the introductory ones, that are connected by the main sub-tree hub, where the main decision-making processes are executed:

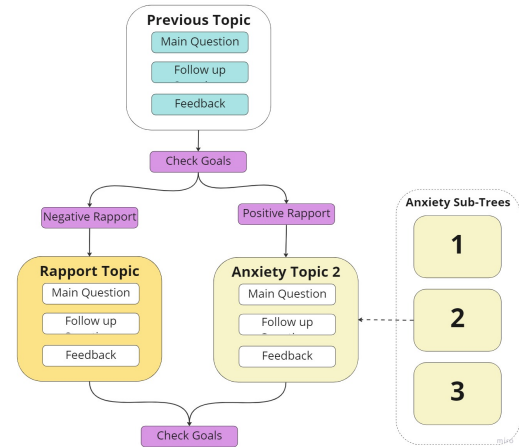


Figure 1: Sub-tree dialogue system

- **Rapport sub-tree.** A total of three sub-trees with day-to-day topics that focus on information sharing and rapport building. If the user shares information during these topics, MHeVA will increase the perceived rapport.
- **Anxiety sub-tree.** A total of six sub-trees focused on obtaining information about the user's anxiety levels, with the following issues: (1) Recent tiredness, (2) Feeling something bad and inexplicable is about to happen, (3) Recent feelings of nervousness, (4) Frequency of getting upset, (5) Anxiety attacks and (6) Sleeping difficulties. Once again, these issues were selected by a mental health support professional, and the user's answers increase or maintain the MHeVA's perceived anxiety levels.
- **Final Diagnostic sub-tree.** At the end of the interaction, MHeVA offers advice to the student about their tribulations, by revealing if it detected signs of anxiety, how serious they appear to be, and how to best cope with them.

## 2.2 Deployment

MHeVA is designed to be an embodied agent with a human model and equipped with a computer-generated voice (CGV) and lip-sync animation. Additionally, it also displays a set of non-verbal behaviours such as eye gaze and idle animations. The end product is a short one-on-one experience playable in any web-browser user developed using both Unity 3D and FAtiMA-Toolkit [18].

## 3 EVALUATION

A user study assessed MHeVA's impact on higher education students, using a two-part self-reported survey. The pre-interaction

<sup>2</sup>fatima-toolkit.eu

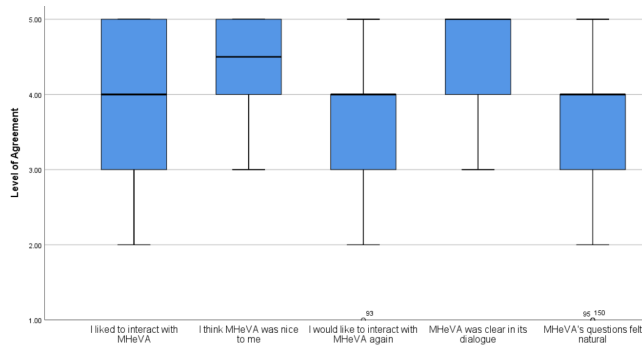
segment gathered user data regarding previous human-agent interactions, mental health support, and anxiety experiences. The post-interaction section gathered participants' feedback about their MHeVA interaction. In addition, participants were asked to submit the outputted log file, a request they could reject. Together with the logs, the survey focused on assessing MHeVA's rapport-building and self-disclosure abilities. The user study was conducted with 44 participants with ages within the 18-29 years old interval, all of which were students of Instituto Superior Técnico, recruited through an open call. Due to privacy and confidentiality concerns, participants were asked to download and run the MHeVA application in their own devices. The identification of the participants was never registered and their answers were kept anonymous.

### 3.1 General Results

The vast majority (79.5%) of participants reported past or current issues related to anxiety or depression. Of this majority, almost half (43%) did not seek any help in dealing with these issues. The data collected also indicated ranges of interaction duration from around 3 minutes to 11 ( $M = 4.24$ ;  $SD = 1.25$ ).

Participants were asked the level of agreement with the sentence "I had perfect freedom of answer", from 1 (Strongly Disagree) to 5 (Strongly Agree). We found middle of the ground results ( $M = 3.37$ ,  $SD = 1.02$ ). Regarding clarity: "Did you feel your answer options were clear about what they meant?" and "Was it easy to choose between the types of answer", results were even more positive, for both clarity ( $M = 4.42$ ,  $SD = 0.7$ ) and easiness ( $M = 4.19$ ,  $SD = 0.88$ ).

In order to assess the acceptance and engagement level of the students towards MHeVA, we utilized five prompts: likableness, politeness, willingness to engage and if the dialogue was clear and natural [12, 19]. For each factor, participants were asked to rate their level of agreement with a statement using the Likert scale already mentioned above. The results are presented in Figure 2. In addition to this, we found that 90% of the participants allowed MHeVA to communicate on a first-name basis.



**Figure 2: Participants average level of agreement with the acceptance related prompts**

### 3.2 Rapport

Rapport was measured following the definitions proposed by Gratch et al. [13]. Emotional rapport was measured using the items "I felt a

connection with MHeVA" and the pair; "How was your relationship with MHeVA during the first 5 questions?" and "How was your relationship with MHeVA during the last 5 questions?", to understand the evolution of the relationship perceived by the students. While the perceived initial relationship ratings were average ( $M = 2.27$ ,  $SD = 0.85$ ), a clear improvement was found at the end of the interaction ( $M = 3.14$ ,  $SD = 1.25$ ). A Wilcoxon Signed-Ranks Test indicated that the rapport levels regarding the last 5 questions were significantly higher than the first 5 [ $Z = -4.15$   $p < 0.000$ ]. Cognitive rapport was assessed through the item "MHeVA and I understood each other", from 1 (strongly disagree) to 5 (strongly agree). Results were slightly higher ( $M = 3.18$ ,  $SD = 1.195$ ), closely related to the perceived strength of the relationship in the last 5 questions.

### 3.3 Disclosure

The majority of participants strongly disagreed with the item "I felt judged by MHeVA" ( $M = 1.14$ ,  $SD = 0.35$ ), on a scale of 1 (strongly disagree) to 5 (strongly agree). Participants were also asked to report their own feelings of disclosure and the level of honesty behind their answers. The study obtained medium to high value ( $M = 3.66$ ,  $SD = 1.14$ ) regarding the prompt "How difficult was it for you to open yourself about personal issues?", scaled from 1 (Hard) to 5 (Easy). Truthfulness, to understand if the disclosed information was reliable, obtained high results ( $M = 4.70$ ,  $SD = 0.63$ ).

Finally, from 501 anxiety-screened questions, including the main and the follow-up questions, 472 were answered, approximately (94%). Additionally, from the 44 participants, 21 answered all anxiety-related questions asked by MHeVA and only 2 out of 44, did not answer at least one anxiety-screened question.

## 4 CONCLUSION

The work presented in this paper is motivated by the ever-growing need to find a way to mitigate the increasing demand for mental health services in higher education facilities. In particular, we developed and studied the use of an Intelligent Virtual Agent to promote self-disclosure and become a first-line diagnostic tool.

We introduced MHeVA – Mental Health Virtual Assistant – an Intelligent Virtual Agent designed to create rapport with higher education students and promote self-disclosure. It makes use of a complex dialogue tree system with more than 400 utterances. The agent's rational decision-making is supported by FAtiMA-Toolkit [20] allowing it to change strategies according to its goals.

A user study was conducted to study the potential and MHeVA's impact on the mental health of high education students. The results obtained show promising data supporting the use of IVAs as assistants of mental health support providers. In general, MHeVA was able to increase self-disclosure in university students regarding their mental state and accurately predict past or present anxiety-related issues. Additionally, it was met with high levels of acceptance. More studies are necessary to further confirm these findings.

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