

Project title: Conversational Agents for Mental Health Self-reports as Experienced by People Living with Mental Illness

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1. Project motivation, background, and hypotheses

1.1 Background

Pen and paper and online tools such as mobile and web apps are used in current practice to log daily diaries and self-reports on health questionnaires for monitoring and assessment of mental health illnesses such as depression and bipolar disorder. [1,2]. While these tools can serve as efficient means of collecting textual and visual data of many forms, these are but one medium, often limit users' capacity for self-expression and often place a burden on users which negatively impacts user experience [2,3].

Research shows that speech, as our primary mode of communication, can engage users in more natural and human-human-like conversations, thereby suggesting the potential of Conversational Agents (CAs) to improve user engagement while fostering more honest and insightful forms of self-disclosure [4]. However, there exist many technical limitations in CAs which could negatively impact user's self-reporting experience, including, CA misinterpreting or not recognizing user utterances causing confusion in the conversation and leading to further errors, the requirement to know in advance what users can or cannot say to the CA, and 8-12 seconds limit to respond to the CA's question.

Hence, there is a need for HCI research to understand, present possibilities as well as the choices available to designers in overcoming these limitations to support more engaging mental health self-reports.

1.2 Purpose

While initial research suggests the potential of CAs to support self-reports, this is a highly complex and emerging design space with many outstanding ethical, technical, and medical challenges [5]. Therefore, this study aims to understand self-reporting experiences of people living with Affective Disorders (ADs) via CAs as well as identifying barriers and enablers to the design of engaging, ethical, and effective conversational interactions.

1.3 Research Questions

In particular, this study seeks to answer the following three research questions:

1. How do people living with AD perceive the use of a CA for the self-report of mental health and wellbeing?
2. What factors -- barriers and enablers -- shape their experiences of mental health self-reports via CA?
3. Which CA design choices and strategies do this user group see as most important to support long-term conversational self-reports?

2. Study methods

We adopted a mixed-method including semi-structured interview and system log analysis to answer the research questions.

2.1 Measurement techniques

1. User's experience with the system was measured using the **User Experience Questionnaire (UEQ)** [6] in addition to a **semi-structured interview** at the end of the study.
2. User's engagement with the system was measured using the **timestamps** of user interaction with the CA, users' **daily diary log**, and their responses to the **WHO-5 questionnaires** [7].

2.2 Experimental design/setup

A four-week-long single-arm 'in the wild' study was conducted with 20 participants who used a custom-designed CA named *Sofia* via Google Nest Device to keep a daily diary log of their mental health and emotional wellbeing and responded to the WHO-5 questionnaire fortnightly.

2.3 Procedure

Pre-study: Each participant was asked to sign a consent form and to provide demographic information including name, email, age, gender, education level, employment, the period during which AD was diagnosed, symptoms last experienced, other known health conditions, technical ability, and prior experience using CA. Participants were provided a Google Nest device and familiarized with the system by taking them through the setup process, which involved pairing the device with users' smartphones and creating an account with *Sofia*, a sample conversation, as well as a briefing on *Sofia*'s limitations.

In-study: During the study, each participant was asked to self-report about their mental health and wellbeing by answering a series of questions every day, and responding to the WHO-5 questionnaire fortnightly.

Post-study: At the end of the study, each participant filled out the UEQ questionnaire, participated in a semi-structured interview regarding their self-reporting experience via Sofia and their views on the technology.

Following the COVID-19 guidelines including social distancing and travel restrictions, 50% of the pre-study sessions were conducted online and the Google Nest device shipped directly to participants. 85% of the post-study interviews were conducted online. Due to constraints on their time, one participant was interviewed via a series of emails.

2.4 Statistical considerations (sample size, statistical analyses)

Interview transcripts were thematically analyzed using following the principles of Braun & Clarke's thematic analysis methods [8]. Participants' responses to the UEQ questionnaire as well as the system log data were analyzed using R (v.~3.6.2).

3. Participant info

20 participants were recruited via online platforms including national patient recruitment site (<http://www.forsoegsperson.dk>), social media (e.g., Facebook, Twitter), university internal email, and poster. Participants were offered a Google Nest Mini 2 device or a gift card corresponding to DKK 300 for their participation.

Participant inclusion Criteria:

1. self-identified as diagnosed with an AD (Depression, bipolar disorder)
2. 18 years or older
3. Access to the internet via wifi

4. Ethical considerations

The study adhered to the highest ethical standards including informed consent from participants which clearly stated the voluntary nature of their participation and their right to withdraw from the study at any point of the time and the compensation for their participation. The participant information sheet attached to the consent form described the project's objective, procedure, compensation, stated the data collected during the study, and confidentiality measures.

Considering possible technical errors causing unwanted stress to the participants, a user guide was provided clarifying the limitations of Sofia and the Google Nest Mini in general.

COVID-19 safety guidelines were strictly followed throughout the study. Traveling and in-person meetings were kept to the minimum. When in-person meetings were essential, social distancing, mask-wearing, and use of hand sanitizer were maintained.

5. Data protection & handling

The Technical University of Denmark (DTU) is responsible for data in the study. All data was be collected over secure (encrypted) lines (HTTPS) and stored in Google Firebase Services which supports OAuth2 authentication, meets all modern security certificates (ISO 27001, SOC 1-3, ISO 27017, ISO 27018), and stores data physically in the EU (Belgium).

All the data collected during the study were fully anonymized by replacing the names and email addresses with numerical IDs. The document containing the mapping of the participants with IDs is secured physically in a locked cabinet at DTU office.

6. Dissemination of results

Results from the study are submitted for publication in Association for Computing Machinery (ACM) journal Transactions on Interactive Intelligent Systems (TIIS), special issue on Conversational Agents for Healthcare and Well-being

7. Future applications and implications of the proposed research

Results from the study inform the design of CA for mental health self-reports, reflecting on enablers and barriers to engaging conversational design, potential ethical ramifications of CA personification, and the value of a relationship-oriented design framing to support sustainable CA-user relationships.

This work contributes towards; (i) An understanding of factors impacting the self-report experiences and behaviors of people with AD, and (ii) Considerations for the future design of engaging and ethical CA self-reports of mental health and wellbeing.

8. Study period

The data collection for the project spanned from June 2020 to Nov 2020.

10. References

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