Case Report

CBT Assistant Platform: web/mobile co-design solution for cognitive behavioural therapy

Stan Jarzabek[1], Kahou Cheong[2], Yi Wen Lim[2], John C. M. Wong[3], Reshmi Karayan Kayanoth[3], Jia Ying Teng[3]

[1]Faculty of Computer Science, Bialystok University of Technology, Białystok, Poland; [2]Department of Computer Science, National University of Singapore, Kent Ridge, Singapore; [3]Department of Psychological Medicine, National University Hospital, Kent Ridge, Singapore

Correspondence to: Stan Jarzabek. Faculty of Computer Science, Bialystok University of Technology, ul. Wiejska 45A, 15-351 Białystok, Poland. Email: s.jarzabek@pb.edu.pl.

Abstract: CBT Assistant Platform is a web/mobile co-design mHealth solution to support cognitive behavioural therapy (CBT). CBT Assistant Platform supports the end-to-end CBT treatment process for clients suffering from psychological disorders and are currently undergoing CBT sessions with trained professionals. A therapist can create customized treatments through a web-based application that guide clients in following CBT homework routine, through their smartphone CBT app. Client support app utilizes evidence-based behavioural change strategies intelligently enhanced through the use of wearable devices and on-board mobile sensors. We built the CBT Assistant Platform hoping to improve delivery of CBT in the following key areas: two-way communication between clients and therapists, cutting the time of a therapy session and helping therapists serve more clients, and client's adherence to the therapy rigor by engaging the client in therapy process and making CBT homework easier and more fun to perform.

Keywords: Medical information systems; cognitive behavioural therapy (CBT); mHealth; mobile apps; web applications; gamification

Received: 21 October 2017; Accepted: 20 June 2018; Published: 17 July 2018.
doi: 10.21037/jhmhp.2018.06.02
View this article at: http://dx.doi.org/10.21037/jhmhp.2018.06.02

Introduction

Mental health has been identified as the leading cause of disability adjusted life years (DALYs), worldwide ranked higher than cardiovascular diseases and all types of cancer and HIV (1). It also has an estimated global economic cost of US$2.5 trillion in 2010 (2). This paper looks into the cognitive behavioural therapy (CBT), an evidence-based treatment for a wide range of mental disorders affecting millions of people world-wide, with significant impact on the economic cost of mental illnesses. CBT has been found to be effective for depression and anxiety disorders (3). It has also been shown to be more cost-effective as compared to other forms of treatment and has a much lower relapse rate as compared to pharmacological interventions (4). The delivery of CBT is centered on working with therapists to identify dysfunctional thoughts, breaking down problems into smaller parts and trying to change unhelpful thoughts and behaviours. These skills would then be practised in real life through a series of homework and reflection exercises by the client. The proliferation of smartphones gives rise to mobile Health (mHealth), which allows the usage of self-monitoring, user sensing and communication capabilities of smartphone apps to formulate novel approaches to administer CBT.

CBT Assistant Platform leverages on web and mobile technologies to support the end-to-end CBT treatment process for clients suffering from psychological disorders that can be helped with CBT as an integral component of the overall therapy approach. CBT Assistant Platform aims at improving two-way communication between clients and therapists, providing the therapist with comprehensive info about the progress of the therapy, and encouraging the client to engage in homework exercises between sessions.

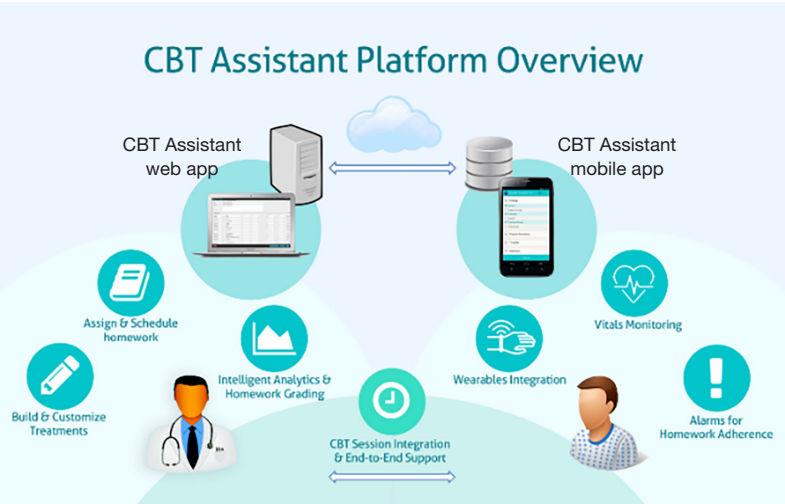

Figure 1 CBT Assistant Platform overview. CBT, cognitive behavioural therapy.

Figure 2 CBT assistant's support for therapists and their patients (5). CBT, cognitive behavioural therapy.
Available online: http://www.asvide.com/article/view/25877

CBT Assistant Platform comprises the CBT assistant mobile app that communicates with a web app serving therapists via a cloud server, as shown in *Figure 1*. CBT web app helps a therapist to define homework exercises and other instructions for client to follow after a given face-to-face therapy session. These instructions are then automatically transferred to a client's CBT mobile app that helps the client to review information provided by the therapist during the face-to-face session, adhere to the recommended CBT homework exercises, and opens up the possibility of addressing behavioural change intelligently through the use of wearable devices or on-board mobile sensors to support evidence-based behavioural change strategies.

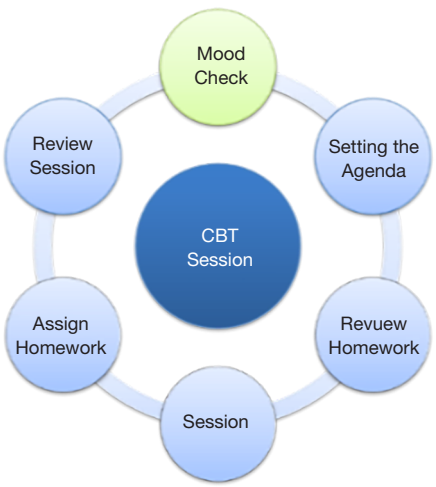

Figure 3 Judith Beck CBT session model. CBT, cognitive behavioural therapy.

CBT assistant workflow

Watch a 5-minute video demo of CBT Assistant Platform (mp4 format) (*Figure 2*).

We assume a general structure and workflow of CBT sessions based on the Beck's model *Figure 3* (6).

CBT assistant web app supports the therapist by integrating seamlessly into the CBT session with a step by step workflow including assigning homework exercises for a client to follow, handling a range of administrative tasks from keeping track of agenda items to reviewing homework.

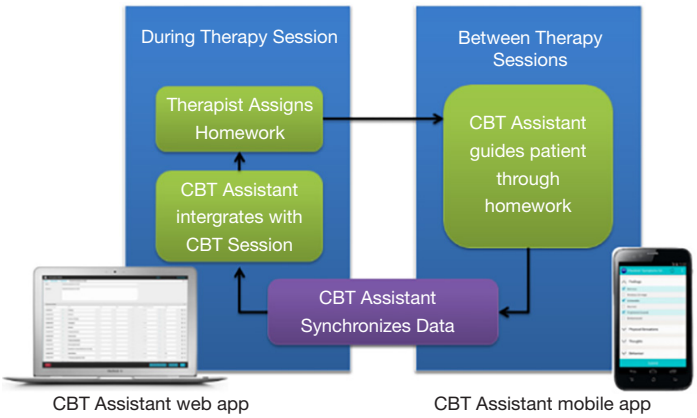

Figure 4 CBT assistant workflow. CBT, cognitive behavioural therapy.

In between therapy sessions, the CBT assistant mobile app provides interactive homework guidance to enhance CBT administration on the client's end. Features such as alarms and gamification elements help improve homework adherence for clients. Therapists are able to monitor the client's progress whenever data from is synchronized as shown in *Figure 4*.

Functional description of CBT assistant web app for therapist

We describe CBT assistant web app in reference to the Beck's CBT session model.

Mood Check

At the start of the session, the therapist performs a check on the client's symptoms, such as mood and anxiety. CBT assistant web app provides pre-session forms to assist the therapist with client's symptom assessment. Later on the therapist can view the graphs showing how the client's symptoms have been changing over time.

Setting the agenda

Here, the therapist bridges the previous and current session and sets the agenda items for the session with the client. CBT assistant web app helps the therapist review past session data at any time it is required. The sidebar of the app provides an easy access to the client's historical data. In particular, agenda items not addressed in previous sessions are brought to the therapist's attention.

Review homework

CBT assistant web app allows the therapist to review the client's homework tasks. The therapist can view client's pre-task and post-task symptom ratings to assess the effectiveness of various exercises. To allow the therapist to sift through large amounts of data, homework can also be visualized with the scores automatically graded. Clients' past pre-task and post-task notes can also be tracked to monitor their progress in detail. Physical parameters such as movement, sleep and heart rate are monitored in the background through integrated wearables such as Jawbone. These allow the therapist to supplement their understanding of the client's condition through his/her symptoms. For example, a sudden increase in heart rate may indicate the onset of a panic attack. The therapist prioritizes the agenda based on this review.

Session

During the session, the therapist can make brief notes on the CBT assistant web app while focusing his/her attention on the client. Therapist and client may review progress and set homework tasks together via the web app. The therapist may indicate on the agenda checklist the items which have been addressed as the as the session progresses, and browse through other items not yet addressed. Unchecked items are brought over to the next session automatically.

Assign homework

Here, the therapist assigns homework exercises discussed

during the session for practice in-between the sessions. CBT assistant web app helps the therapist set schedules for clients to adhere to. CBT assistant web app supports flexible scheduling to accommodate the different needs of clients.

Review session

At the end of the session, the therapist reinforces important concepts with the client. CBT assistant web app presents a summary of the session, allowing the therapist to summarize and wrap up the session. The therapist can review the session at any time.

In summary:

Before the session, a therapist can quickly review the client's data:

- The stage of the therapy, recommended homework for a week;
- The feedback from the client regarding the overall changes in symptoms;
- Pre-task and post-task symptom ratings;
- Adherence to recommended homework exercises;
- Problems with homework, and client's perspective of its effectiveness;
- Client's vitals such as movement, sleep and heart rate can be monitored in the background through integrated wearables such as Jawbone;
- A calendar interface allows a therapist to monitor homework adherence, and scheduled homework versus the submitted homework.

During the session with a client, a therapist can take brief notes regarding the client's response to the treatments and select homework tasks for the client to complete in between sessions.

After the session, CBT assistant web app presents a summary, allowing the therapist to review and wrap up the session. The therapist can work out a detailed plan for the next phase of and the plan is uploaded to the client's mobile app. The therapist selects treatments from a list of pre-defined common CBT homework worksheets. Existing treatments can be modified and new treatments created. Each treatment has also a large number of additional features that can be customized to the client's needs.

CBT assistant web app displays graphical views to help the therapist easily monitor the client's progress, analyse homework or background vitals, and adjust treatment as needed.

Functional description of CBT assistant mobile app for clients

CBT assistant mobile app helps clients to engage in the homework task schedule recommended by the therapist. Homework responses are initially stored in the client's smartphone memory, and then uploaded to the server for the therapist to review. The mobile platform also allows the client to key in reflective notes before and after each homework exercise. The therapist and client can review these notes together and discuss if the homework tasks have been helpful.

CBT assistant mobile app interfaces with phone sensors and wearables to monitor client's physical parameters such as heart rate, sleep and movement. Such a background collection of data provides important information on the client's level of physiological arousal, activity levels and rest periods. These complements and builds upon the intelligent analysis of changes in the client's physical and psychological state over time.

CBT assistant mobile app incorporates gamification strategy such as goals and achievements for clients to visualize their progress. This caters to clients of all ages, especially for children, to keep them motivated to do their homework.

In *Figure 5*, the interface includes a graphic of birds on a tree which displays the progress of the client. Each time the client uses the app for a homework exercise, the tree grows taller and more owls appear. Furthermore, the background changes as the client completes certain number of responses, giving visual feedback that the client has improved. The different owls can also be added in by the therapist and through other achievements.

As an example, we illustrate how CBT assistant mobile app can be used by clients suffering from Social Anxiety Disorder (SAD):

- The therapist and client develop a Fear Hierarchy and plan for graded exposure exercises with the guidance of the app.
- App provides the detailed instructions for each exercise for a client to refer to on the move.
- On the first attempt of each exercise, the client is asked to fill in a Fear Plan. The app helps the client think through the different problems that he/she may face in the upcoming situation and the possible steps or skills that can be used to overcome these challenges.
- A self-assessment tool based on the Watson and

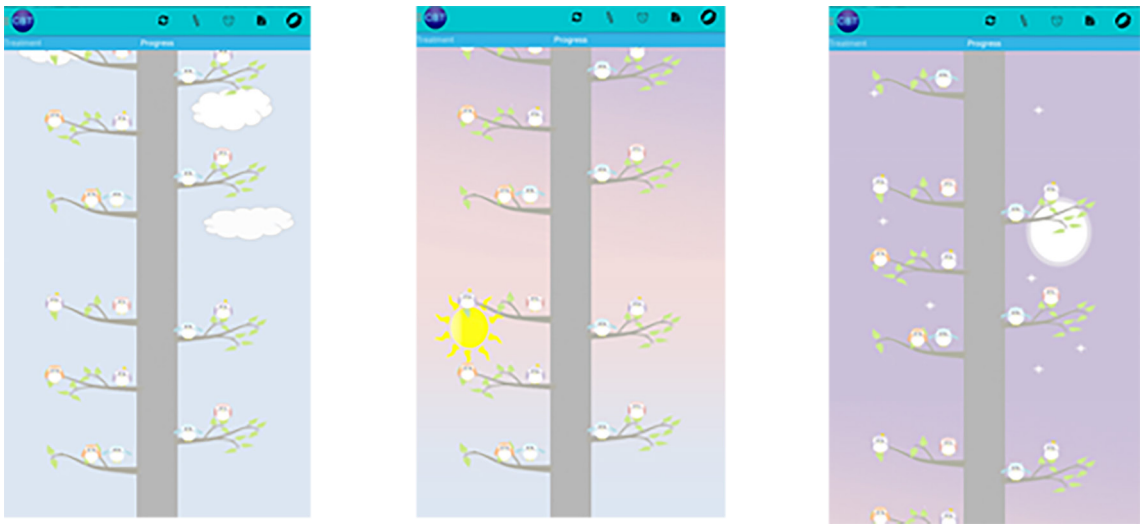

Figure 5 CBT assistant gamification element.

Friends' Social Avoidance and Distress Scale (SADS) (7) is available to allow the client to evaluate his/her level of social anxiety before and after the exercise.

- Immediately after performing the exposure exercise, the client is asked to record the thoughts, feelings and behaviours associated with the experience in an exposure diary, and their reflections on their learning from this exposure exercise.
- Aside from the exposure exercises, the CBT mobile app also supports other forms of monitoring with templates such as Personal Diary and Thought Diary. Checklists for symptoms and triggers of Social Anxiety Disorder are available to allow the client to constantly record and monitor the respective items.
- A psychoeducation page is present for clients to review past concepts that have been discussed during their therapy sessions.

Design considerations

To design CBT Assistant Platform, we analysed existing CBT-related apps and explored the idea of co-design.

Existing applications

We started by surveying currently available web/mobile apps for CBT. We found that 23 out of the 37 applications surveyed had the feature to record the user's mood and emotions through journals or worksheets. Five of the applications provided some CBT intervention support which were cognitive in nature. Most of the applications were self-help in nature and assisted users in identifying their own specific problems. Some also supported a single, specific CBT intervention (8). Another study on healthcare applications done by IMS showed that most of the healthcare applications available were mostly educational. Less than half of the applications could guide or alert the user (9).

Design methodology

Based on the analysis of the design considerations we created a co–design solution that involved three main steps, namely modelling, development and collaboration as shown in *Figure 6*.

Modelling

To design the system, we collaborated with the National University Hospital Department of Psychological Medicine (NUH) to analyse the problem domain. While previous approaches tended to focus on treatments for a specific disorder per mobile application, we identified opportunities for systematic software reuse since they shared common use cases. Through collaboration, we recognized opportunities for empowering therapists to create treatments for clients.

Development

As the platform spans across web and mobile components,

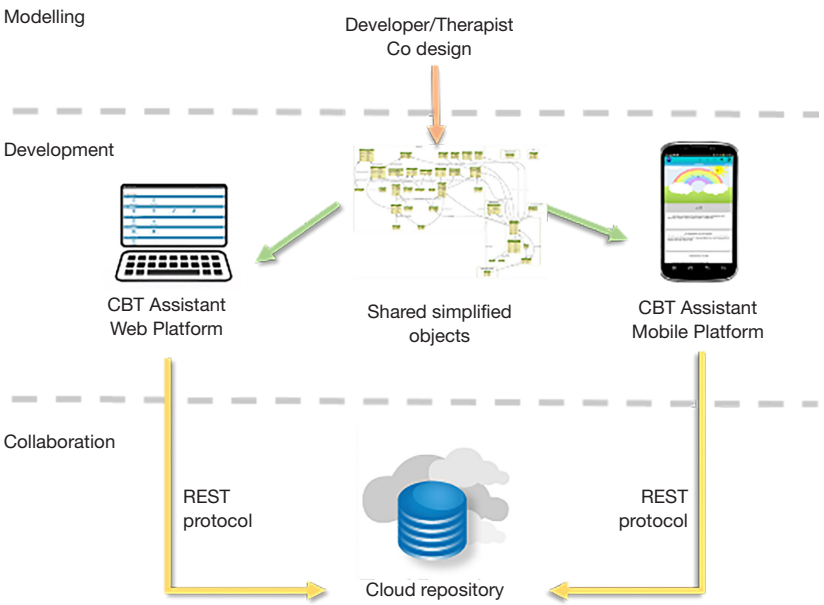

Figure 6 Design methodology.

they implement the treatment by following the domain model defined. These serve as key inputs to allow each platform to dynamically generate code according to their own design domains.

Evaluation, experimentation

The next important step would be to evaluate the CBT Assistant Platform in research and clinical settings. This would determine if the applications are effective, feasible and safe for clients and therapists. It is crucial to obtain feedback from the users to identify elements that can be improved on for future versions of the applications.

Conclusions

CBT Assistant Platform described in this paper is an integrated web/mobile app solution supporting the end-to-end CBT treatment process. A therapist uses CBT web app to create customized treatments for the client. Uploaded to a smartphone, treatments guide a client in following CBT homework routine, through the smartphone CBT mobile app. CBT mobile app utilizes evidence-based behavioural change strategies intelligently enhanced through the use of wearable devices and on-board mobile sensors.

We applied user-centric design and co-design concepts to ensure that our solution is practical and easy to use. Working hand-in-hand with therapists, we based CBT assistant on the therapy protocols actually used in their clinical practice. We think close collaboration between therapists and computer scientists was the single most important success factor for our project.

We built the CBT Assistant Platform hoping to improve delivery of CBT in the following key areas: two-way communication between clients and therapists, cutting the time of a therapy session and helping therapists serve more clients, and client's adherence to the therapy rigor by engaging the client in therapy process and making CBT homework easier and more fun to perform.

Our CBT Assistant Platform is fully operational, however it needs further validation. So far we have done usability tests in which we obtained favourable feedback on ease of use and friendliness of CBT apps. We plan to conduct yet other controlled experiments with healthy subjects, and then to test CBT apps in clinical settings. There is much room for enhancing CBT Assistant Platform functionality. We plan to develop a more active support for clients in areas of CBT homework and client motivation. For that we further study behavioural change strategies in order to adapt them for smartphone delivery in CBT context. CBT web app used by therapists will be equipped with stronger capabilities to analyse client data that will help therapists

determine more effective therapy strategies for the clients.

Acknowledgments

Authors thank Dr Bimlesh Wadhwa of the Department of Computer Science, School of Computing, National University of Singapore, for her invaluable comments on various aspect of the design of the CBT Assistant Platform.
Funding: None.

Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/jhmhp.2018.06.02). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Ustiin TB. The Global Burden of Mental Disorders. Am J Public Health 1999;89:1315-8.
2. WHO Investing in Mental Health: Evidence for Action. World Health Organization, 2013: 17-18.
3. Butler AC, Chapman JE, Forman EM, et al. The empirical status of cognitive-behavioral therapy: a review of meta-analyses. Clin Psychol Rev 2006;26:17-31.
4. Rodebaugh TL, Holaway RM, Heimerg RG. The treatment of social anxiety disorder. Clin Psychol Rev 2004;24:883-908.
5. Jarzabek S, Cheong K, Lim YW, et al. CBT assistant's support for therapists and their patients. Asvide 2018;5:622. Available online: http://www.asvide.com/article/view/25877
6. Beck J. Cognitive Behavior Therapy. Guilford Press, 2011
7. Watson D, Friend R. Measurement of social-evaluative anxiety. J Consult Clin Psychol 1969;33:448-57.
8. Tan QYM, Jarzabek S, Wadhwa B. CBT Assistant: mHealth App for Psychotherapy. IEEE Global Humanitarian Technologies Conference, GHTC'2014 South Asia, Trivandrum, India, September 2014:135-40.
9. IMS Patient Apps for Improved Healthcare From Novelty to Mainstream. IMS Institute for Healthcare Informatics, Parsippany. 2013.

doi: 10.21037/jhmhp.2018.06.02
Cite this article as: Jarzabek S, Cheong K, Lim YW, Wong JC, Kayanoth RK, Teng JY. CBT Assistant Platform: web/mobile co-design solution for cognitive behavioural therapy. J Hosp Manag Health Policy 2018;2:34.