The Future of Depression Prevention and Treatment: an HCI Perspective

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ABSTRACT
UPDATED—April 21, 2016. This paper describes how at the point of intersection of HCI, AI and psychology, technology may be used for prevention and treatment of mental disorders and depression in particular.

Author Keywords
Persuasive technology; psychology; depression; therapy; AI; captology; emotion recognition

INTRODUCTION AND BACKGROUND INFORMATION

Mental health issues are of a growing concern throughout the world. World Health Organisation claims that mental disorders of childhood and adolescence bear a very high cost for our society [6]. Indeed, looking from a human perspective, 80% of people who committed suicide were suffering from major depression [2]. From the financial perspective, "*stress, depression or anxiety and musculoskeletal disorders accounted for the majority of days lost due to work-related ill health, 9.9 and 9.5 million days respectively*" [5].

According to the Office of National Statistics in 2010 - 2011 19%, i.e. nearly 1 in 5 people in the UK aged 16 and over showed "*some evidence of anxiety or depression with a higher percentage of women (21%) than men (16%)*" [7]. Moreover, by 2020 major depression is expected to be the second most disabling condition in the world [2].

These facts call for further exploration of how technology and namely persuasive technology can be applied in order to tackle this problem. This article concentrates on the ways of preventing and treating depression through application of persuasive technology methods used within the HCI (human-computer interaction) scope in particular.

Since the main question that this article focuses on is applying HCI aspects in preventing and treating depression, it will review existing technology-related approaches currently used as supplements to the traditional treatments. The article also present ideas on how certain types of traditional treatments can be improved by means of technology.

PREVENTING AND TREATING DEPRESSION: COMMON APPROACHES

There exist various approaches in treating clinical depression, including talking treatments, antidepressants and other treatments, e.g., electroconvulsive therapy (ECT), lithium.

When considering application of persuasive technology, talking treatments are the most relevant. There are the following types of talking treatments [1].

- Cognitive behavioural therapy (CBT) that aims at helping patients understand their thoughts and behaviours. Usually CBT is performed by a professional therapist either directly or online.
- Interpersonal therapy (IPT) focuses on relations with people and problems that a patient may have in their relationships.
- Psychodynamic psychotherapy within which a therapist encourages patients to speak about what is on their minds. Later on the obtained information is analysed for hidden patterns.
- Counselling encourages patients to look into the problems that they are experience in their lives and find ways to address these issues.

In addition to the traditional methods, modern technology made it possible to extend the possibilities for people suffering milder forms of depression. For example, Jane McGonigal's SuperBetter game [11] aims at keeping people motivated and optimistic when going through complicated situations in their lives. MoodGYM, a five-module web programme developed at the National Institute for Mental Health Research at the Australian National University, aims at preventing depression and is available free of charge to anyone [3]. SPARX, specifically developed for young people suffering from anxiety and mild depression, utilises CBT principles to teach the youth how they can deal with the issues they are facing. This self-help e-therapy tool is, however, available for residents of New Zealand only [4].

TECHNOLOGY INSIGHTS AND FUTURE POTENTIAL

Throughout the history of computing there has been substantial research made in the area of AI (artificial intelligence). A computer program Eliza [12] used natural language processing to analyse user input and 'respond' appropriately. One of the most famous scripts that Eliza processes is called DOCTOR. It is a mock simulation of a psychotherapy session. It was not aimed to substitute a real psychoanalyst but it gives an idea of future possibilities in this area, especially with big data processing and machine learning being of broad and current interest.

When looking at how technology can be applied in the future in terms of treating depression, it is important to distinguish between HCI and CMC (computer-mediated communication).

The aim of this article is to show how technology can be utilised in the area of depression prevention/treatment from an HCI perspective. Therefore, we would like to mention captology – from CAPT, Computers As Persuasive Technology. Unlike general persuasive technology which is used both within HCI and CMC, captology is a purely HCI-related concept.

Captology focuses on how interactive computing products can be used to change one's attitudes and behaviours [8].

Within the scope of captology such computing products can be used as *tools* that increase capability, as a *medium* that provides experience as well as a *social actor* that creates relationship. These are described in more detail in Figure 1.

Among the benefits of captology are the following: interactivity, persistence, anonymity, volume of data, scaling and access. In order to show how exactly captology falls into the scope of depression prevention and treatment, each of these benefits is discussed in detail below.

Interactivity

Interactivity helps engaging people. For example, if the only thing a person can do on a computer is to read the information, it may or may not engage them. However, if there is an opportunity to interact with technology and change the final outcome through such interaction, this usually provides a more engaging experience.

Interactivity and use of technology as a social actor has also proven to lift up the mood and minimise user's frustration from using software. One of the examples include a piece of code that developers included in MATLAB 3.5. In that version of the software when a user got frustrated and happened to type 'f***' at the command line, the program would respond 'Your place of mine?'. Even if this functionality was included as a joke, there is evidence that it helped users to forget about their frustration and encouraged them to explore the software further [10].

Taking the above into account, interactivity seems to be relevant and beneficial for depression prevention and treatment. Interactivity can come in various forms like games with elements of virtual reality, auditory or textual chatbots and so on.

Persistence

Another advantage of technology is that unlike humans, computers are more 'patient'; they are able to keep on persuading even though their user is not very receptive or gets into a defensive mood.

This is beneficial in general. However, it is important that such software does not put too much pressure on a user. This is due to the fact that in the given context the users are usually vulnerable people either suffering or prone to suffer from depression.

Anonymity

Technology provides a sense of anonymity, which helps vulnerable people open up and express their feelings easier. This principle is utilised by the SPARX game. Nevertheless, e-therapy tools like that one are only supplementary and there is still further research needed until a product that can function with minimal interference from people is created.

Volume of data

This aspect is growing in relevance with the increasing AI-related research. With the capability of processing larger volumes of data and gradual improvement in the area of machine learning future computing products should produce more accurate outputs.

One of the areas that can benefit from faster processing speed of large volume audio, video and text data is emotion recognition.

Emotion recognition is a key point for creating an effective software solution that would tackle depression-related issues. This is because effective e-therapy software should be capable to read emotions as precisely as possible in order to provide the right feedback to the users.

In [9] the authors attempt to create a software capable of recognising emotions by combining different modalities, namely audio cues, video cues and text cues.

The audio cues are made up of "*(i) spectral shape, (ii) spectro-temporal modulations, (iii) periodicity structure due to the presence of pitch harmonics, and (iv) the long-term spectral variability profile.*" [9]

Analysing videos helps in tracking motion and, therefore, detecting potential mood changes, provided that the software is trained appropriately. Figure 2 depicts facial landmark fitting and motion tracking, which are used for this purpose.

Figure 2. Motion tracking and facial landmark fitting [9].

The text cues are based on affective lexicon, i.e., specific words used that help predicting possible emotions of the speaker.

Other sources of information that future e-therapy tools can utilise may include data taken from social media. For example, the records about an individual's interactions with other people can be used to incorporate aspects of interpersonal therapy into a software solution.

Psychodynamic psychotherapy, in particular search for hidden patters, can be also improved by the computing capabilities that modern technology offers. If computers can access anonymous data for other patients living anywhere in the world, then they may find patterns that a human therapist may not be able to access and recognise otherwise.

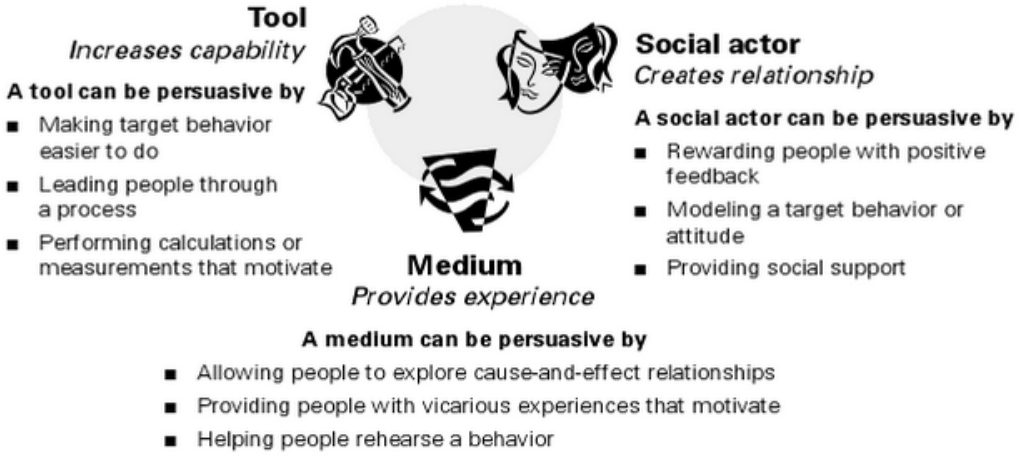

Figure 1. Captology functional triad: different ways how the computing technologies can be used to persuade. Source: [8].

Scaling

The ubiquitous nature of the Internet facilitates relatively quick scaling of software solutions. It is easier to provide software through web and mobile channels then arrange for a single therapist to visit everyone who needs help. Both MoodGYM and SuperBetter serve as a good example of the scaling benefit.

Access

Unlike traditional therapists and online therapists, e-therapy software can be available to users 24 hours a day 7 days a week. This is an important benefit because a person in need does not need to book and wait for an appointment. The issues they are facing with can be dealt with immediately.

ETHICS AND CONSTRAINTS

Although substantial work has already been done in order to develop depression prevention programs, the obtained solutions still remain supplementary to the traditional methods. The reason is that further interdisciplinary research is required before an effective and complete solution is developed. Such research should be done in cooperation between psychologists (therapy aspects), linguists (lexicon aspects) and computer scientists (AI, emotion recognition, HCI, security aspects, etc.).

At the current stage of machine learning development there still exists a problem of how accurate the training data should be to produce expected quality of the output. Since such output will be provided to vulnerable individuals, it is important there is minimal amount of error. Otherwise, it may be damaging for their well-being.

Another ethical aspect is how the information that a user provides is handled. It is important that all personal data is kept secure. This can be potentially a problem as with scaling the amount of data stored will increase rapidly.

There also exists a danger of such technology being misused to manipulate people. Therefore, ethical aspects should be of utmost importance and developers should ensure that such software is safe for the users.

CONCLUSION

To conclude, currently there exist various approaches to preventing and treating depression. In this article we have looked at how persuasive technology is currently used for this purpose. We have also reviewed ethical issues, technological constraints and how the future technology development can potentially lead to creation of AI-based e-therapy software, which can be easily accessible to those in need for help.

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