

**Wearable devices in the treatment of mental disorders:**

***Motivational gadgets or new opportunities to improve treatments?***

Pim Cuijpers<sup>1,§</sup>

Soledad Quero<sup>2</sup>

<sup>1</sup> Department of Clinical, Neuro and Developmental Psychology, Amsterdam Public Health research institute, Vrije Universiteit Amsterdam, the Netherlands

<sup>2</sup> Department of Basic, Clinical Psychology and Psychobiology, Universitat Jaume I, Castellón, Spain

<sup>§</sup> Corresponding author:

Pim Cuijpers, Ph.D., Professor of Clinical Psychology, Department of Clinical, Neuro and Developmental Psychology, Amsterdam Public Health research institute, Vrije Universiteit Amsterdam, the Netherlands, Van der Boechorststraat 7-9, 1081 BT Amsterdam, The Netherlands, tel. # 31 20 5988757, fax. # 31 20 5988758, email: [p.cuijpers@vu.nl](mailto:p.cuijpers@vu.nl)

Researchers and clinicians in the field of cognitive behavior therapy have always been interested in the use of technology in therapies. Already in the 1960s, when the idea of exposure therapy was only a decade old, researchers recorded instructions for patients how to apply exposure to themselves on long-play records and tapes (Kahn & Baker, 1968; Cuijpers, Marks, van Straten, Cavanagh, Gega, & Andersson, 2009). In the 1980s and especially in the 1990s, personal computers as support in the treatment of anxiety disorders were examined in a growing number of trials (Cuijpers et al., 2009). Most of these interventions however, used face-to-face therapies as model and just translated these to computers. The core ideas of the interventions did not change and technology was just used as a means to deliver the interventions.

Since smartphones have become available for large parts of the general population this approach is changing rapidly (Linardon, Cuijpers, Carlbring, Messer, & Fuller-Tyszkiewicz, 2019). Smartphones are typically carried all day by their owners and they have a whole series of sensors that can measure location, speed, sound, movement, contact with other smartphone owners, the use of social media and many other things. It also allows experience sampling, also called ecological momentary assessment, the measuring of mood, anxiety, stress or any other subjective feeling during random moments of the day. Such measurements offer possibilities to measure elements and predictors of mental health in daily life in a way that has never been possible before.

Wearable devices build on this development and increase the possibilities to measure elements and predictors of mental health to a level that was not possible before. Hunkin, King and Zajac, in this issue of *Clinical Psychology, Science and Practice* (Hunkin et al., 2019) give an excellent overview of the current state of wearable devices that may

be used in the treatment of anxiety disorders. This review shows that the field is moving fast forward and that there is an increasing number of devices available.

### Motivational gadgets or new opportunities to improve treatments?

Wearable devices are innovative, new, and offer possibilities for registering behavior that have never been available before. That makes them attractive for research and for users that are seeking novelties and technological innovations. One of the key questions for the use of these devices in therapy is, however, whether they are actually capable of improving outcomes. Or maybe they just make therapies easier, more accessible, and lower the threshold to seek treatment, but do not actually improve outcomes. Will they increase effect sizes, or are they gadgets that make therapies more attractive but do not change the basics of the therapies?

Many researchers think that seeking treatment in itself is the result of an internal process of patients, in which they realize that their mental health problems are serious and that they are not capable to solve them without help. These patients then realize that they actually have to act, find a clinician to help them and take the necessary steps to go to this clinician. That requires motivation and determination to actually do something about their problems. They also must have expectations and hope that the therapist can really do something about their problems.

In therapy, this motivation of the patients is needed to continue to go to the therapist in all therapy sessions and do the necessary homework for the treatment. Proponents of the common factors model would say that when the therapist is capable of generating a working alliance with the patient and make use of other common factors such as the expectations and hope for improvement in the patient, the therapy will be successful.

Supporters of specific therapies would say that in addition to these expectations, hope, motivation, and common factors, a therapy is successful when the specific factors of the therapy are realized, such as change in maladaptive cognitions during cognitive therapy and change in maladaptive behaviors in behavioral therapies.

The question is whether wearable devices are capable of improving these outcomes. According to the existing models of how change is realized, there must be some window of opportunity to realize change and make patients better. Wearable devices may facilitate these processes, but will they actually improve outcomes?

In the field of virtual reality, we have seen that interventions based on virtual reality are indeed effective in improving outcomes in anxiety and several other mental disorders. Direct comparisons between conventional therapies and therapies based on virtual reality show, however, that the effects of these two types of therapy are very comparable (Fodor Coteț, Cuijpers, Szamoskozi, David, & Cristea, 2018) and that virtual reality does not really improve efficacy over conventional therapies. However, this could change in the future years, since experimental studies are being conducted that show that exposure therapy for specific phobias to different VR contexts and stimuli may facilitate generalization of the results, maximizing this way exposure therapy. Further improvements in procedure and technology could even yield superior effects of VR exposure. One could assume that wearable devices can also facilitate therapies, but will not lead to a further improvement of treatments. Or it is also possible that, by allowing ecological momentary assessments and ecological momentary interventions in the natural settings where the patients experience the problems, they trigger other mechanisms than regular therapies, or realize insights in patients that are not possible in other ways. Ecological momentary assessment and interventions build

on real-time experiences of patients, which has not been possible at this level before. This may lead to new applications and personalisation of treatments that have not been feasible before. Of course, these are all empirical questions that have to be examined in future research.

Improvement of treatment outcomes is, however, very much needed. A modeling study showed that on a population level, current treatments cannot take away more than 50% of the disease burden of anxiety disorders and one third of the disease burden of depression (Andrews Issakidis, Sanderson, Corry, & Lapsley, 2004). And that is only in optimal conditions, when all people with these disorders in the population get an evidence-based treatment. The hope with all innovations, including technological ones, is that they can realize a further reduction in the disease burden of these disorders. That can only be realized, however, through treatments that are more effective than the existing ones, or to treat more people who otherwise would not get (an evidence-based) treatment. Future research will have to show whether wearable devices can make this promise come true.

#### Wearable devices to reduce drop out and increase treatment rates?

Improving outcomes of treatment is not the only goal that wearable devices may realize. One important other goal is that they may help in the development of interventions that are conducted without the involvement of humans. In most research on technological interventions for mental disorders, it has become clear that human involvement is needed to realize effects. Without human involvement, drop-out of treatment is huge, and goes up to 90% in some studies, with hardly any participants finishing the full interventions, although it may differ across disorders whether this

human involvement is actually needed. Even if there is human support, drop-out rates are high and large groups of patients stop with the intervention after one session, with few patients finishing all sessions. If technological interventions can be developed that can be conducted without human involvement and limit the huge drop-out rate, especially in unguided interventions, that would improve the efficiency and scalability of interventions immensely.

It is not exactly clear why human involvement is needed to realize the effects of interventions. The motivational aspect may very well be one of the key factors. If a patient has a personal relationship with a clinician, it is clear that dropping out of treatment is difficult because it has to be explained to the clinician. If there is no human involvement, dropping out does not require such interpersonal stress. So, if no human is involved in interventions, the motivational aspect to stay in the treatment has to be realized in another way. Informative and engaging wearable devices may be helpful in realizing less drop-out, because they are capable of engaging patients in other, non-conventional ways. However, whether this is the case has not been tested and again more research is needed to examine this.

Another important potential benefit of wearable devices is that they may increase the uptake of psychological interventions for mental health problems. These devices may attract patients who are not inclined to seek conventional help for mental health problems. Especially those who are eager to test technological innovations will be inclined to engage in such interventions. However, this will only result in increased uptake rates if at the same time the drop-out rates can be reduced and patients can be motivated to stay into treatment without the personal bond with the clinician.

## Conclusion

Wearable devices, together with other technological innovations, have the potential to facilitate the application of psychological therapies, improve outcomes of these therapies, increase the uptake of these therapies in patients who otherwise would not seek treatment, and maybe help in developing interventions that are not supported by humans, but can be delivered in unguided ways. However, it is not clear whether these promises will actually come true. Research will have to show that these devices can drive up the effects to a level above those found in conventional therapies and beyond the ‘window of opportunities’ that current therapies have. Research will also have to show that these devices help to replace the motivational aspects that are generated by human contact with clinicians, so that patients will have the motivation to conduct the therapies on their own. However, in order to do that research we have to have a good overview of the available devices and their assumed working mechanisms. The overview by Hunkin and colleagues is therefore an essential guide to lead this future research program.

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