

# Sleep and Health on the Smartphone



By DANIEL GARTENBERG

Exploring potential behavioral treatments for insomnia.

**M**obile computer technology can potentially utilize behavioral treatment to address a variety of psychological and physical illnesses. Currently, behavioral treatments are used for a variety of sleep and mood disorders including insomnia, delayed sleep phase syndrome, depression, anxiety, and bipolar disorder. Such behavioral treatment can have advantages over medications, especially if the cause of the illness is rooted in an unhealthy behavior, as opposed to being rooted in a chemical imbalance. Another benefit of behavioral treatment is that it does not cause side effects and dependency that are common with medication. Smartphone applications (apps) have advantages over other methods of administering behavioral treatments because they can provide real-time feedback and are extremely accessible. Moreover, if the unique relevant behavioral characteristics of an individual can be identified, the treatment can be individualized to optimize its benefit.

Various applications target sleep problems using relaxation and meditation techniques. Such applications include Deep Sleep with Andrew Johnson, aSleep, pzizz sleep, and the Proactive Sleep Alarm Clock. While relaxation can be useful to address insomnia, most behavioral treatments for insomnia require a direct measurement of sleep quality.

Examples of smartphone applications that measure sleep quality are the Sleep Cycle Alarm Clock and the Proactive Sleep Alarm Clock. These applications track sleep by integrating an alarm clock with the data collection process. However, unlike cognitive behavioral therapy, stimulus control therapy, and sleep restriction therapy, these applications have yet to be clinically proven for treating insomnia.

The idea behind the Sleep Cycle Alarm Clock is to wake users in a lighter phase of sleep, based on their body movements. Since the iPhone has a built-in accelerometer, this app accesses the accelerometer to measure when the device is moved. By placing the iPhone on a bed during a period of sleep, the Sleep Cycle Alarm Clock determines if movement occurs within a half hour of when the alarm is set. If movement is detected, then the alarm goes off. Additionally, the Sleep Cycle Alarm Clock displays these periods of movement throughout the night in graph form.

Photo by Nicolas Tan



The Sleep Cycle Alarm Clock is a useful device for measuring sleep quality and promoting awareness of the importance of sleep. There is also some value to using the Sleep Cycle Alarm Clock to measure sleep quality based on movements during sleep, an important step toward implementing behavioral treatments for insomnia.

The Proactive Sleep Alarm Clock is another app that tracks sleep quality, but is more geared toward addressing the problem of difficulty falling asleep and staying asleep. This application tracks behaviors that sleep clinicians track when evaluating insomnia. Sleep clinicians typically assess insomnia by asking patients to track their time in bed and to estimate how much time in bed was spent sleeping. Based on this information, the severity of insomnia can be assessed. In severe cases of

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insomnia, for example, patients will have a lower percentage of time spent sleeping when they are in bed.

The Proactive Sleep Alarm Clock tracks sleep amount during time in bed by using a button that can be pressed after the alarm is set, so the user can indicate if they awaken during the night, and by directly asking the user how long it took to fall to sleep. This information, along with the duration of sleep and bedtime, is then displayed to the user in an editable graph.

Additionally, the Proactive Sleep Alarm Clock can track other behaviors that sleep clinicians use to assess sleep hygiene, and it includes some degree of behavioral feedback. Behaviors that the Proactive Sleep Alarm Clock can already track include exercise, diet, caffeine use, alcohol use, and medication use. These behaviors are then analyzed in order to provide the user with information on how these behaviors relate to one another. For example, if caffeine use is correlated with difficulty falling to sleep, the Proactive Sleep Alarm Clock informs the user of this correlation. As a result, users can make themselves more accountable for unhealthy behaviors related to sleep, exercise, and diet. Awareness of these relationships may lead to healthier decision-making and

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can be used by clinicians to evaluate mental and physical health.

The next step for these applications is to provide feedback similar to the feedback that a sleep clinician would give to a patient dealing with insomnia. An important first step for these applications is to collect the same information that a sleep clinician would collect when evaluating insomnia. When these applications mirror the standard pencil and paper sleep diaries that clinicians administer to patients, then behavioral interventions can be effectively administered. Additionally, such applications may have benefits over the standard treatments and can improve on current behavioral treatment for insomnia, because smartphones can be used to integrate the data collection process into everyday tasks and are more dynamic data collection tools. For example, incorporating the Sleep Cycle Alarm Clock that tracks body movements during sleep with

other measures of sleep quality, such as those assessed by Proactive Sleep, may improve compliance with tracking sleep and the accuracy of behavioral treatments for insomnia.

New technology is providing the potential for improved techniques of administering personalized medicine, yet these applications have not yet implemented clinical treatments for behavioral disorders. If the scientific and clinical community embraces these applications, great strides can be made in improving behavioral treatments of health-related problems. This could lead to health care that is more accessible, affordable, personalized, and preventative. **SR**

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