



# FOQUS: A Smartwatch Application for Individuals with ADHD and Mental Health Challenges

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## ABSTRACT

This paper reports on the design of *foqus*, an app running on a smartwatch to aid adults with mental health conditions like ADHD and mild forms of attention deficiency through two main routes – tools to foster extended focus and tools to reduce anxiety/stress. Using a user-centric design approach, three important features are identified, implemented and evaluated which aim to leverage the benefits of wearable devices: a flexible implementation of the Pomodoro time management technique, a tool for guided meditation, and positive message priming. Initial user test results suggest smartwatch-based interventions as a viable, ubiquitous tool for addressing mental health and stress related conditions.

## Keywords

Wearables, Smartwatches, ADHD, Attention Deficiency, Mental Health.

## 1. INTRODUCTION

In the emerging era of wearables and the quantified self, new opportunities arise for the application of computing technology in the area of health and wellness. Whilst much work has been done regarding physical fitness tracking, a less addressed area of inquiry is the application of wearables to mental health and wellness issues. Mental health issues such as ADHD, which materialize in the form of obstacles to sustained task focus and constantly elevated levels of anxiety, can be a debilitating challenge to adults as well as children [2]. Unfortunately, the impact of such mental health issues on the quality of life, are less likely to be observed by the general public, and not given appropriate attention. In addition, for adults with mild forms of ADHD and stress, few tools exist that can help them adopt behavioral change approaches to improving their condition. To address this, the current study presents a working prototype (*foqus*) of a wearable application with feature that assist a user in improving task focus and reducing stress.

### 1.1 ADHD and Work

Traditionally, ADHD has been viewed as a childhood disorder which youngsters outgrow as they get older. However, recent studies have highlighted ADHD diagnosis within adolescents and older demographics [2]. Attention deficit problems in the workplace can cause an individual to exhibit symptoms such as anxiety, depression and low self-esteem. They appear to be flighty, edgy, late, disorganized, constantly unable to meet deadlines,



Figure 1. Interface screenshot for *foqus*.

prioritize appropriately, fidget and daydream. The work of de Graaf et al [2] shows that 3.5% of all working adults (age 18 – 44years, n = 7075) across 10 countries met the standard (DSM IV) diagnosis criteria for ADHD. This suggests that a significant percentage of ADHD cases persist into adulthood, and only a small amount receive appropriate treatment. Their findings also highlight the impact of ADHD on job role performance for workers (employed and self-employed). Specifically, workers with ADHD had an excess of 8.4 more sickness absence days per year and greater annualized average excess number of workdays associated with diminished work quantity (21.7 days) and quality (13.6 days). Taken together, it is projected that various forms of ADHD are associated with 143.8 million lost days of productivity each year [2]. For such adults, there is value in assistive tools that help manage their conditions.

## 2. DESIGNING A SOLUTION

Given the neurobehavioral nature of ADHD, this work explores the design of technology tools that implement behavioral management techniques (BMT) approaches to ADHD treatment. BMT covers a range of cognitive behavioral approaches such as cognitive training, and social skills training which have been identified to be particularly helpful when patients are unresponsive to medication, intolerant to medication, when symptoms are mild or where there are strong ethical or moral objections to medication [5]. Related work includes interventions where a video game gets harder when a player's brainwaves indicate waning attention[6], and a tool that utilizes skin conductance sensors to estimate stress and offer positive priming messages [7]. Other recent work in this area explore the use of smartphones, EEG and heart rate monitors to track ADHD behavior in children [6]. A drawback of these approaches is a lack of ubiquity and complexity of their setup that may limit their effectiveness especially within the workplace. These drawbacks can be addressed through the use of smartwatches (as highly ubiquitous and personal devices) while leveraging their multiple sensors such as heart rate, ambient conditions (light, pressure, UV) and proximity sensors [1]. To build the proposed solution, a user-centric design approach was adopted which began with a user survey (n=27, age 16-40), followed by artifact prototyping and usability tests (n = 10). Results from the survey showed that most of the individuals were highly interested in

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wearable devices and felt wearable apps were *more likely* to help them realize their mental health goals compared to smartphone or desktop apps. Participants also described their attention deficit issues mainly as an *inability to complete* extended tasks and *high levels of stress/anxiety*.

### 3. RESULTS

#### 3.1 System Design

Based on the initial survey, the following app features were implemented.

**Pomodoro:** This feature implements the Pomodoro time management technique (see <http://pomodorotechnique.com>) which suggests tasks be broken down into 25 minutes of uninterrupted work sessions followed by 5 minute breaks. This technique has been acknowledged to help reduce procrastination, avoid distraction as well as engender flow and focus. In our implementation we abide by the tenets of the Pomodoro technique but allow for a flexible control of work and rest durations to accommodate users with diverse time schedule granularity. Haptic feedback (vibration cues) are also used to notify users of focus milestones and end of sessions.

**Mindful Meditation:** This feature provides timed visual and haptic cues which guide users on regulating their breathing pattern as a meditation session progresses. Users can adjust the inhale/exhale cycle duration for deeper meditation and vice versa as well as modify the length of the entire session. Users are then presented with their average heart rate before and after the session as an objective measure of its effectiveness. This instant feedback on the benefit/quality of the completed meditation session, coupled with a visualization of progress is designed to improve the user's motivation and effort.

**Message Based Priming:** Priming is implemented in two ways throughout *Foqus*. First, positive messages (e.g. Awesome job!) are displayed on successful completion of a Pomodoro or meditation session. Secondly, there is a dedicated Health Tips screen that provides mental health tips (adapted from the mental health foundation).

#### 3.2 Usability Study Results



Figure 2: User test of *foqus* hi-fi prototype

To evaluate the usability of *Foqus*, a working prototype (see Figure 1) was developed and deployed on the Samsung Gear 2 smartwatch. A cognitive walkthrough was performed to ascertain functional completeness, followed by usability tests ( $n=10$ , age=21-30) with participants who indicated they struggled with attention deficiency in their daily work. Each was asked to perform at least one focus and one mindful meditation task over a 7-day period. The focus task involved the use of the Pomodoro feature in completing 2 hours of focused work while the meditation task involved completing at least 3 meditation sessions. They were then asked questions about the value of the app, its usability and to review the session results. Findings are summarized as follows:

i.) Users made less interaction mistakes on the interfaces where functions were disaggregated into multiple screens. E.g. rather than

adding 4 buttons on the screen, a horizontal scroll menu with 4 distinct screens produced better results.

ii.) Context was an important factor for users in constructing the value of app functions. For example, a user mentioned “*This app would be most valuable to me ... especially during my yoga or meditation class*”.

iii.) While there were concerns regarding the accuracy of the smart watch heart rate readings, users were excited about the *instant feedback* on the effect of their meditation session. A reduction in measured heartrate made users feel more satisfied with a session.

iv.) 8 users (80%) reported reduced levels of stress/anxiety after each meditation session.

v.) Inhale/exhale vibration cues helped users remain mindful during meditation session and was particularly amenable for sessions at their work desks.

### 4. CONCLUSION

In this work, a smartwatch app designed to help users improve their ability to focus on tasks (via a flexible implementation of the Pomodoro time management technique), reduce their anxiety via mindful meditation and improve their overall mental health via positive message priming was designed and implemented. The intervention provided in this study is put forward as a first step in designing assistive tools for adults with attention deficiency and stress challenges in the workplace. In conclusion, the choice of the wearable platform in this study is timely, given recent investments in smartwatch development from large technology companies like Google, Microsoft, Samsung, Asus, Apple as well as fashion and consumer electronics companies like Withings and Montblanc. As these firms push the envelope regarding the array and quality of sensors embedded within smartwatches, design direction from this work will likely become even more pertinent. Future work will entail a larger field study and in depth analysis of the efficacy of *Foqus*.

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