Towards Better mHealth Apps: Understanding Current Challenges and User Expectations

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ABSTRACT

Mobile health (mHealth) apps have become ubiquitous and offer several different features to provide a better health outcome for end-users. While the availability of thousands of mHealth apps offers a great many options for consumers, they also introduce several challenges if needing to use more than one app. We designed an anonymous survey based on constructs of the Technology Acceptance Model (TAM), the Mobile App Rating Scale (MARS) and the Value Proposition Canvas to collect data on the user experience (UX) around these challenges. We surveyed 70 people over the age of 18 having experience with mHealth apps and found issues such as limited customizability, unwanted and redundant features, and data entry challenges that lead to a degraded UX overall. These challenges are also valid from a developer's point of view where they spend significant efforts in developing these redundant or unneeded features for more than one platform. In this paper, we discuss these user challenges and emerging implications for mHealth app developers.

KEYWORDS

Mobile health, applications, micro-mHealth apps, tool demo

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1 INTRODUCTION

mHealth applications support health delivery through mobile phones, wearables and other devices [28]. Several mHealth systems have been created for various applications and it is estimated that more than 350,000 digital health applications are currently available in app stores [17], with the market still growing. Similarly, the number of mHealth app users has also constantly increased with the projected number of users reaching 87.4 million by 2020 in the US alone [21].

Although the presence of numerous applications provides end users a variety of features to choose from, it also introduces several challenges in the user experience (UX) leading to complaints and poor acceptance. Evidence has shown that most apps do not offer a complete set of information and features end-users need with many features fragmented across several apps [15, 27]. Similarly, users have also been shown to prefer not to download health apps as they would unnecessarily increase the number of apps on their smartphones [27]. There is therefore a need to design fewer apps that can meet several requirements where good design of functionality provided by apps would be more beneficial than using several apps [25]. A significant number of health application users also stop using such services due to issues such as hidden costs and a *significant* burden of data entry [12] which also affects app usability [30]. End users are also known to stop using health apps after a few times of use [12, 26]. Similarly, challenges around less-than-ideal mobile interfaces along with system learnability issues [7, 10, 16] only push users away.

Although studies have been conducted around the usability and user experience of mHealth apps [2, 5, 14], most focus on individual services and often ignore the challenges associated with the use of more than one app. To the best of our knowledge, this is the first study investigating the challenges with the use of more than one app. While the aforementioned challenges were critical when smartphones had limited storage, we sought to investigate the current state to determine if these challenges are still valid today. Our objective in this study was there to evaluate the experience around the use of multiple mHealth apps. We attempt to answer the following key questions:

(1) What are the main challenges end-users face when using more than one mHealth app?
(2) What are the expectations end-users have of their future mHealth apps?

To address these questions, we designed a user study for people above the age of 18 with experience using mHealth apps. The study was based on the constructs of the Technology Acceptance Model (TAM) [6], the Mobile App Rating Scale (MARS) [24] and the Value Proposition Canvas [18] to identify the pains (challenges) users

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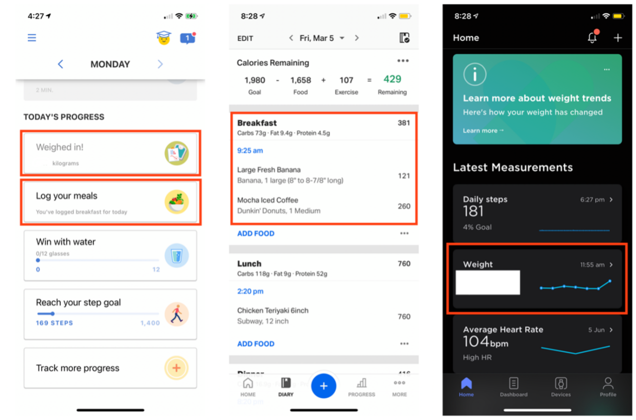

Figure 1: App screenshots showing feature overlaps (in red) and different implementations of these features

face with current mHealth apps and expected gains (expectations) from future apps.

2 MOTIVATING EXAMPLE

Consider a weight-loss scenario where a person wants to keep track of their diet and exercise along with their body measurements. Many mHealth applications are available for this use-case with some being more suitable for certain tasks. For instance, for weight-loss coaching one may decide to use Noom[1] - a very popular health and weight loss application that offers very basic tracking features for weight and meals. However, a better alternative for tracking nutrition may be an app like MyFitnessPal[2] that offers a much more comprehensive food database. Similarly, for tracking physical parameters such as weight and body composition, one may choose to use smart devices from companies such as Withings which offer apps such as Health Mate[3] that work with their own hardware. While a combination of all three apps would provide the ideal functionality, many other features offered by these apps could remain unused, which combined with the feature overlaps would result in confusing interfaces, potential data privacy issues, app bloat and wasted storage. Similarly, users may need to manually enter the same data across each app which further degrades user experience. Although frameworks such as Google Fit provide mechanisms for sharing data between apps, many such features have only partially been implemented in many mHealth apps. Figure 1 highlights these issues across three different apps.

The three apps discussed above have some feature overlaps where one app may offer a better implementation of a certain functionality. While this is highly subjective, it supports our view that not all features may be received equally by consumers. Similarly, each app also included unique features; however, users may not require them all if their needs are limited to specific activities. While this example is limited to one task, we hypothesize that this is true for other tasks as well affecting app adoption and UX when considering the use of several apps - a gap that needs to be addressed. This paper presents a part of our work in validating this hypothesis and is discussed further in the following sections.

Dimension	Description
Discovery and Acceptance	User awareness of apps and factors influencing app acceptance
Functionality	App features for completing tasks
Design	App design aspects - aesthetics
Usability/Ease-of-Use	User friendliness and ease of use
Data Management	App data collection, storage and management

Table 1: Key dimensions derived from the chosen frameworks

3 METHODOLOGY

We designed a user study combining the TAM constructs of *Perceived Usefulness and Ease of Use* [6], and the MARS constructs of *Design and Aesthetics, Engagement and Functionality* [24]. These segments were then aligned with the *Pains* and *Gains* components of the Value Proposition Canvas [18]. The frameworks were chosen because of their extensive use in evaluating and understanding user experience and adoption of mHealth applications [19, 22, 23], evaluating app quality [1, 3, 9] and value proposition in eHealth apps [13]. Table 1 lists the main dimensions derived from these frameworks.

Our survey questions were based on these dimensions which were then arranged into four blocks to obtain details around (1) Usage pattern to identify the kind of apps being and the users' objectives; (2) App discovery and acceptance; (3) Key challenges around using mHealth apps (to align with the *pains* component); and (4) Expectations from future health apps (to align with the *gains* component). Categories (1) and (2) had 9 questions and were more subjective and gave the users some flexibility with an option to describe their answers. Categories (3) and (4) comprised 13 and 6 questions respectively and used a five-point likert scale[4].

We conducted this study as an anonymous survey hosted on Qualtrics[5] to answer our main questions. The public link to the survey was distributed on a professional networking site (LinkedIn[6]) as well as social media forums where we used snowball sampling [20] to reach more potential participants.

4 RESULTS

We received 82 responses which were then filtered to remove the incomplete ones. Overall, we obtained 70 complete and usable responses. The majority of the respondents (64.3%, 45/70) fall into the age group of 18-30 and 60% identify as male (n=42).

4.1 Challenges with current mHealth apps

Table 2 summarizes the responses to the user challenges reported, and these are detailed below.

Installing and managing several apps: We expected most respondents to agree to the statement but got a mixed response with

[1]https://play.google.com/store/apps/details?id=com.wsl.noom
[2]https://play.google.com/store/apps/details?id=com.myfitnesspal.android
[3]https://play.google.com/store/apps/details?id=com.withings.wiscale2

[4]This conference paper presents a small subset of our survey, the complete dataset from which will be compiled and submitted later as a full paper.
[5]https://www.qualtrics.com/
[6]https://www.linkedin.com

Question	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
My current mHealth apps provide additional features I don't need or intend to use	1	8	17	28	16
I use multiple mHealth apps to achieve even one health goal (e.g., multiple fitness apps)	4	19	20	20	7
I always need to install and manage more than one app to achieve my intended health goals	5	12	23	21	9
I found some overlaps between the features provided by the mHealth apps I use	2	5	20	32	11
I am happy to manually enter data in mHealth apps	10	20	12	23	5
I am happy to manually enter data across the several mHealth apps I use when needed	20	19	12	17	2

Table 2: A summary of key user challenges

Question	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
I would prefer an mHealth app that allows me to add/remove health-related features based on my needs	0	4	11	31	24
I would prefer a single mHealth app providing me all the health-related functions I need instead of using several apps	0	2	13	24	31
I would prefer automated data collection using peripherals or built-in sensors	3	5	17	22	23

Table 3: A summary of key user expectations

32.9% of the respondents remaining indecisive. A sizeable number (42.9%, n=30), however, agreed with a smaller number disagreeing (24.3%, n=17).

Functional overlaps and unused features: Although additional app functionality can be useful, an overhead of the same can also be perceived as bloat which may drive users away. Most users (45.7%, n=32) indicated they found overlaps between features offered by different apps and that they also provide functions that they don't intend to use (40% agreeing with 22.9% strongly agreeing).

Data collection and management: mHealth apps work off data collected from sensors or by manual user entry and we expected some resistance to the latter. Our observations show a mixed opinion with 40% of the respondents (n=28) happy with manual entry and 42.9% (n=30) indicating a preference for automation. This, however, was not the case when dealing with more than one application with more than half the respondents (55.7%, n=39) indicating their dislike for manual data entry across several mHealth apps.

4.2 Expectations from future mHealth apps

Table 3 summarizes the key user expectations and are expanded below.

The need for a single app and feature customization: Given the importance of health data and the convenience expected by consumers, it is not surprising that most respondents preferred a unified platform for managing their health data (44.3% strongly agree, 34.3% somewhat agree).

Similarly, given the challenges around using several mHealth apps, especially with fragmented and often overlapping features, respondents were more inclined towards a highly customizable app that would allow them to customize features according to their needs (44.3% somewhat agree, 34.3% strongly agree). This is also highlighted in a participant's comment - *"My main requirements are calorie tracking & step counting. If a single app can do both, I would be more than happy to use it."*

Support for automation: Automated data collection is expected to improve the UX and a majority of the respondents indicated a strong preference for automation (64.3%, n=45). Although useful, it can be a double edged sword as peripherals can add to the overall cost. A participant's comment - *"...is there any way to not need to invest in more devices to make mhealth apps useful?"* - shows the aversion to additional expense and indicates the need to integrate more cost-effective, built-in sensors and to investigate more innovative use of current sensors.

5 DISCUSSION

5.1 Challenges and Expectations

mHealth applications and devices are being increasingly adopted and services that meet user expectations can further "increase the use of these apps or services regardless of health literacy levels" [4]. Studies around the design and use of mHealth applications have been conducted in the past that have helped understand design expectations of health applications[4, 8, 11, 29]. However, most studies focus on one single domain or a single application, and to our knowledge, our study is the first to analyse the challenges around the use of several mHealth apps and expectations from future mHealth apps.

Challenges: Given the availability of thousands of health apps in the marketplace, it was not surprising to see most of the respondents remaining either neutral or indicating their need to use several apps for managing their health goals. Similarly, we were not surprised to see most participants reporting additional, unnecessary features along with feature overlaps. While additional features may not necessarily degrade performance, they may add extra complexity to the apps which may end up confusing a user more. Manual data entry across several apps is also a growing challenge given the shift towards using more than one mHealth app. Overall, while the apps helped the respondents achieve their health goals, these challenges were faced by almost all participants and can have a significant impact on the acceptance and adoption of services where good quality apps may be rejected for not completely satisfying a user.

Expectations: Users expect a lot more from current apps and having the option to install only one app with the ability to add or remove functionality as required was a common preference among the respondents. While such capability would address challenges around feature overlaps and unneeded *bloat*, a few participants had a different opinion suggesting an apprehension towards potentially more complex apps. Similarly, another concern could be around security and privacy where a single platform has control over all their health data. However, these concerns can be addressed more user-friendly designs and open-source platforms that offer complete transparency on how data is stored and managed. Manual data collection was not collectively seen as a big challenge for single or several apps. However, 64.3% (n=45) of the responses show a preference for using built-in sensors or peripherals suggesting that although it is not necessary, convenience through automation does have a strong influence and is a *good-to-have* addition.

5.2 Emerging Implications for Developers

Above we introduced the challenges and expectations from the user's perspective. Here, we discuss their implications from a software engineering perspective.

End-user feature toggles: Not all users may need every feature provided by their apps. While this is not a challenge in itself, developers may invest significant efforts to add several potentially unused features that adds to app complexity. A better approach perhaps would be to make apps customizable using *feature toggles*[7] to manage an app's complexity and appeal.

Prevent redundant feature sets: The need to use more than one app also highlights fragmented functionality among different services. While installing several apps is not unusual for mutually exclusive goals, challenges arise when these apps offer similar features. Though this does not directly impact the development of individual apps, these feature redundancies can collectively degrade the UX, especially if they work with the same data. A participant's comment - *'...Data reliability is hence an important concern. My experience on Apple Health is that a lot of apps ask permissions to write/overwrite existing health data which doesn't properly convey the boundaries of those write operations'* - also highlights the need to avoid such potential conflicts. Allowing users to personalize app features can help remove this redundancy and we speculate that a single, customizable app supporting individual features as app plugins could help overcome this challenge.

Data collection: Automated data collection with sensors is mostly preferred as they involve less interaction with apps. However, while manual data entry is necessary for several reasons, users dislike repetitive manual entry specially if the data is already available on their smartphones. A shared data model or framework storing such data is suggested and integrating apps with them ones would be beneficial. Although Google and Apple provide their own health frameworks, they may be limited in supported datatypes, and custom types may not be compatible with all apps. More work needs to be done in creating an all-inclusive framework that works across both platforms.

Need for more innovative mHealth apps: Our results suggest app designs need to incorporate features offering more control to end users while not increasing app complexity. Modern mobile web app frameworks are already blurring the lines between web and native apps, but they can quickly fall behind in supporting new platform features. However, with hybrid apps blending the best of both native and web apps, we believe that a hybrid platform may be the most suitable for addressing these challenges. Inspiration can be drawn from successful commercial examples such as WeChat[8] and Huawei's Quick Apps[9] to create an mHealth platform and an ecosystem of install-free mini apps specific to the health domain.

5.3 Threats to validity

While we tried to limit the survey to genuine participants through our recruitment advertisement, plain language statement and survey terms, it was not possible to determine if the respondents were genuine given the anonymous survey design. However, since participation was voluntary and offered no compensation, the likelihood of invalid participants is low. Another threat to validity was the small number of respondents with a higher proportion of young adults because of which the data from this study may not be generalizable to a wider population.

6 CONCLUSION

The availability of thousands of health applications and the tendency of users to often use more than one app for managing their health or to achieve a health goal introduces several challenges. To explore user opinion, we designed a survey targeting mHealth apps users above the age of 18 on such challenges around the use of more than one app and expectations from future mHealth apps. Our anonymous online survey obtained 70 valid responses which outlines the need for end-users to use several apps for managing their health goals, the presence of redundant and unused features, and a dislike for manual data entry across multiple apps. Participants also indicated their preference for flexibility and a unified platform for managing their health. Overall, our findings can guide the design of future mHealth services to hopefully have a positive impact on improving the design of health and wellness applications.

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[7]https://martinfowler.com/articles/feature-toggles.html

[8]https://www.wechat.com

[9]https://developer.huawei.com/consumer/en/huawei-quickApp

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