# Designing for Engaging Experiences in Mobile Social Health Support Systems

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## Abstract

In spite of a rising interest in the use of mobile platforms to promote and sustain healthy behavior, the effects of design choices on user experience and user engagement in such applications have been relatively under-explored. This paper reports on two studies of VERA, a mobile phone application that allows users to document and share their health decisions with other users. Findings show how different aspects of the sociotechnical design—social vs. individual usage, and whether groups of users share common health goals—impact sustained engagement with the system. These findings, supported with evidence from qualitative interviews, help us to reflect on the lessons that we learned while deploying each of these designs with representative users, lessons that can be leveraged to design for effective persuasion and social support in future mobile health systems.

## Keywords

H5.m. Information Interfaces and Representation (HCI): Miscellaneous; J3.b. Life and Medical Sciences: Health; J9.d. Mobile Applications: Pervasive Computing

Over the last several years, there has been significant academic and commercial interest in using mobile platforms as a means for fostering improved health. Although most of the published research in this area has focused on a system's efficacy in promoting health, the kinds of *experiences* afforded by these systems are also important [1], particularly with regard to system adoption and continued use over time. This question—how to design for sustained engagement in the context of supporting or encouraging health and wellbeing—has been relatively under-explored.

In this paper, we explore this question through two studies of a mobile social health application called VERA (Virtual Environments for Raised Awareness), which we developed and deployed over the course of two years. VERA allows users to share health-related activities and decisions with one another in an open-ended fashion. That is, VERA does not focus specifically on one area, such as physical exercise or nutrition, and it does not prescribe specific actions for users to take with respect to their health decisions. Rather, it allows users to define health and to determine for themselves what is related to health, providing a contrasting approach to existing systems that sense and analyze only a specific set of human behaviors [2]. Based on analysis of usage data and interviews with users from each of these two studies, we present lessons learned from our experiences, which serve as informal design suggestions to facilitate engagement in the context of mobile health applications. The lessons that we learned both pertain to and extend beyond common technology concerns—the application's visible interface and the infrastructure behind it—to include strategies for deploying mobile social health applications within real-world cohorts and recognition of relevant external social contexts that govern social interactions within the mobile platform.

In this research, we take a sociotechnical systems approach to design. That is, system design includes not only the interface and architecture of an application itself, but also the various social contexts in which the application is embedded. Thus, the two studies presented here, while involving few changes to the technology itself, explore different social configurations among the system and groups of users. This approach allows us to examine how different interpretations of the general open-ended design principle described above impacted users' engagement

and experiences with the system. Though the focus is primarily on a system for promoting and supporting health, the design recommendations presented here may be applicable to the creation of spaces for health awareness and social engagement, and for designing engaging experiences in other contexts, as well.

**RELATED WORK**

In the relatively short history of mobile health, much of the work has been persuasive in its aims—encouraging users to improve health or health-related behavior. Such work often draws on Fogg, who contributed a set of guidelines, derived from cognitive, experimental, and social psychology, for creating persuasive technologies for changing user behavior [3]. The persuasive technology paradigm has certainly been useful for work in mobile health [4, 5], and others have argued that mobile devices are particularly useful in this context, as they allow intervention at the moment of decision-making [6]. However, while many of the guidelines put forth by Fogg may lead to sustained user engagement (e.g., the use of intrinsic and extrinsic motivators such as challenge or reward [7]), the intent of persuasion is to drive behavior change, and it is not necessarily true to assume the two go hand-in-hand.

A prime example of a persuasive mobile health system designed with an eye toward sustaining user engagement is UbiFit Garden [8]. The system epitomizes persuasive technology; users' activities are passively recorded using simple sensors (wearable accelerometers and geo-location via cell towers) and the app provides fun real-time feedback and rewards. What makes UbiFit Garden special from the perspective of user engagement is the manner in which the feedback is delivered. The app responds to physical activity on the part of the user by growing a virtual garden on the phone's home screen, with different life-forms in the garden growing in response to different types of activity. Given the frequency with which individuals access mobile phones, this "glanceable" display not only provides a subtle, constant reminder of the user's progress, but it also encourages—or even forces—the user to engage with the system many times each day.

Other successful mobile health systems have found different ways of encouraging user engagement. For some, the value and quality of the content provided is enough to sustain engagement. Text4Baby has been a tremendously successful mobile health campaign, yet the "system" consists of nothing more than receiving daily SMS messages about one's pregnancy and forthcoming baby [9]. Many diet tracking systems, particularly those intended for individuals with acute dietary needs (for example, diabetics), fall into this category as well [10]. The users of such systems are compelled to use the systems by external forces that demand use of the systems' content and services.

Still other systems rely on sociality to involve and engage users. EatWell, for example, is a voicemail-based system in which users call in to record and to listen to open-ended messages about challenges and solutions to healthy eating in low income, urban communities [11]. Users' attachment to their community, their shared ground with other users, and their desire to overcome significant challenges all play roles in making EatWell engaging. Although not examining mobile health applications per se, numerous studies have focused on online social support systems to examine the features of these systems that lead to growth and user engagement [12]. Our research differs from most of this previous work in its emphasis on user-defined health awareness. We suggest that a minimally prescriptive system may be more engaging, not only because it is broadly applicable to a range of health behaviors (as opposed to just food or exercise), but also because it motivates users to continually self-define and explore what it means to be healthy. Furthermore, the complex and highly situated nature of health makes it particularly amenable not only to this open-ended system design but also to the sociotechnical systems design approach we employ. Thus, this paper explores how not only the technology design but also the ways in which technology use is embedded in and shaped by social practices may influence engagement with these health systems.

**VERA: TWO STUDIES, USER ENGAGEMENT, AND LESSONS LEARNED**

The VERA application began as a tool for sharing images. It emerged from research in socially supportive emotion-sharing applications [5], and resulted from our observation that users wanted to take their own pictures as part of their emotion tracking. We initially piloted a prototype of the application as a food-sharing platform; users took photographs of their food and tracked their emotional experiences as they corresponded to their eating behavior. As we analyzed the early data about the content that our beta testers were posting—and because we noticed that people

tended to share pictures of general health behaviors—we decided to re-frame VERA as a more open-ended mobile health-sharing platform. In VERA, users' photographs, comments, and self-assessments represent an open-ended model of health behavior, and the system serves as a platform for recording, sharing, and reflecting upon these facets of day-to-day life, with the specific role of the system evolving and expanding through each of our studies.

**Study 1 – Social vs. Individual**

Initially, VERA was developed as an Android application and deployed as part of a controlled experimental study. During the study, participants were instructed to document their health behaviors and given examples of health behaviors (such as "food" and "exercise").
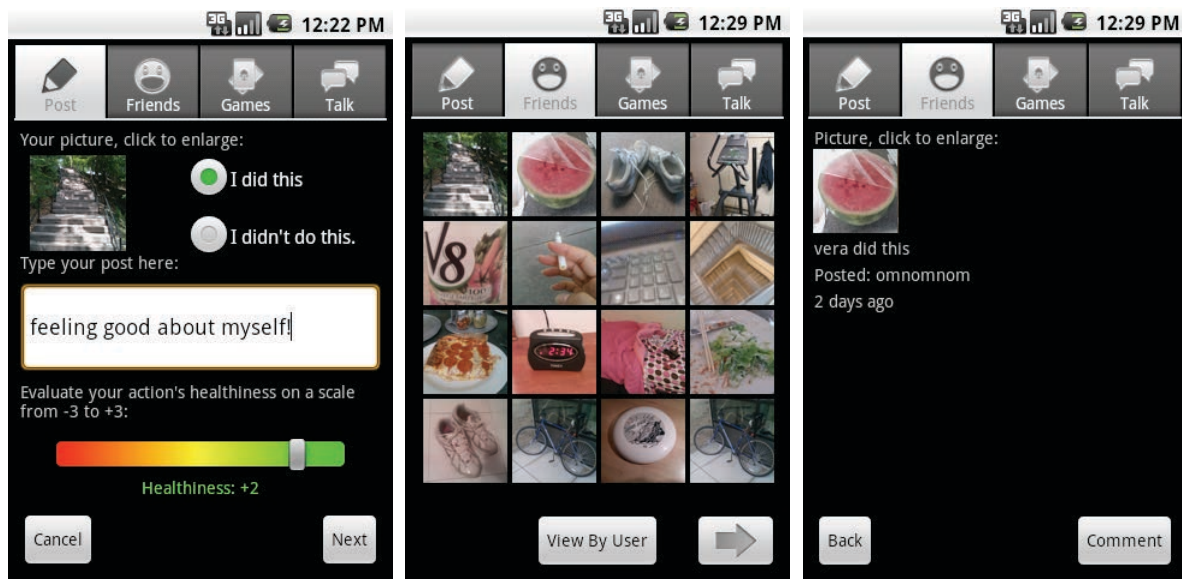


Figure 1. The interface of VERA's first iteration: Submitting post details (left), group view (center), and detail view (right)

To post an activity, participants opened the application (either on a personal or a lab-issued mobile device). Participants were immediately prompted to take a picture using the built-in camera. This picture was intended to represent the health activity they were about to perform, or had just performed, whether it was eating food, exercising, using a technological device, engaging in a social activity, or anything else. It is important to note that users could also take a photograph to represent a health activity that they *did not* perform, such as choosing not to eat a piece of cake or deciding not to go to the gym. It was left entirely to the users to decide what constituted a health activity, and to report it as such. Next, users were brought to a screen where they indicated whether they did or did not perform the health activity that they photographed, and they were asked to briefly describe the image or the activity. Finally, users were instructed to assess the healthiness of this activity (Figure 1, left). Users were instructed to assess their choice, and not the photograph, itself—for example, if the image was of a food that they chose not to eat, they were asked to assess the healthiness of not eating the food that they photographed. After submitting the image of the health activity, the user was prompted to reflect on their emotional state and instructed to choose, from an established array of thumbnails, an image that most closely reflected their emotional state at the time of performing (or not performing) the selected health activity [13]. After completing their post, users were shown images of other health activities that had recently been posted (Figure 1, center).

Participants in our experimental study were randomly placed into either a social ($n = 17$) or an individual condition ($n = 17$). Individual-condition users could only access their own previous posts (Figure 1, center) and, in essence, experienced VERA as a personal mobile health diary. The participants in the social condition could see all of the

previous posts of all participants in the social condition. Because recruitment for the study was done in the form of fliers and general email solicitation, the participants in the social condition did not, for the most part, know each other in advance. Users were encouraged to use the application every day for two weeks. At the conclusion of our two-week trial, in addition to completing a quantitative survey, participants were interviewed to learn about their views on healthiness and the role of the VERA application in their day-to-day health decisions.

In the social condition, VERA provided a variety of tools allowing users to browse and interact with the data shared by others in the study. Participants could click a thumbnail to view a larger image, learn whether the other user did or did not perform the activity, review the photo's description, and post comments (Figure 1, right). They could also filter posts to see only the content posted by another specific user. The design of the posting interface and experience—using an arbitrary photograph, requesting minimally constrained details, allowing for submission of a free-text caption—were intended to afford open-ended, user-driven definitions of health and healthiness [2].

We were also interested in learning whether placing participants into social conditions would lead to differences in engagement with the system. In order to encourage honest disclosure, users' emotional and health self-assessments were not visible to others (Figure 1, right). Participants were asked to post a certain number of health activities each day and encouraged to post comments on other peoples' posts.

*Results:* We compared the two conditions—individual vs. social—with respect to changes in engagement from the first to second week of the study. Specifically, we calculated the average number of posts made in the system during each day of the study. In the social condition, while the number of daily posts decreased slightly from week one to week two, the change was not statistically significant ($44.4 > 36.3$, $t(12) = 1.52$, $p = .15$). In the individual condition, the number of posts per day dropped significantly from the first to second week ($49.3 > 33.3$, $t(12) = 2.79$, $p = .016$)—almost twice as much as in the social condition ($16.0$ vs. $8.1$) (see Figure 1). These differences suggest that the social condition may have proven more engaging, a conclusion for which we found some support in our open-ended interviews.
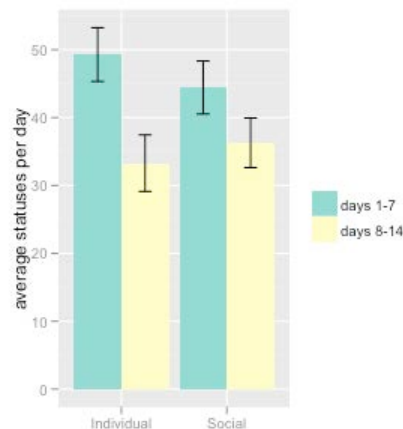


**Figure 2. In the individual condition, the number of statuses submitted per day decreased significantly from the first to the last week of the study, but it did not decrease significantly in the social condition.**

Participants in the social condition reflected on the impact of other peoples' posts on their experience of using the application: they were curious about who the other participants were and noticed patterns in other users' posting behaviors and the locations of their posted images. This increased interest in others' posts likely helped draw users back to the system and helped to facilitate sustained engagement. However, this social inquisitiveness was somewhat stymied by the VERA interface. Participants had to click on the thumbnail of the image to see whose it was, a degree of indirection that hindered the association between content and users. Users also reported difficulty in filtering the posts to find content posted by a particular user. While this functionality was supported, it was not intended as a primary interaction of the application.

Our initial deployment also prompted us to reconsider the design of our recruiting process. In interviews, participants expressed concern about being asked to share photos and comment on strangers' content in the application and compared the relative lack of privacy settings on VERA with other social platforms. These recruitment processes, and, more generally, the social contexts in which the system was deployed, became a primary focus in the subsequent iterations of the system.

**Study 2 – Shared Goals**

Several months later, we ran a second study using the VERA application. Given participants' interest in running VERA on their own devices (in mid-2010, participants with smartphones most often used iOS), we developed an iPhone version of the application. Functionally, this version was identical to the Android app, albeit with a few aesthetic differences resulting from variation in the affordances provided by the operating systems' interface toolkits.

Based on the interviews from our initial study, we hypothesized that social engagement among users in this type of health app might be most productive in groups sharing similar health goals. That is, our decisions to support both sociality and not open-ended definitions of "health" made sense, but users with varying/disparate motivations for using the app might be too motivationally disconnected for effective social engagement.

In this second study, we changed our participant recruitment strategy. Working with a university Health and Wellness Program, which offers classes and social support (email lists, walking groups, etc.) for staff, faculty, and their families, we recruited from two of their mailing lists: a general health and well-being list for all members of the program, and a weight-loss mailing list for individuals trying to lose weight. Based on volunteer responses, we assembled two experimental groups: a control group of participants from the general list with no particular shared health goal ($n = 16$), and a group of participants from the weight-loss list who all shared a goal of losing weight ($n = 8$). Some dyads or triads of users previously knew each other, but most groups were comprised of strangers. Participants used VERA for one month and were interviewed approximately three weeks into the study. As described above, we did not implement changes to the system itself but rather sought to examine the effects of the sociotechnical design—the interaction of the application's design and the social context in which it was adopted— on user engagement.

*Results*: As with Study 1, to assess sustained engagement, we examined changes in the number of posts between the first and last weeks of the study. In the group of general wellness program members (the "general" group), the number of posts per day dropped significantly from the first week to the last week ($34.1 > 19.6$, $t(11.7) = 2.36$, $p = .036$). However, in the weight-loss group, where participants had a shared goal, the change from the first to last week was not statistically significant ($10.9 > 7.6$, $t(8.4) = 1.35$, $p = .21$). In the general group, the decrease was several times larger ($14.5$ vs. $3.3$) (Figure 3, left).

Unlike Study 1, both groups in Study 2 were in social conditions, so we can also examine changes in the number of messages sent using VERA. Here, the story is somewhat different. The general group showed a decrease in the number of messages sent per day between the first and last week, but the change was not statistically significant ($7.6 > 1.8$, $t(4.4) = 2.29$, $p = .077$). However, the weight-loss group demonstrated a significant decrease in the number of messages per day ($17.9 > 6.2$, $t(9.5) = 3.26$, $p = .009$) (Figure 3, right). Thus, sharing common health goals helped to reduce the amount of drop-off in health behavior posting but not the decrease in the amount of comments on others' posts. Again, we turn to the qualitative interview data to help interpret these findings and ensure that the differences that we observed were not solely due to the difference in the sizes of our two participant groups.
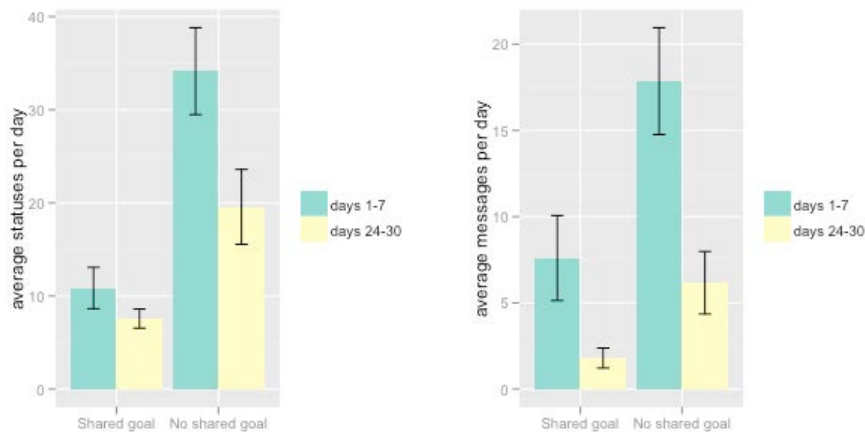
**Figure 3. The number of statuses posted each day decreased significantly from the first to the last week of the study, but only for participants without a shared goal (left). However, those with a shared goal sent significantly fewer messages to one another from the first to the last week (right).**

Participants reported being aware of others' posts inspiring them to be healthier, for example, seeing others going to the gym in the morning. Sometimes this went further; participants spoke of feeling like they were "in competition" with ambiguous others (e.g., seeing five sets of running shoes in one day) and accountable to these others, even within a space where they were identifiable only by username (at most, first name and last initial, though often these were also obfuscated).

Several members of the weight-loss group indicated the value of belonging to a group of individuals with more similar (health) motivations. Sometimes this value related simply to a desire to be in a group of people 'more like me,' with similar struggles, for example, maintaining a lower weight after weight loss. Often, an activity-focused community has its own set of language use and interaction mores. For example, participants reported appreciating others in their group understanding weight loss in-jokes and jargon (e.g., "reefy," a colloquial abbreviation of "re-feeding," as a reference to overeating) and talked about the carefully constructed positive and negative feedback styles used in weight-loss groups to provide social support. The extra attention needed to ensure that the content of comments were supportive while still being appropriate may have been one factor contributing to the drop off in messages among members of the weight-loss group; weight loss, as with many other health-focused areas, is one in which social support is especially valuable but where the potential for offense is high.

More generally, participants in the weight-loss group showed a particular interest in 'getting to know' the others in their group. However, rather than seeking a medium for conversation, they cited a desire for profile pages to communicate a short slogan or other information that could be used to assess group-mates' personalities. This request indicates interest in similar others and of self-presentation (weight loss members wanted to broadcast meta-information such as a personal weight loss goal), but a profile page was also referenced when discussing a desire for control over membership in their group, or at least control over which other users could see the posts that they had shared in the system.

Some participants of the general group reported converse desires. Specifically, according to one participant, "to know what other people are doing is irrelevant to me. I mean, it may have been different if I was in a weight loss program." Several participants in this group said that VERA would be more useful (e.g., as a training tool) if the user and/or the group shared a more specific health goal.

On the other hand, curiosity about others' activities may explain the lack of a significant decrease in the average number of messages within the general group. We are currently involved in qualitatively coding the content of VERA messages, and early findings suggest that many messages in the general group were *information requests* and *responses*, commonly with the purpose of clarifying, interrogating, and sharing more about the diverse health

decisions and behaviors presented. Our interview data anecdotally support this interpretation, as general wellness participants reported using messages to try and make sense of who did particular actions or cared about specific posts (e.g., "oh, *he's* the runner").

In summary, our second deployment of the VERA system was somewhat more successful than the first. Specifically, deploying the system to groups of users who had similar motivations and health goals helped to improve sustained engagement. However, this approach did not necessarily help the groups cohere. As a result, we argue that the social context into which a system is introduced should indeed be seen as part of the system design from a sociotechnical perspective.

**DISCUSSION—LESSONS LEARNED**
Our design of the VERA application was originally intended to embody an insight that arose from our previous research: that a mobile health application should represent health in an *open-ended* way, that is, to afford a wide scope of user inputs [2]. While many commercial applications excel at encouraging a narrow range of behaviors (such as eating or physical exercise), there are few that allow for a holistic, open-ended approach to documentation where users are allowed to classify and define health-activities on their own terms, using their own creative resources. These studies show how different sociotechnical approaches to this overarching design principle impacted engagement with the system. In this section, we step back to consider lessons learned that may be of value in informing other work in the space of pervasive healthcare applications.

*Make it social*: A sense of social presence is an important factor for engaging users in a mobile health application. In study 1, not only did participants in the social condition continue using the system, but they also reported feeling more motivated to post their own activities when there were other people posting. Making the VERA platform social decreased attrition and provided social support for users' health behavior.

*Allow degrees of social sharing*: We learned that affording a variety of social interactions helped to meet different user needs. For prolonged browsing on a mobile device, user behavior is similar to web browsing—excepting the different scale and ergonomics of phones—but when designing for short-term browsing, the designer should make sure that information is not obfuscated in the interface. In study 1, VERA users complained about having to click on the images to learn who uploaded them. If interaction is too cumbersome, it is not reasonable to expect that mobile users will participate with the same degree of engagement. The application should also allow a variety of social interactions, such as commenting and "liking" or supporting a post without having to type a comment. This is as important for different browsing contexts (participating on the go) as it is for promoting social support. As noted in study 2, the design of the interactions needs to be carefully curated so that there are easy ways to afford positive feedback about health decisions without unintended judgments on sensitive topics. Another request that emerged from interviews about social sharing of health information was to allow varied degrees of social sharing, or privacy settings within the application, to provide more nuanced negotiations of what information users disclose to whom.

*Leverage existing social structures*: The different contexts in which we deployed VERA had real implications on the way that it was adopted and appropriated by its users. Social users reported being more engaged when they felt connected, either by social ties, common goals, demographics, or location, with the other people posting content on the platform. Participants reported trusting other users on the application if they felt like they had things in common with them. Participants who felt like they were working toward a common health goal or had similar lifestyles as the other participants reported being more motivated to participate in the application (and the surrounding community). As a general take-away, this suggests that the representation of social groups in pervasive health applications should not be random but should leverage existing social structures, such as the weight-loss group from study 2.

*Afford individual-to-group relations*: In study 2, we observed the importance of enabling participants to explore other group members' interests, goals, and contributions. In a social environment, a mobile sharing platform for health should allow the user to relate to the general group, but also to build relationships with specific members of that group. Design choices have implications for users' ability to build individual relationships on a social media platform. A lot of these relationships are built silently (they require silent behaviors) as much as they do productive

social interactions (like commenting). The VERA interface did not explicitly support these types of person-to-person or person-to-group interactions, and it was one of the most requested capabilities for future versions of the system in our interviews.

In sum, the specific findings highlight important relationships between participants' engagement with the VERA system and the social contexts in which the system was used. The quantitative and qualitative data that we collected help to underscore the importance of these sociotechnical facets of the VERA system's design and the context in which it was deployed. We believe that these take-aways may provide value to others working in this space.

## CONCLUSION AND FUTURE WORK

This paper presents the findings from two of our deployment studies of VERA and a discussion about how the design of these kinds of mobile health applications can help facilitate sustained engagement. Most previous work on mobile applications for supporting health has focused on the application's ability to effect health changes [4, 6, 9, 10]. While promoting health outcomes is certainly important, previous work has documented problems with user drop-off over time [cf. 1]. Our contributions, then, are a series of observations from our work that might serve as informal recommendations to help others address this challenge. 9While VERA foregrounds the user's definition of health and healthiness, we believe that the recommendations that we reflectively distilled from our experiences—emphasizing *social* experiences in an application that *allows degrees of social sharing, leverages existing social structures,* and *affords individual to group relations*—may be useful in a variety of health systems, and even perhaps more broadly. Thus, this work represents an effort not only to design systems that help promote health but that also provide for sustained, engaging user experiences. Here, we have examined how manifestations of an open-ended design approach to health impacts user engagement and awareness in the context of mobile phone applications. In the future, we hope to gain a better understanding of the implications of different types and sources of feedback, monitoring, emotional state, and social networks on behavior. We believe that the sociotechnical design insights provided here may be generalized and used effectively in a variety of other health-related applications including tobacco cessation, treatment of alcoholism, chronic pain management, and chronic disease management. With a better understanding of the relationships between system design and the mechanisms of persuasion and social influence, we can further develop comprehensive and empirically validated design guidelines to effectively support maintaining a healthy lifestyle.

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