

This forum is dedicated to personal health in all its many facets: decision making, goal setting, celebration, discovery, reflection, and coordination, among others. We look at innovations in interactive technologies and how they help address current critical healthcare challenges. — Yunan Chen, Editor

Toward Supporting Personalized Tracking Experiences in Healthcare

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Self-tracking is a powerful means to enhance people’s awareness of their own behaviors, thoughts, and feelings. People use self-tracking to achieve various types of goals, such as to satisfy curiosity, to document data, and to change behaviors. To realize the full potential of self-tracking in pursuit of these different goals, people need to employ a tracking regimen that matches their motivation levels, capabilities, and preferences. Some people have a high level of motivation to engage in self-tracking, whereas others are less motivated and thus do better with a minimalist approach. People may also have different levels of technical proficiency and financial capability, as well as different preferences for tracking mechanisms (e.g., pen and paper, mobile apps, wearables). Furthermore, these aspects may change over the course of a tracking period, or over the course of a lifetime. Enabling people to personalize their self-tracking regimen is a promising way to address diverse tracking needs while at the same time enhancing a user’s sense of identity and engagement with the tracking tool.

We define *personalized tracking* as an act of tailoring a tracking regimen to suit an individual’s specific situations, preferences, and needs. The objects of the personalization include: 1) tracking items (i.e., what to track); 2) tracking means (i.e., what tracking mechanism to use, from manual to automated); 3) tracking rules (e.g., when and how often to track); and 4) tracking aids (e.g.,

reminders). To accommodate these aspects of personalization, we enabled people to construct their own trackers, while leveraging existing tracking services.

Personalized tracking is beneficial in many health contexts. For example, in the context of food tracking, people’s tracking needs vary depending on dietary problem (e.g., irritable bowel syndrome, eating disorder, diabetes), as well as a dietitian’s practice style [1]. In the context of sleep tracking, factors such as stress, caffeine, meals, alcohol, exercise, and medication affect sleep, requiring people to focus on individualized factors. Personalized trackers that support capturing only the most relevant data could ensure the clinical relevance of the collected data and cultivate a sustainable data-collection practice. Furthermore, when patients and clinicians collaboratively engage in identifying relevant data to be captured, the personalized tracking approach could help them communicate about health-related concerns and identify actionable insights [2].

Insights

- Personalized tracking can address diverse tracking needs while enhancing people’s sense of identity and engagement with the tracking tool.
- HCI methods (e.g., personas, co-design, focus groups) help us understand how and what to personalize for a particular health context.
- OmniTrack, a flexible self-tracking platform, enables people to construct personalized trackers on their mobile phones.

LEARNING PERSONALIZED TRACKING NEEDS

The knowledge about how and what to personalize for a particular health context needs to exist before one can optimize the personalization. Here, we discuss a few HCI design methodologies that can help researchers elicit individuals’ tracking needs, which can feed into the design of personalized trackers.

Patient personas and co-design.

In our recent study to understand how to personalize food trackers, we asked dietitians to create *patient personas* to characterize goals and symptoms of representative patient types (e.g., irritable bowel syndrome, eating disorder, diabetes) [1]. Then we conducted co-design workshops with dietitians to create customized trackers for each identified persona, considering how they would customize tracking items, means, and rules, as well as add any aids (e.g., reminders, sharing features). We learned that the patient type as well as dietitian practice style affected the resulting tracker design.

Focus groups and card sorting with experts. We conducted focus groups and card-sorting activities with 14 student-health professionals to investigate expert perspectives on the usefulness of different types of personal self-tracking data in the context of stress management [3]. Based on the findings from the four informal focus groups, we created representative hypothetical situations for stress management, each of which was made up of a persona and a clinical scenario. By combining card sorting with note taking and retrospective think-aloud, we could



collect feedback on what experts found useful in each scenario and whether considerations or concerns arose surrounding specific types of data.

The findings from these studies can be used as a starting point to create template trackers, which can be further personalized to assist patients with specific issues, meeting their individual tracking needs. In both studies, we worked closely with health domain experts who could leverage the data that patients collected to aid in better treatment and progress monitoring. That said, patients should also be involved in further personalizing the tracking regimen, as they are partnering in the care relationship and collecting the data by following the regimen.

OMNITRACK: SUPPORTING FLEXIBLE AND PERSONALIZED TRACKING

Existing self-tracking tools provide some level of personalization, but the support is heavily limited to the *aesthetics* of the tool. Commercial wearable devices and their accompanying apps commonly offer paid options to customize their aesthetics—both software (e.g., a wide variety of watch faces) and hardware

(e.g., types and styles of band), treating the device as a fashion statement. Some tools, though not many, do allow people to configure what information is shown (e.g., step count, sleep) and how the information is presented (e.g., layout of a dashboard and watch face). Existing tracking technologies also provide limited ways to personalize *functional* aspects of the tools, helping to improve the accuracy of the tracked data. For example, during the setup, Fitbit asks people to enter details for their profile, such as gender and height, from which they estimate the stride length to be used in calculating the distance. While clearly valuable, these personalization supports fall short of realizing the full potential of personalized tracking because they are applied to the ancillary side of the tracking tool, not to the tracking regimen itself.

When self-tracking tools do not satisfy tracking needs, people resort to developing their own custom trackers (if they have technical skills) and adopting more flexible alternatives (e.g., spreadsheet, calendar, paper notes, social media), or they give up tracking entirely [4]. To learn and accommodate a wide range of tracking needs, we have been exploring ways to support personalized tracking experiences,

going beyond existing personalization approaches.

We designed and developed a flexible mobile platform called OmniTrack [5] that allows people to construct personalized trackers on their mobile phones without programming. OmniTrack is based on the *semi-automated tracking* approach [6], which combines both automated and manual capture mechanisms. Automated tracking helps lower the capture burdens (which may be useful for less motivated people), while manual tracking allows you to collect data that is typically difficult to track automatically, as well as to promote awareness. Consider exercise tracking, which people track in different ways. Some simply mark it on their calendar when they exercise. Others manually journal the data captured by the treadmill (e.g., distance, calories, average speed) on a spreadsheet. There is also the option of a wearable device, which automatically captures and saves information for each workout (e.g., duration and average heart rate from a run or walk). With OmniTrack, people can flexibly construct their tracking regimen. They can incorporate automatically tracked data from existing mobile and wearable sensing



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through application programming interfaces (APIs), and add subjective measures that are hard to automate. In addition, they can personalize the type and granularity of data to be collected through combining various data types.

To examine the feasibility and usage of OmniTrack in accommodating diverse tracking needs, we conducted in-lab and field studies [5]. In both studies, we found that participants constructed a variety of trackers, some of which were modified over time. Furthermore, the value of OmniTrack's personalized tracking approach has been examined with different user groups such as knowledge workers [7] and adolescents with autism spectrum disorder (ASD) [8].

FACILITATING THE ADOPTION OF PERSONALIZED TRACKING

Although personalized tracking is valuable, this approach requires a significant amount of effort when each individual devises a personalized tracker from scratch. One way to address this barrier is to provide a set of example trackers that can be easily revised. For example, participants of our OmniTrack field study adopted and revised four example trackers (coffee counter, diary, step-counter comparison, restaurant tracker) that we provided, and also created their own from scratch.

In healthcare contexts, the unique expertise provided by patients and clinicians may help to more evenly distribute the personalization burden. Patients bring personal preferences and their lived experiences of dealing with a disease, while clinicians, as domain experts, bring medical knowledge and clinical experiences. Both can contribute to devising a suitable tracker for a personalized care; for example, for an eating-disorder patient, a dietitian can adopt a tracking template designed for the eating disorder, and then she can fine-tune the tracker (including tracking

items, means, sharing preferences) collaboratively with the patient to suit the individual's unique preferences.

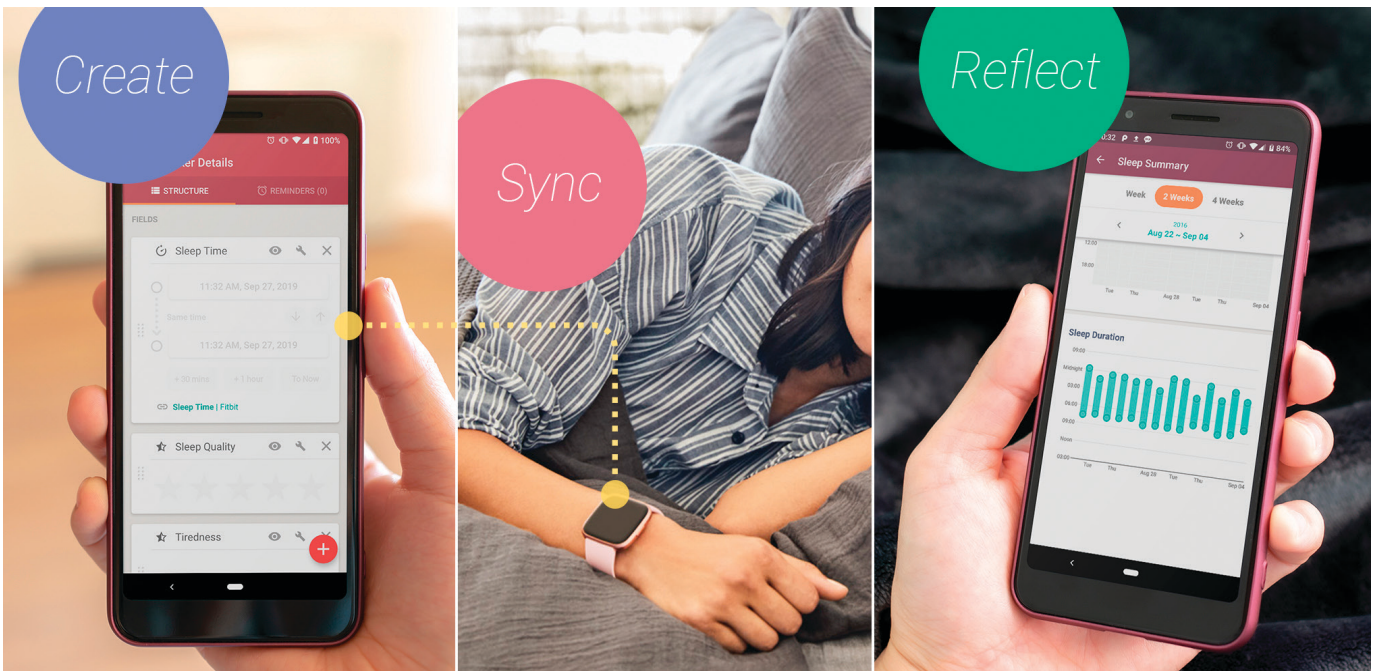
Templates for personalized tracking can be designed in two ways. When tracking items are well defined, such as in cognitive behavioral therapy for insomnia or diabetes care, tracking templates can be designed based on the current practice and also be shared among clinicians. In other cases where tracking items are unclear (e.g., identifying food triggers for allergy, enigmatic diseases), tracking templates can be designed through HCI design methodologies, including the ones we described earlier (e.g., co-design). Furthermore, to facilitate the use of these personalized tracking templates, we envision an ecosystem (e.g., a "marketplace" for trackers) where people can both create trackers and share them easily. It is important to create virtuous cycles of designing and creating sample trackers and sharing them as templates. For those who do not have the desire to personalize, the marketplace equipped with ample templates may suffice, because someone can decide which is most closely aligned with their goals. These people who are initially reluctant to personalize may become willing to personalize their trackers as they benefit from self-tracking and realize their personal needs.

LOOKING AHEAD

Our discussion so far has been centered around the data-collection aspect of self-tracking. However, the true benefit of self-tracking emerges when people reflect on the data they collect either at the time of capturing (e.g., jotting down the distance of a run), glancing at it (e.g., looking at the step count on a smartwatch), or while performing a more serious data exploration [9]. Furthermore, good feedback helps maintain user engagement, reducing the chance of device abandonment. Given that the majority of data collection is done using a mobile device, supporting data reflection on a mobile device could maximize the benefits of self-tracking.

We believe that a personalized tracking approach can empower patients and clinicians, as well as self-trackers, helping them construct appropriate trackers to capture

The true benefit of self-tracking emerges when people reflect on the data they collect.



With OmniTrack, a flexible self-tracking platform, users can create a personalized tracker (left), connect external services (e.g., Fitbit) to integrate automatically tracked data, such as sleep duration (middle), and reflect on the collected data using a visualization (right).

their health, wellness, and other life experiences. The OmniTrack project is our ongoing effort to fill the gap in promoting personalized tracking. We have been extending OmniTrack as a toolkit for other researchers to employ personalization, and we have examined ways to elicit personalized tracking needs for different health contexts. As for the next step, the following questions remain: How might a personalized tracking approach affect clinical workflow? How can we support the seamless sharing of patient-generated data in the clinical setting? Would the sharing of the data collected from personalized tracking lead to patient engagement and meaningful health outcomes? Further research is needed to examine whether and how the personalized tracking approach can lead to tangible outcomes.

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