

When Fitness Meets Social Networks: Investigating Fitness Tracking and Social Practices on WeRun

Xinning Gui¹ Yu Chen¹ Clara Caldeira¹ Dan Xiao² Yunan Chen¹

¹ Department of Informatics
University of California, Irvine
Irvine, CA, United States
{guix, ychen25, claram, yunanc}@uci.edu

² School of Animation
Shenzhen Polytechnic
Shenzhen, Guangdong, China
xiaodan10@szpt.edu.cn

ABSTRACT

The last two decades have seen growing interest in promoting physical activities by using self-tracking technologies. Previous work has identified social interactions in self-tracking as a crucial factor in motivating users to exercise. However, it is unclear how integrating fitness features into complex pre-existing social network affects users' fitness tracking practices and social interactions. In this research, we address this gap through a qualitative study of 32 users of WeRun—a fitness plugin of the widely adopted Chinese mobile social networking service WeChat. Our findings indicate that sharing fitness data with pre-existing social networks motivates users to continue self-tracking and enhances their existing social relationships. Nevertheless, users' concerns about their online personal images lead to challenges around privacy. We discuss how our study could advance understanding of the effects of fitness applications built on top of pre-existing social networks. We present implications for future social fitness applications design.

Author Keywords

Behavior change; fitness; motivation; personal informatics; physical activity; privacy; self-tracking; social influence; social interaction; social network; sharing; wearable; WeChat; WeRun.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g. HCI): Miscellaneous; J.3 Life and Medical Sciences, Health, Medical Information Systems.

INTRODUCTION

In recent years, personal informatics and fitness tools have gained popularity. Personal informatics practices such as fitness tracking have evolved with fitness tools, from pedometers to more advanced gadgets like wearable devices,

and smartphones that leverage built-in sensors. Using data from devices that track users' physical activities, many fitness applications attempt to motivate users to exercise through a variety of features, such as goal-setting [35], games [30], virtual rewards [11], and social influence [14].

Studies have shown promising effects of integrating social influence into fitness applications on increasing users' activity levels [11,14,30]. Social influence primarily involves sharing fitness data with other users [4], competing or collaborating [11,30], and keeping others accountable to their fitness goals [34]. Stressing the power of social influence, prior work has focused on scenarios where fitness data from standalone trackers are shared on social networking sites such as Facebook and Twitter. (e.g. [17,24,35,37,42]). However, these scenarios reportedly led to limited peer support and reciprocity [35] and even negative reactions from non-trackers [19,35], because contacts in users' pre-existing networks might not share similar interests in self-tracking or fitness, and sharing with small groups might not provide enough support [35]. Therefore, we ask the following question: *how might users experience fitness data sharing with a large group of pre-existing contacts who are mutually interested in tracking and sharing in a social network?*

We investigate this question by studying *WeRun*, a fitness plugin built in *WeChat*, the largest mobile social networking application in China. Like Facebook, WeChat supports a wide and complex spectrum of social relationships, ranging from strong offline connection to strangers [16,46]. Different from standalone fitness tracking tools that allow users to share data within the fitness community, WeRun is embedded in WeChat and built upon pre-existing complex social relationships on WeChat. As opposed to the many fitness applications that allow users to share their data within their social networks to both trackers and non-trackers, WeRun automatically shares real-time fitness data with all contacts who signed up with WeRun. Therefore, WeRun is an ideal site to investigate the effects of sharing fitness data with pre-existing contacts who also track.

We conducted a qualitative study with 32 participants who had used WeRun for at least two months to understand their fitness tracking and social practices. In this paper, we use **fitness tracking practices** to refer to fitness data tracking, reflecting, and sharing behaviors of our users. We chose to

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CHI 2017, May 06–11, 2017, Denver, CO, USA
© 2017 ACM. ISBN 978-1-4503-4655-9/17/05\$15.00
DOI: <http://dx.doi.org/10.1145/3025453.3025654>

study long-term users, aiming to offer insights into the impact of a large pre-existing social network on the user experience and retention of fitness applications in the real world context. We found that participants chose WeRun over other social fitness applications because it allowed automatic, mutual sharing of fitness data with pre-existing contacts. They cared less about the accuracy of tracked data, and were motivated to sustain fitness tracking because of an active social environment instead of competing with others. On the other hand, our participants reported inferring others' activities and lifestyles from shared fitness data, and were aware of how others might infer their own lifestyle. Participants found that their fitness tracking practices helped enhance social interaction and closeness with their WeRun contacts. However, being able to interpret other's lifestyles also raised privacy concerns under certain circumstances.

Our study contributes to the HCI community by extending existing knowledge on social influence on fitness practices and investigating the effects of fitness applications built on top of pre-existing social networks in a natural setting. More specifically, we present the mutual impact of social practices and fitness practices on each other. Finally, we offer implications for the design of self-tracking tools that balance social influence and privacy, and that benefit both fitness practices and maintaining social relationships.

RELATED WORK

Social influence plays a crucial role in fitness tracking [14]. Two common modes of soliciting social influence in existing fitness applications are sharing fitness data among peer users such as a fitness community built around a tracking device, and broadcasting fitness data on social networking platforms to both trackers and non-trackers.

Many systems allow users to connect with peers who also track fitness data. Prior work on social influence in peer-based fitness applications aim to help users who share similar goals [2,44] to form teams who can exercise together [3,10,30], to compete [3] or cooperate with others [30], and to be accountable for fitness goals [11]. These social features not only promote users' physical activities, but also provide benefits such as enjoyment and enhanced interpersonal relationships within the group [30,32]. These studies mainly examined the impact of peer support of fitness practices among small groups and relatively homogeneous social relationships, such as among family members, at schools and universities [3,32], in the workplace [30], in small groups of friends, or among strangers who have similar fitness goals [2]. Sharing fitness data among strangers with similar goals can provide instrumental support, but lacks emotional support; sharing among a small group of known contacts can provide emotional support, however it can be ineffective due to the incompatibility of capabilities in physical activities [11]. Furthermore, these fitness tools are usually standalone applications and devices, and the impact of social influence is studied within a short period of time. The long-term effects

of leveraging social influence for fitness tracking in pre-existing complex social networks is understudied.

A second model of soliciting social influence in fitness applications is to encourage users to post their fitness data on social networking platforms such as Facebook and Twitter. For example, MyFitnessPal [37] users can share several types of fitness-related data on Twitter, such as calorie intake and exercise logs. Studies have investigated users' sharing of physical activities on Twitter [24,42], analyzing the posts' content [42], and identifying the characteristics associated with more retweets and favorites [19]. Park and Weber [37] have found that the development of implicit social influence through a sustained network of users interested in fitness correlates with long-term fitness data-sharing. In these studies, users shared fitness data as regular posts, or tweets, on social networking platforms; the fitness tracking tools themselves were standalone. However, studies have pointed out a few limitations of broadcasting fitness data on social networking sites, such as receiving limited peer support and reciprocity [35] and even negative reactions from non-trackers [19,35], as only a few people in these pre-existing networks had similar fitness interests. To the best of our knowledge, there has been no study on integrating fitness features as part of a widely adopted social networking platform, in which users can mutually share their fitness data.

When evaluating systems that facilitated behavior change, researchers emphasized the importance of investigating users' experiences with the technology in order to design effective fitness systems [26]. Previous studies about technologies that promote physical activities have mainly focused on how social influence facilitates fitness-related activities, but less on how these technologies influence social relationships. As Lupton argues, "*the reasons why a person may choose to take up self-tracking and the meanings she or he gives to the practice are socially enculturated. Self-tracking as a phenomenon has no meaning in itself. It is endowed with meaning by wider discourses on technology, selfhood, the body and social relations that circulate within the cultural context in which the practice is carried out.*" [31]. Coupled with the nature of social influence, people's fitness-tracking practices have a significant and inseparable social dimension that is worth investigating.

In summary, with the shown promises of integrating social influence in fitness applications, previous research has mainly investigated standalone tools that allowed users to share fitness data among peer users or broadcast data on social networking platforms. Each of the above models has limitations. Another model – building fitness applications on pre-existing social networks with fitness interests – has yet to be studied. Further, while previous work mainly evaluates the unidirectional impact of social influence on fitness practices, how pre-existing social networks and fitness tracking practices mutually impact each other is understudied. Our study fills the gap by examining social fitness application users' fitness practices alongside their

social behavior. In our study, in addition to examining how building a fitness application upon a pre-existing complex social network may impact the uses and outcomes of self-tracking applications, we also study how fitness tracking practices affect social relationships. To build upon previous studies that were largely based on short-term experimental settings [20], we used a long-term and naturalistic usage setting to study fitness tracking and social practices in a fitness application built upon pre-existing social networks.

WERUN: FITNESS TRACKING BUILT ON PRE-EXISTING SOCIAL NETWORKS

WeRun is a social fitness plugin built on WeChat, China's most popular mobile social networking application. Launched in 2011, as of April 2016 WeChat has reached over 700 million monthly active users [9]. WeChat's fundamental functions include multiple forms of instant messaging, such as text messages, voice messages, sending photos, sharing locations, and group chats. Users can also post updates to their networks using *Moments*—similar to Facebook's Wall.

Because of WeChat's pervasive and multi-functional characteristics, Chinese people use it to communicate with close friends and families, as well as with less familiar contacts such as coworkers, acquaintances, and strangers without previous offline connections. WeChat only allows one personal account per mobile device, making it inconvenient for users to simultaneously use different accounts to manage diverse social networks. Each user's WeChat contacts usually include both strong and weak ties, personal and professional contacts. With public and private social spaces collapsing into a single social-technical system, WeChat is characterized by its complex social networks [46].

Launched in February 2015, WeRun is a fitness-tracking function and one of the most used features of WeChat [45]. WeRun imports fitness data from compatible fitness tracking tools and automatically shares fitness data within users' WeRun social networks. WeRun can import fitness data from smartphones that provide built-in fitness tracking functions. It is also compatible with many popular fitness tracking apps and wearable devices. Since WeRun imports and displays only users' daily number of steps, this paper uses fitness data and the number of steps interchangeably.

Built upon WeChat networks, WeRun supports multiple social functions. The prominent social feature is WeRun *Ranking*, which automatically ranks the daily steps of users and their WeChat contacts who also use WeRun (Figure 1 (a)). WeRun rewards the top-ranking user by displaying his/her WeChat cover photo at the top of the Ranking, also known as “*setting the cover.*” In Figure 1(a), for example, the cover photo of the Ranking page is the leader's cover photo, i.e., the blue sky. Since each user has a unique WeChat network, the members in each user's Ranking are unique. Users can *like* each other's steps. They can also *follow* other users' steps, meaning that WeRun prioritizes the display of specified users' steps, e.g., friends or loved ones (Figure 1

(b)). Users can also send their fitness data in a message to specific friends or post it to their Moments (Figure 1(b)).

WeRun does not have privacy controls. The fitness data shared can only be seen by users' WeChat contacts who also use WeRun, but users have no control over who cannot see it. Because users' WeRun contact lists are formed by pre-existing complex social relationships, their fitness data are shared to strong ties, weak ties, and even strangers, and among both personal and professional relationships. This complex yet natural setting makes WeRun an ideal application to study the mutual influences of pre-existing complex social relationships and fitness tracking practices.

METHODOLOGY

From April to July 2016, we conducted 32 semi-structured, audiotaped interviews with WeRun users in order to understand their usage and attitudes “in the wild” [38]. We recruited our participants with two methods: direct contact and snowball sampling. At the time of writing this paper, four of our authors had used WeChat for at least two years, and WeRun for at least five months. We first interviewed 10 direct WeChat contacts who used WeRun, and then invited them to refer their friends who are also WeRun users. We found 22 participants through snowball sampling.

Our participants had diverse demographic backgrounds; the 14 female and 18 male participants ranged in age from 19 to 63 and lived in 15 different cities in Mainland China. All of the participants' native language was Mandarin Chinese. Their educational backgrounds ranged from high school to doctorate. Their occupations included office worker, government official, public service worker, student, retiree, manager, teacher, freelancer, psychological consultant, IT practitioner, and engineer. At the time of the interviews, 28 participants had used WeRun for more than a year, and the other 4 had been using WeRun for more than two months by the time of the interviews. Although 15 out of 32 participants

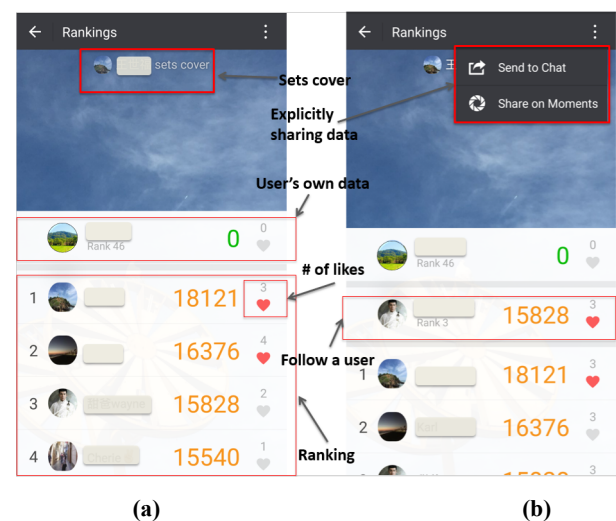


Figure 1. WeRun interfaces: (a) ranking, setting the cover, and liking; (b) following a user and other sharing options

used tracking devices or applications other than built-in smartphone sensors to feed data to WeRun, such as *Le Dong Li* (乐动力) and *Mi Band*, all of our participants checked data only on WeRun.

During the semi-structured interviews, which lasted between 30 minutes and two hours, we asked participants what kinds of fitness applications they used, their reasons for using the application(s), what factors made them use WeRun instead of other fitness applications, what shortcomings of WeRun they had observed, how they used WeRun data, whether they self-reflected on the data, and whether, where, with whom, and why they shared the data. We conducted interviews online through Skype, phone call, or WeChat Video Call, audio-recorded them, and then transcribed them in Chinese.

All participants were added as WeChat contacts by at least one author. With participants' permissions, we collected screenshots of WeRun that our participants shared with us. Institutional Review Board approval was obtained prior to the beginning of data collection.

We employed a grounded theory approach [15] to analyze our data. We conducted memoing and theoretical sampling [15] during and after each interview. We read all interview transcripts and used our initial understanding to generate a starting list of codes. We then returned to the data to conduct a systematic axial coding [15] and identify the emergent themes. To validate the codes, the first and second authors double-coded the data and compared the results. The first author also went back and compared the codes against the interview data to make sure the codes fits with the data [15]. After several iterations of coding, we identified and categorized themes that emerged naturally, which we present in our findings. We then returned to our transcripts to find related quotes and later translated them into English. When we report quotes from interviews, we retain original punctuation. To protect our participants' identities, we use pseudonyms to anonymize them. When we use screenshots, we blur identifiable information.

FINDINGS

In this section, we report on the mutual influence between pre-existing complex social relationships and users' fitness tracking practices.

Pre-existing Complex Social Relationships Impacted Fitness Tracking Practices

All participants in our study had over 100 WeChat contacts, which represented different kinds of relationships, including friends, families, colleagues, superiors, business partners, and even strangers. It was common for participants to add someone whom they recently met or had never met as a WeChat contact, for business, professional, and information-seeking purposes. Participants emphasized the complex pre-existing social relations among their contacts who used WeRun (reported between 40 and over 100). The following subsections uncover how such social relationships may impact fitness tracking practices.

Choosing WeRun over other applications

Many of our participants chose to use WeRun over other fitness applications because the real-time, automatic sharing feature of WeRun enabled them to effortlessly share data and view others' fitness data. For instance, Min, a 53-year-old government official who had been using WeRun for over one year, explained:

I mainly use WeRun. WeRun is actually a fitness network of WeChat contacts. It does not directly track my physical activities, since it has to be connected to a tracking app and synchronize data from the app... I prefer WeRun because I can automatically share my data and also observe my friends and family members' data. For example, it enables me to automatically report how many steps I have to my son and daughter-in-law who live overseas... There are many other fitness apps, such as Yuedongquan (悦动圈). However, they just track and record my own physical activities. Yuedongquan indeed allows me to see other users' data within the same city, but I do not care about that. So I stopped using them... Sharing data with friends and family and looking at their data is more fun than comparing with strangers.

From Min's perspective, compared with other fitness applications he tried, WeRun's main merit is that its instant and automatic sharing allows him, his family members, and his friends to easily check each other's fitness data. He preferred sharing fitness data with pre-existing social networks than with strangers. Min further emphasized WeRun's convenience:

I often check my WeChat for messages anyway. So it's convenient for to check my own and others' fitness data (on WeRun) within WeChat.

Built on a popular social networking application, users can, as Min pointed out, check fitness data on WeRun whenever they check messages and updates on Moments on WeChat. There was no additional cognitive demand to check fitness data that is needed on a standalone fitness application. In his evaluation of fitness applications, Min considered data-sharing within existing social networks and the convenience of checking fitness data as part of social media use more valuable in comparison with other features.

Participants also chose WeRun over other fitness apps with more comprehensive health features. Nan, a 35-year-old psychological consultant who had been using WeRun for six months, told us:

My smartphone also has a built-in health app, which has more fitness related functions than WeRun. For example, the app can suggest daily exercise goals and estimate the calories burned based on my age, weight, and height. Despite of more comprehensive functions, [...] I only use that app to feed fitness data into WeRun so that it can be shared in my social networks... It's not just about tracking myself. It's simply because my friends are there (on WeRun), so I can see how they are doing.

Nan chose WeRun over other applications because of the presence and awareness of her friends' fitness data. From Nan's point of view, sharing data within pre-existing social networks was more important than comprehensive functions.

Some participants expressed that they were particularly interested in seeing fitness data from people they cared about. Xun, a 30-year-old doctoral student, commented,

If I am not interested in someone, even if he/she exercises a lot, unless I were a sport maniac, I will not care about his/her fitness data.... So it truly depends on whom I care about, who is sharing the data, how is our relationship.... Between fitness and social networks, social networks must come first. Only based on the social relationships do people really care about each other's fitness data.

Xun was only interested in the fitness data of people in his social circles; for him, building upon pre-existing social relationships was the prerequisite and motivation for sharing data on fitness applications.

Accuracy is nonessential

As opposed to previous literature that has demonstrated the crucial role of accuracy in fitness tracking tools [18,20,23,47], our participants did not place much value on the accuracy of fitness tracking data. In fact, many of them reported that the tracked data shown on WeRun was not very accurate, speculating that: 1) WeRun may stop synchronizing fitness tracking data when there is no Internet connection; and 2) activity sensors embedded in smartphones and other fitness tracking devices may not accurately detect physical activity. For example, Lei, a 49-year-old government official, reported:

The data shown on WeRun is not that accurate. For example, when I'm on the bus or on the train, my phone considers me as walking even when it is the train or bus that is vibrating. I was on a business trip in the past few days. After getting off from the train, I already had more than 4,000 steps. My phone considers the vibration of the train as a sign of walking.

Lei understood that his phone's built-in sensors could not precisely detect physical activities, and, consequently, that the data automatically reported on WeRun were inaccurate.

Even though the tracked data shown on WeRun were sometimes inaccurate, our participants reported that inaccuracy did not affect their fitness tracking activities or the choice of application. For instance, Cai, a 55-year-old female retiree, reported:

I don't think the data are accurate... The main feature that interests me is that we are aware of each other's fitness status within WeRun and can "like" each other.

Cai did not deem inaccuracy a problem, because she valued awareness of each other's data and resulting social interactions more than self-tracking. The fact that WeRun supports mutual awareness of fitness activities and social

interactions within pre-existing social networks increased our participants' tolerance of inaccuracy.

Many participants felt that they no longer needed to track daily physical activities, as they had become capable of estimating their activity levels after having used WeRun for a period of time. For example, Jun, a 63-year-old retiree who had been using WeRun for over a year, said,

I have very regular lifestyle and routine walking routes. I walk my grandson to and back from school every day. I go out to folk dance every evening in the park. Thus, I can estimate how many steps I have by walking on those regular routes (based on my previous tracking history).

Despite having gained enough self-knowledge to estimate their daily activities, our participants continued to use WeRun because it allowed them to share fitness data with a pre-existing social network. For example, Ping, a 52-year-old engineer told us,

I don't track my fitness any more. I can already estimate how many steps I have walked within a certain amount of time or on some familiar routes... But I check WeRun every day, even when I don't exercise some days... I will "like" my friends who have more than 10000 steps. I also check whether someone has "liked" me.

Checking friends' fitness data and interacting with them led Ping to continue using WeRun. For these types of users, the social functions based on pre-existing social networks sustained their interests and WeRun usage.

Acknowledging individual differences instead of competing
Ranking features are by nature designed for comparison and competition. WeRun ranks users by their daily number of steps. As an incentive, the Ranking page displays the cover page with (Figure 1 (a)) that of the top-ranking user, i.e., "setting the cover." However, for most participants, competition was not a primary motivation for fitness tracking.

Since they were formed on top of pre-existing social relationships instead of fitness goals, WeRun users' contacts are usually diverse in terms of occupation, age, health status, and lifestyle. Our participants acknowledged the diversity, considering it more reasonable to evaluate their individual situation before comparing steps. For example, Min told us this during the interview:

I seldom "set the cover." It doesn't matter.... Don't compete for ranking, as it may end up with over-exercise or even disease likes synovitis. We should exercise according to our own physical conditions.

Min emphasized that there was little basis for competing on WeRun, since everyone had different physical conditions.

Given that participants already knew some of their WeRun contacts very well, they were familiar with their lifestyle differences, such as how they commute. Xun commented,

I used to compete with my best friend. But he had natural advantages: he got many steps by commuting on foot. I usually sit in office and live near my office. So I stopped competing. Our situations are not comparable.

Age difference was another factor that led participants to consider that competing with WeRun contacts was not realistic. Wu, a 50-year-old government official, said,

... It's hard to set the cover. Usually you need about 26,000 steps to be No.1. I am older than many friends on WeRun. I don't think I can compete with them. As long as I reach my own daily goal—10,000 steps—I'm satisfied.

Wu was uninterested in competing with others because he saw his younger contacts as naturally more active. For him, setting his own goal was enough to motivate him.

Considering individual differences, rather than competing with others, is a theme present in all of our interviews. Previous studies have shown that it is essential to consider the comparability of competing members when designing social fitness applications features intended to motivate users [11]. However, our findings showed that users who shared pre-existing social relationships had enough knowledge about themselves and their WeRun contacts to judge their comparability. More importantly, fitness goals, such as competing with peers, were not the primary motivation among WeRun users. Thus, people were not demotivated if they were unable to attain first place.

Rather than using WeRun to compete with others, participants used the ranking feature as a reminder to exercise. For instance, Hu, a 46-year-old male manager, explained how WeRun motivated him to exercise more routinely:

It's like when kids do homework together, they will be more motivated, as there's an atmosphere of learning. Similarly, I see some friends exercise a lot on WeRun. The atmosphere of exercising reminds me that I haven't exercised today.

Rather than motivating users through competition, the feeling of being surrounded by physically active contacts incentivized our participants to maintain their daily exercises.

Fitness Tracking in Pre-existing Social Networks Impacted Social Practices

Users' fitness tracking and sharing practices influenced social interactions in multiple ways, which we present in the following subsections.

Beyond self-reflection: social reflection

Many prior studies have emphasized how reflecting on fitness data on the individual level enables users to compare personal information at different times and discover trends and patterns [28]. In our study, we found that participants also reflected on others' fitness data displayed on WeRun and used the insights they gained to speculate on the potential impression their fitness data might make on others.

Most of our interviewees mentioned that they often inferred their contacts' ongoing activities or daily habits through shared fitness data on WeRun. For example, Zhong, a 52-year-old IT manager commented,

Some people usually have zero steps at 7 am, while some already have 100 steps at 5:30 am and 2,000 steps at 6:00 am. Having several hundred steps means that this person is probably just walking at home, like drinking water and doing some household work. But if it's 1,000 steps or more, it means this person has started exercising. Based on the temporal changes of steps during the day, I can get a sense of their living habits.

Although the speculation based on fitness data may not always be accurate, many participants felt that the fitness data helped them better understand their WeRun contacts.

Fan, a 63-year-old retiree explained,

If someone only has dozens of steps one day, I can tell that this person probably just stays at home all day long. If someone has 20,000 steps or so, I can tell that this person is probably having fun outdoors or traveling. Most of the time, my guess was proved correct after seeing them uploading photos on WeChat Moments.

For Fan, sometimes she could better infer other's activities by considering their fitness data alongside updates on WeChat Moments.

Inferring others' activities and lifestyle through fitness data often served as a way of initiating communication or group activities. For instance, Nan said,

I often guess my friends' activities based on their fitness data on WeRun and then chat with them. For example, once I noticed Mr. Wang was still walking after 10 pm, as his fitness data was continuously increasing... So I messaged him through WeChat, "Why are you walking so late?" ... I am often curious when my friend's fitness data suddenly increase or decrease. I will ask what they have been doing that day.

Similarly, Ying, a 45-year-old female public service worker, often joined her friends after noticing that they were exercising,

When I see some friend's fitness data is rapidly increasing, I will call her or message her on WeChat, asking: "Where are you running?" She will tell me her location, then I will join her to run. It is not easy to schedule a workout together as plans often change, but by knowing whether others are running or not through their steps, it's much easier to join each other's workout.

For our participants, checking others' data and inferring their activities was also a way of caring for their loved ones. Many interviewees reported that they often checked whether their friends were doing well after noticing unusual data, and then reminded their friends to exercise. They were also often

monitored and reminded by their friends. Wu, a 50-year-old male public service worker, told us,

We chat a lot after inferring each other's fitness data... when I see someone who usually has 10,000 steps only had 3,000 yesterday, I messaged him asking whether he went out drinking and didn't exercise last night. Others also ask me when they see I had much fewer steps than usual. We often remind each other that we should exercise more. When I only have 3,000 or 4,000 steps one day, some friends will say, "You are lazy again! Don't drink! Don't play poker! Don't drive that much!"

Our interviewees recognized that others could infer their activities and lifestyles in the same way, which they considered a form of caring and communicating. Nevertheless, due to the complexity of social relationships on WeRun, our interviewees also acknowledged that fitness data played a role in influencing their online images. Sometimes, they might speculate the impression their data might have on others, especially among co-workers with whom they maintain a professional relationship. For example, an interviewee who was a business owner said,

Doing physical activity is a good thing that's worth sharing. It can cause positive effects. It's different from showing off a luxury bag... I love physical exercises and sharing my fitness data. It shows I am diligent. If I am physically active for a long term, people will feel I must also be energetic and persistent when I work.

The interviewee perceived being physically active as an indication of his diligent personality, and believed that sharing it could benefit his professional reputation.

Participants showed mixed feelings about the privacy issues about the possibilities of speculating their lifestyles based on sharing fitness data. Dong, a 32-year-old project manager, considered fitness data important for personal image, and not a worrisome privacy issue.

It's not a privacy concern, but it's about others' impression of me. Because of my work, I often need to walk among different project sites every day. When I walk a lot before getting off work, my superiors who are also on my WeRun contact list can see that. Sometimes they praised me that "You are so hardworking! You have walked so much today!" My colleagues often commented on each other's fitness data as well. For example, we ask each other, "You walked so much yesterday. You must have been working hard."

While some participants did not consider sharing data a privacy issue, others had concerns. For most participants, whether exposing fitness data on existing social networks raises privacy issues depends on the social relationships with their contacts on WeRun and their occupations. Zheng, a 30-year programmer, expressed his concern,

... in some cases, exposing my fitness data is not good. I am a programmer, so I am supposed to be sitting in front

of computer at office most of time. It will be unusual if I have many steps on weekdays... if my boss notices that, he may doubt my working attitude.

For most participants, whether they have privacy concerns for sharing fitness data mainly depends on their occupations and who they share it with. On WeRun, many participants reported cases of self-presentation [8] with fitness data among co-workers.

Beyond fitness: promoting social interactions

When asked whether they have become more physically active after using WeRun, few participants reported significant changes in their number of steps: most people did not report making an effort to increase their steps after using WeRun; some felt they were already active enough, thus there was no need to exercise more; and others did not have time to exercise more due to their busy lifestyles.

However, most participants mentioned that WeRun promoted social interaction with their WeRun contacts. First, "liking" each other's data on WeRun helped them express care toward each other, regardless of the physical distance between them. Liking each other's fitness data served as a communication channel to express care and encouragement for others' physical activities. For example, Cai shared her experience,

Some of my friends live far away from me. When I find out from WeRun that some friend does not walk enough today, I will give him a "like", which represents my care towards him. It's also a form of social interaction, as he will also "like" me back. Although there is no direct communication, we can feel the connection and friendship. Fitness becomes a communication medium... We can feel that we care about each other's fitness activities, which strengthens our friendship.

Compared to WeChat Moments, which also allows people to "like" each other's posts, WeRun's specific focus on physical activities means that "liking" shows special care for one another's fitness. Older users like Cai did not update their status on WeChat Moments often, whereas on WeRun they could "like" each other's fitness data every day. Fitness data became a facilitator of expressing care towards each other, which resonates with previous research findings that "liking" on Facebook maintains interpersonal relationships [40].

Second, fitness data shared within pre-existing social networks carried a quality of playfulness. In the study, we found many participants played with the numbers for fun, which led to increased communication among their WeRun contacts. Most of our participants reported the experience of manipulating and sharing their step numbers in an entertaining way. For example, Feng reported,

WeRun itself is entertaining. You can observe how others play with their data, and you can share your manipulated data to others. Playing numbers is very funny and can

actually increase closeness. For example, one time I intentionally reached 250 steps and put my phone on table to stop tracking. Then my friends screenshot it and sent it to me, joking that I was a silly billy that day.

Besides its numerical meaning, 250 is a Mandarin slang term meaning being silly. When manipulating the numbers, our participants' goal was to create playful interactions with their contacts, rather than to prevail in competitions.

Third, sharing data within existing social networks created topics for people to talk about on WeChat, and thus increased communication opportunities. For instance, Yue, a 60-year-old retiree who moved to another city after retirement, found that through sharing fitness data on WeRun, both his old friend in his hometown and his new friend in the current city frequently communicated with him about his fitness data. Yue felt that sharing fitness data facilitated communication and thus strengthened his social ties. He told us proudly, *"Some people directly message me on WeChat, praising me for doing exercise or asking me how I can walk so much."*

Some participants also appreciated that sharing data on WeRun increased online communication. Meanwhile, they wished for more interaction channels. For instance, Quan, a 49-year-old government official, commented,

We can only "like" each other (on WeRun). We do often talk about each other's data and encourage each other through WeChat messaging. ... WeChat enables users to form groups, but WeRun doesn't support that. If WeRun allows us to comment, send message, share playlists for workout, form fitness groups, and discuss about fitness within the groups, it would be much better.

While previous research and fitness applications have leveraged existing social relationships as a way of promoting fitness, for our participants, social interaction around fitness data was also a means to strengthen their existing social relationships and convey a sense of caring to each other.

Overall, we found that the combination of fitness tracking and pre-existing social networks on WeRun benefitted both fitness and social practices. It provided motivation for users to sustain their use of WeRun, and created new opportunities for social interactions among pre-existing social contacts.

DISCUSSION

We have reported the findings of WeRun users' fitness tracking and social practices. Sharing fitness data within a pre-existing complex social network was one important factor that sustained our participants' interest in fitness tracking. The fitness practices also benefitted users' social interactions, but there were instances of privacy concerns regarding how others interpreted their behavior. Next, we discuss how our study could advance understanding of integrating fitness tracking into social networking platforms.

Sustaining Fitness Tracking Practices

We found that WeRun, by leveraging pre-existing WeChat contacts, facilitated our participants' fitness tracking

practices. Previous research has shown that users stopped using tracking devices after a period of time due to having learned enough from fitness data about daily routines and fitness plans, lacking a cross-platform tool that allows users of different tracking systems to compare and compete, and inaccuracy of tracking data [13,19,23,27]. Our study showed that most participants had already learned enough about their lifestyles, used a diverse range of tracking tools, and were aware that some of their fitness data were not accurate. Despite these circumstances, our findings indicated that the combination of sharing fitness data within existing social networks, the social interactions facilitated by sharing fitness data, and the convenience provided by WeRun was helpful in participants' sustained interest in fitness tracking. Given that participants were long-term users, we cannot determine how our findings may explain early abandonment or adoption. Our contributions lie in pointing out the factors that lead to the sustained use during the maintenance phase when the initial user interest and excitement has faded.

First, the pre-existing social network provided our participants with a supportive environment and created an atmosphere of caring about each other's physical wellness. Previous studies have addressed the importance of peer influence in fitness applications [11], such as sending encouragement and reminders, and liking each other's progress. However, sharing fitness data with strangers even with similar exercise goals can fall short in providing emotional support commonly found among friends and family members [34]. Sharing fitness data among a small group of friends or family members with incompatible exercise capabilities sometimes might de-motivate users [11]. Studies have also found obstacles in sharing fitness data on social networking sites. For example, the lack of a supportive exercising community on Facebook made people feel uncomfortable sharing fitness data [36], and Twitter users may consider posting fitness data as bragging [19].

In contrast, in our study, a closed fitness community naturally formed out of a large pre-existing social network, rather than being deliberately designed or initiated. WeRun provided a collective atmosphere of fitness. WeRun users self-tracked and observed their contacts' data, which made sharing fitness data a natural and motivating activity. Even though participants reported disinterest in competition, seeing their friends' active updates on WeRun motivated them to exercise and achieve their own goals. The community of WeRun contacts created social facilitation, an increase in interests in fitness caused by observing others doing the same task [21]. Compared to posting fitness data on existing social networking services such as Facebook and Twitter, WeRun contacts served as a supportive fitness community as a subset of the WeChat network, where members could mutually support each other. Only users who joined the fitness service could see the fitness data. WeRun network became a fitness community that helped maintain users. All WeRun members self-track and share fitness data, and at the same time know and care about one another. Thus,

our study suggests that having a large fitness-tracking group within a user's social network could potentially support long-term fitness tracking practices.

Second, WeRun's incorporations of fitness data from multiple tools also facilitated its users' sustained usage and fitness tracking practices. Previous studies have found that an inability to compare data with friends who use different self-tracking tools is a major reason that users stop self-tracking [6,13,23]. Although our participants and their contacts used different kinds of self-tracking tools, WeRun's integration of various sources of fitness data allowed these users to form a large fitness community.

Third, the convenience brought by natively integrating fitness data into an existing popular social networking service instead of a standalone fitness application is another important characteristic that contributed to sustained fitness tracking practices. According to a recent report in 2016, WeChat is highly pervasive, as 94% of WeChat users use it daily, and 61% open WeChat more than 10 times per day [45]. Thus, WeRun users can easily check fitness data when they use WeChat without switching or remembering to check data in a separate application. This is also reflected in the study of Zhao et al. [48], which showed that when designing new social systems, it is useful to extend a user's existing ecology of social networking systems to provide convenience and reduce unnecessary switching costs.

In summary, WeRun motivated our participants to continue their fitness tracking practices, primarily due to a naturally formed virtual fitness community that provided support from preexisting contacts who were also conducting fitness tracking practices. The ability to choose from a wide range of compatible self-tracking tools facilitated establishing such communities. Furthermore, building features in an already widely adopted app reduced user effort compared with using a standalone application. Thus, we propose the following design implication:

Consider building cross-platform fitness applications on pre-existing social networks to facilitate long-term fitness tracking practices and exercising.

Balancing Awareness and Privacy Concerns

In our study, we found that our participants easily and frequently inferred their friends' activities and lifestyles from WeRun data. Some participants also mentioned inferring others' activities using fitness data combined with WeChat Moments posts (similar to Facebook updates).

Fitness data is usually considered less sensitive than location and audio recordings [25]. However, a recent study [17] found that some participants preferred to keep fine-grained fitness data private, or to only share them with friends or interested contacts. Another study about a workplace fitness campaign showed that over time participants developed more privacy concerns about being able to infer each other's private life through daily steps [22]. In the study, participants logged their steps on a website, and shared within the

workplace. Most participants did not continue after the 21-day campaign ended due to privacy concern. In our study, the WeRun networks were mixed with friends, family members, co-workers, and strangers. Users' fitness data were automatically shared on WeRun Ranking in real time. As our findings reveal, our participants' attitudes towards fitness data sharing were nuanced. Many participants reported enjoying inferring friends' activities from shared fitness data. They also often appreciated having their own activities inferred by others, seeing it as a way of caring and communicating, rather than an invasion of privacy. However, at times they did have privacy concerns, which depended on who could see their data, their occupations, and timing, especially among co-workers. For example, they perceived that a programmer should not have many steps during working hours, while a project manager should have active workdays. On the other hand, when they felt their fitness data could create a positive self-image, such as being diligent and hardworking, they wanted others to see it.

Privacy issues in data sharing have been widely studied [39]; location [43] in social media and genomic information in the health domain [5] have led to serious concerns. Sharing fitness data, especially without locations, is usually considered safe [25]. As a previous study [22] has shown, revealing daily step count could provide information of participants' private life on a daily scale. Our study indicates that by sharing real-time steps within one's own network, users could even infer others' activities in real time. Combining users' fitness data with their updates on WeChat Moments may lead to further privacy concerns. While previous research has found that users want to control who can access their data [20], an opt-in approach of selecting a group of friends has not provided satisfactory social support [35]. Because the large group of contacts in WeRun seems fundamental to forming a fitness community within one's pre-existing social network and promoting sustained fitness tracking practices, we propose that an opt-out approach might be better able to balance social influence and privacy control. Thus, we suggest a second design implication:

Consider designing features that allow users to control how, when, and whom with not to share fitness data to balance social awareness and privacy concerns.

Increasing Social Interactions and Closeness

Previous research has investigated how to leverage social interactions to promote physical activities [14]. In this study, we found that fitness practices could also create opportunities to enhance social interactions, particularly among users who are interested in fitness. Our participants perceived increased closeness with WeRun contacts due to being aware of their physical activities and lifestyles, "liking" each other's fitness data, manipulating their data to joke with friends, and communicating about fitness topics. The above findings shed light on three aspects of how social fitness could promote social interactions and increase closeness between users and their WeRun contacts.

First, providing mutual awareness of fitness data improves users' knowledge about their contacts' activities and lifestyles. In our study, participants who lived far away from their friends felt more connected when their friends could infer that they were physically active, even though they were not explicitly communicating with each other. This indirect and implicit caring supports previous findings that awareness of *seemingly trivial* information, (e.g. location [7] or online game activities [12]), could trigger users to think about and imagine the life of their friends and family members, and thus lead to an increase in perceived closeness.

In addition, social interactions such as liking and chatting create opportunities for participants to directly communicate with others and participate in group activities. Participants reported that actively "liking" others' fitness data was an easy way to express that they cared about their contacts on WeRun. Since WeRun provides automatic fitness data updates, participants can easily use the liking function to send the "caring" signal to friends.

Besides using WeRun's social features, participants also found creative ways to interact with their contacts, such as sending screenshots of their step count with specific meanings to their friends and joking to create joyful social experience. Although this is not a design feature of WeRun, users' voluntary social interaction reflects playfulness [41]. Previous studies have indicated that playfulness positively influences users' intention to use social fitness applications [1]. In this study, we found that users' spontaneous play with fitness data could also enhance social interaction. Therefore, we propose a third design suggestion:

Consider providing social interaction features in fitness applications to promote social relationships.

Contributions

This work contributes to our understanding of how pre-existing social networks could help sustain fitness tracking practices, and how fitness tracking practices could reinforce social interactions. In the following, we highlight how our work advances current knowledge of social fitness applications, comparing our findings with prior research.

First, previous research has suggested that leveraging social influence [13,19,23], particularly comparing and competing with others [19,23], might address abandonment issues in fitness tracking. Our empirical study of long-term users show that, the ability to integrate a wide variety of tracking devices into WeRun facilitated the emergence of large supportive fitness communities within each user's pre-existing social network. The fitness community built around pre-existing social relationships motivated our participants to continue using WeRun despite having reached the maintenance phase [29], being aware of data inaccuracy, and not interested in competition. One future research direction is to further investigate how WeRun's characteristics affect abandonment factors through comparative studies with both short-term and long-term users.

Second, previous studies have shown that sharing fitness data with unknown peers may provide limited social support [35], sharing with friends and family members with diverse exercise goals may demotivate users [11], and sharing on large social networking sites raises concerns about over-sharing [33]. In contrast, we did not observe these concerns among our participants. A potential explanation is that WeChat does not support fitness data sharing with unknown peers, and only supports sharing with mostly known contacts, such as friends, coworkers and family members. Hence, WeRun's unique social fitness network allowed us to obtain additional insights regarding social sharing of fitness data beyond previous studies.

Third, we raise a potential privacy issue in social fitness applications. By studying the effects of sharing fitness data without privacy controls, our study identified the potential risk of inferring others' activities from their data, especially in a network with diverse types of social relationships, including strangers and co-workers. This privacy issue is further aggravated when combining users' fitness data with their status updates and uploaded photos.

Finally, we examined the role of sharing fitness data in enhancing social interactions. In addition to promoting physical exercises and fulfilling fitness goals, we found that simply viewing fitness data and basic interactions around it, – such as "like" chatting around fitness data, and playing with numbers – could enhance social interactions and social relationships.

CONCLUSION

Previous research has argued that integrating social features in fitness tracking can promote physical activities, but little is known about the impact of mutual sharing of fitness data on pre-existing complex social networks. We report a qualitative study with 32 users of WeRun, a fitness data sharing plugin of the pervasive social networking app WeChat. We have found that WeRun's social features motivated participants to continue fitness tracking practices in the long term, and that fitness tracking practices created new opportunities for social interactions among contacts. These findings indicate that integrating fitness data sharing functionalities into widely adopted social networks could potentially help promote long-term fitness tracking by leveraging a pre-existing social network. Further, our findings suggest that sharing fitness data could raise privacy concerns, while benefitting social interactions and relationships among users.

ACKNOWLEDGEMENTS

We are grateful to our study participants for their dedication. Many thanks to our labmates for insightful comments, and to our anonymous reviewers for their insightful feedback. This work was partially supported by the US National Science Foundation under grant HCC-1219197 and Swiss National Science Foundation under the grant P2ELP2_158933.

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