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# Exploring Virtual Rewards in Real Life: A Gimmick or a Motivational Tool for Promoting Physical Activity?

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## ABSTRACT
Leading companies in the wearables market have introduced different virtual reward systems to their products and services to increase user engagement and enhance playfulness. While existing studies report mixed views on the effectiveness of virtual rewards offered by activity trackers, we still have a limited understanding of people's lived experiences with virtual reward systems. A four-month *diary-based autoethnography* reflecting on the use of three popular activity trackers (i.e., Fitbit, Apple Watch, and Google Fit) and their associated virtual reward systems, plus an *online survey* with 113 current users of the same activity trackers were conducted. Results provide rich insights into how users interact with virtual rewards in real-life, and how these impact people's engagement in physical exercise. A set of considerations to design user-centric virtual reward systems that provide more meaningful experiences to activity-tracker users are derived.

### Author Keywords
Activity tracker; physical activity; virtual reward; digital badge; points; autoethnography; user experience

### CCS Concepts
**•Human-centered computing → Empirical studies in HCI; User studies;**

## INTRODUCTION
As people's interests in healthier lifestyles have been increasing, activity trackers are being adopted not only for health reasons, but also to enjoy the potential benefits of advanced technology [17]. Mostly fueled by wrist-worn activity trackers and smartwatches, it has been predicted that the global wearable market will continue to grow, expecting the annual total shipments to reach 190.4 million units in 2022 from 122.6 million units in 2018 with a compound annual growth rate (CAGR) of 11.6% in the next five years [16].

Activity trackers, also known as fitness trackers, are commercial tools capable of monitoring physical movement and other physiological information [37]. With multiple embedded sensors such as accelerometers, altimeters, and even electrocardiograms, they enable people to monitor activity-related data such as step counts, distance, speed and pace, calories burned, heart rate, hours slept, and so on [37]. Activity trackers are often accompanied by mobile applications where all recorded data are accumulated, shared with other users or friends, and visualized to show the progress and the feedback to their users. These technical advances in commercial activity trackers can benefit people by promoting physical activity through quantified feedback [10], and helping manage their overall health more effectively with less effort [27]. This may lead to a positive behavioral change in health and well-being.

While *self-monitoring* technology allows people to become aware of their behavior by presenting ongoing data, it is also asserted that for the majority of people, the information provided is not motivational enough to encourage a sustained engagement in a healthier lifestyle [41]. Thus, activity trackers often combine multiple persuasive technologies, with one of the most used techniques to be *conditioning* [10, 20, 32]. Conditioning technology is often approached by establishing a system of virtual rewards, where users are extrinsically reinforced for desirable behaviors via digital incentives mostly in the form of digital badges and points.

To increase user engagement and enhance playfulness, leading companies in the wearable market such as Apple, Fitbit, Google, and Samsung, have introduced different virtual reward systems to their products and services, each with their own approach. Although these differences may yield different behavioral and motivational outcomes, the actual use and impact of the current designs have been underexplored. Existing studies report mixed views on the effectiveness of virtual rewards offered by activity trackers in the wild [10, 17, 19, 40]. Some studies showed positive effects on users' everyday practices, whereas people were indifferent in other studies.

As such, we still have a limited understanding of people's lived experiences with virtual reward systems. Also, it is still not clear what effects virtual rewards have on user motivation and how they influence people's engagement in physical exercise. To address this knowledge gap, this study aims to answer the following research questions:

• *How do people experience and engage with virtual rewards provided by activity trackers in everyday practice?*
• *What effects and value do virtual rewards have on people's behaviors and motivations for physical activity?*

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To better understand the overall experience of virtual rewards in the daily lives of activity-tracker users, in our study we used mixed methods with three different types of virtual reward systems. We conducted a four-month *diary-based autoethnography* reflecting on the use of three activity trackers and an *online survey* with 113 existing users of the same activity trackers. Our work makes the following contributions. First, we provide a rich understanding of how users interact with virtual rewards in real-life, revealing the components that could influence the quality of virtual reward experiences. Second, the study gives further evidence on the influence and role of virtual rewards in real-life practices and where the value of virtual rewards comes from in the context of activity tracking. Last, a set of considerations to design user-centric virtual reward systems that provide more meaningful experiences to activity-tracker users are derived.

## RELATED WORK

### Virtual Rewards as the Manifestation of Gamification

Virtual rewards are digital or intangible incentives awarded for desired behaviors or outcomes, given in the form of points, badges, or extra game items or resources [44]. A system of virtual rewards is commonly included in games as a fundamental mechanism to increase player engagement, direct gameplay behaviors, and promote enjoyment [11]. Thus, virtual reward systems in activity trackers can be identified as the manifestation of gamification. Gamification, the integration of game design elements in non-game contexts [6], has been receiving large attention from practitioners and researchers in recent years, and its application has been extended to diverse areas. Deterding [5] argued that existing gamified systems are 1) not systemic by merely adding game design elements, 2) reward-oriented by focusing on motivating through extrinsic rewards, 3) not user-centric by emphasizing the goals of the system owner, and 4) pattern-bound by limiting themselves to a small set of feedback interface design patterns. Cugelman [3] pointed out the misconception of gamification, claiming that gamified systems work effectively only when used in the right way based on a thorough understanding of game tactics.

In line with this movement, efforts have been made to establish a theoretical foundation for more effective gamification. Nicholson [30] argued that gamified systems are required to help people find meaningful connections between game elements, activity, and their own goals by providing relevant information to users' interests, allowing user customization, and increasing the transparency of the system. Hamari et al. [14] indicated that the effectiveness of gamification can become different depending on the context being gamified and user types. This is in line with Deterding's [4] theoretical study on situated motivational affordances. Also, Vassileva [39] described the importance of modeling users and adapting the motivational strategies to users' interests and needs.

In conclusion, all of the above research points to the importance of understanding actual users and the context where the systems are employed in order for gamified systems to produce intended motivational and behavioral outcomes.

### Digital Badges and Points as Virtual Rewards

Virtual rewards are often awarded to users through digital badges or points in gamified systems. They are expected to function in the same way as they do in games by building the relationship between user actions and outcomes, giving a sense of achievement and pleasure, and allowing users to reflect their status and collections [42]. However, there are also some differences between badges and points in terms of how information is represented (non-numeric vs. numeric), where values come from (social vs. individual), and their assumed roles, which could yield different effects on users' perceptions and behaviors [11].

A digital badge is a digitized image or an icon that contains associated information or metadata [36] indicating one's accomplishment, skill, quality, or interest [15]. It is theoretically constituted by three primary elements: signifier, completion logic, and reward [13]. Different functions of digital badges in various contexts were identified from the previous studies. Montola et al. [28] identified digital badges as sub-goals in a secondary reward system that add additional motivations for using the core service. In an educational context, Jobe [18] stated that badges indicate recognition, validation, and accreditation of non-formal learning by displaying to the public the skills or accomplishments that people have learned or completed. Antin and Churchill [1] presented five functions of badges in online social platforms: goal-setting, instruction, reputation, status/affirmation, and group identification. With a focus on the social function, badges can also represent the social norms of a system by manifesting the types of valuable activities and interactions [1, 3].

While badges represent people's interests and experiences in a graphical way, points use numbers to signify a user's performance [42]. In other words, points refer to numerical scores in a system that are awarded for users' behaviours [11]. Sometimes, a composite metric is created and used in order to reduce the complexity of data into a single number [43]. Zichermann and Cunningham [43] listed five different kinds of points that can be used in gamified systems: experience points, redeemable points, skill points, karma points, and reputation points. In gamified systems, points primarily provide feedback on users' actions and performance [23, 26, 35], but can also perform as tools for self-assessment and comparison [42], as well as indicate an individual's progression and can be used as a goal-setting tool [11, 35].

### Application Cases of Digital Badges and Points

Along with theoretical considerations [3, 14, 30, 39], scholars took more experimental approaches to clarify the potential of gamification in their field of study. When it comes to health-related interventions, Zuckerman and Gal-Oz [44] developed three different types of research prototypes, evaluating the effectiveness of different game design elements to promote opportunistic physical activity. In their field studies, most participants perceived points systems as meaningless and were more interested in the measured data than in arbitrary numbers. Moreover, they did not find any significant difference in the level of a participant's physical activity between prototypes. Munson and Consolvo [29] explored how the strategies of

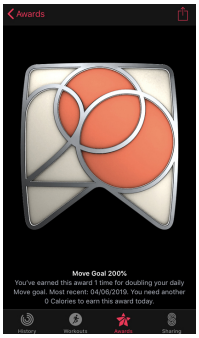
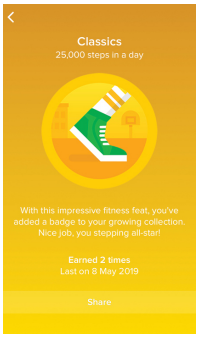
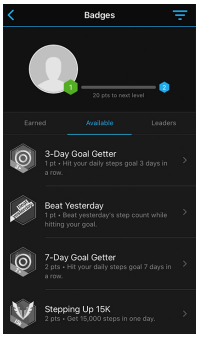
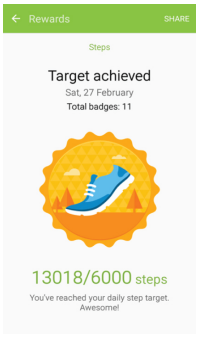
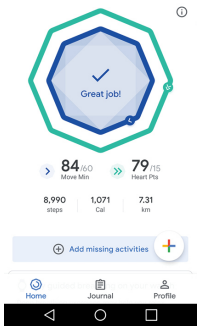
| | Apple | Fitbit | Garmin | Samsung | Google |
|---|---|---|---|---|---|
| Applications | Activity (Apple) | Fitbit | Garmin Connect | Samsung Health | Google Fit |
| Types of Rewards | Badges | Badges | Badges/Points/Levels | Badges | Points |
| Completion Logic (Rewards based on) | Rate of daily goal achievement | Amount of measured data | Amount of measured data | Achievement of Individual activity goals | Intensity and amount of physical activity |
| Range of Rewards | Daily calorie goal • Lifetime goals • Best record • Workouts • Challenge • Others | Daily steps/floors • Lifetime distance/floors • Weight • Challenge | Daily steps • Best record • Active minutes • Workouts • Challenge • Others | Daily steps/active minutes goals • Individual activity goal attainment | Heart Points (intensity of exercise) • Move Minutes (amount of exercise) |
| Unique Points | Multiple levels of a daily calorie goal • Link between three daily goals | Metaphorical representation of lifetime badges | Digital badge system highly intertwined with points and levels | Manual goal setting for individual activity | Different amount of points awarded based on the intensity of exercise |
| Current Designs |  |  |  |  |  |

Table 1: A summary of the features of the current virtual reward systems in activity trackers.

goal-setting, rewards, self-monitoring, and sharing encourage physical activity. In their four-week field study, digital rewards analogous to badges failed to motivate most participants, although the reactions to virtual rewards were positive in their preliminary survey, posing a question about how such rewards should be designed within this context.

In sum, the results of these two studies indicated that virtual rewards had little effect on users' attitudes and motivation for physical activity.

### Activity Tracking and Virtual Rewards in Real Life

The widespread adoption of activity trackers has allowed us to deepen our understanding of users, their lived experiences, and the actual impact of virtual rewards on physical activity practices. Fritz et al. [10] showed that rewards systems like badges and points can have positive effects by promoting more physical activity, giving a sense of achievement, and serving as an alternative goal. Positive responses to virtual rewards were also given by Vooris et al.'s [40] examination of how gamification elements impact on users' usage patterns of activity trackers. They indicated that badges help people stay active, let them move more to earn them, and check the app more often. These results conflicted with Munson and Consolvo's [29] earlier findings. Meanwhile, other studies pointed to more mixed outcomes. Jarrahi et al. [17] carried out in-depth interviews with 29 Fitbit users, exploring how prior motivations affect the perception and adoption of such devices. Their findings showed that motivational features such as virtual rewards are useful only for certain types of users who want to be more active. Novak and Loy [31] discussed the limited motivational capability of a virtual reward system based on the first-person research with a Garmin activity tracker carried out by one of the authors. They claimed that the current reward system fails to provide any real context or meaning for users and to fit the advancement of personal goals.

As described above, the findings of the previous studies were mixed regarding the effectiveness of digital rewards provided by current activity trackers. In most cases, study findings were drawn from in-depth interviews or focus groups with a relatively small number of users, where there is a risk that participants recruited may not represent the entire user group [10, 40], thus the need for research with a larger and broader population [17, 40]. Moreover, many studies [19, 44, 29] only focused on motivational effects of virtual rewards, providing a limited understanding of how these have been incorporated into the real-life experiences of activity-tracker users.

## BACKGROUND

As of this writing, leading companies in the wearables market offer virtual rewards, mostly digital badges and points, through their activity tracking apps, such as Activity[1] (Apple), Fitbit[2], Garmin Connect[3], Samsung Health[4], and Google Fit[5]. By examining the apps above and their associated websites, similarities and differences among those systems were identified and summarized in Table 1. While Apple and Samsung

[1] https://apps.apple.com/us/app/activity/id1208224953
[2] https://apps.apple.com/us/app/fitbit/id462638897
[3] https://apps.apple.com/us/app/garmin-connect/id583446403
[4] https://apps.apple.com/us/app/samsung-health/id1224541484
[5] https://play.google.com/store/apps/details?id=com.google.android.apps.fitness

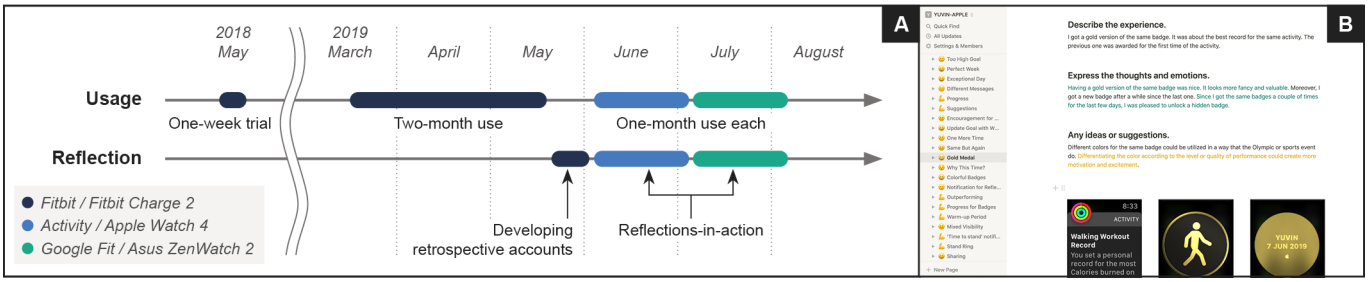



Figure 1: A) Overview of the autoethnography, B) Example of collected data (reflections-in-action)

focus more on users' goal attainment, Fitbit and Garmin award badges based on the amount of measured data. In addition, Apple and Garmin provide a range of rewards in diverse contexts, while Fitbit and Samsung's are limited to a few activities. Furthermore, Apple awards different digital badges according to the achievement rate of a daily activity goal, while Samsung allows users to manually set goals when they engage in physical activity and rewards them accordingly. Uniquely, Fitbit uses distance-related, real-world information to metaphorically present how many miles users have walked since they started tracking. Unlike the other four companies, Google created two new metrics, i.e. Heart Points and Move Minutes, and awards points based on the intensity and amount of exercise. By incorporating WHO's (World Health Organization) activity recommendations in its points system, Google allows users to become aware of whether people's activity level meets WHO's guidelines. Considering a company's market share, the type of reward, and the completion logic, Apple's Activity, Fitbit, and Google Fit are regarded as the most representative cases of goal-based badge system, data-based badge system, and a point-based reward system, respectively. Therefore, the lived experiences of their users were further investigated.

## STUDY 1: AUTOETHNOGRAPHY

Autoethnography is a form of autobiographical research in which the researcher's thoughts and lived experiences are expressed as the central element of the study and are systematically analysed [9, 34]. By conducting autoethnography, researchers can gain first-hand user experience of the device, generating deep and rich insights [2]. However, its inherent nature—subjectivity, emotionality, and researcher's influence on research—is often challenged [25]. Conducting a third-person perspective research along with autoethnography can help develop a nuanced understanding and elicit novel insights while alleviating the challenges that autoethnographic research faces. Thus, we combined autoethnography with a user survey.

### Method

The first author conducted a diary-based autoethnography with three different activity trackers (Figure 1, A). One activity tracker, Fitbit Charge 2, and two smartwatches, Apple Watch Series 4 and Asus ZenWatch 2, were used due to the availability of long-term use of devices. Since the Fitbit Charge 2 had been adopted by the first author for personal use unlike the other two smartwatches, data were collected in two ways: by developing retrospective accounts [8] to reflect the experience of the Fitbit activity tracker, and by making diary entries for the ongoing experience of the Apple and Asus smartwatches as reflections-in-action [8] (Figure 1, B). The Fitbit Charge 2 was used in two separate periods: a one-week trial in May 2018 and two months of use from mid-March to mid-May in 2019. To bring a greater detail of experience, multiple sources of evidence were utilized, such as a calendar, emails, records of push notifications, chat messages with friends, and app screenshots. After that, a diary-based autoethnography with two other smartwatches, Apple Watch and Asus ZenWatch, was carried out for two months in total, a month for each device, from early June to early August in 2019. Reflections-in-action were collected using the 'Notion' app, a cross-platform note-taking tool. Each diary entry included a description of the inspiring experience, captured screens of the smartwatches and mobile phones, and comments on the researcher's thoughts and feelings.

### Analysis

As a result, 12 retrospective accounts about Fitbit's virtual reward system and 49 reflections-in-action of the Activity (33) and Google Fit (16) apps were collected. A total of 61 retrospective accounts and reflections-in-action were thoroughly reviewed, during which statements that described positive or negative influences of virtual rewards on behaviors, attitude, and emotion were extracted. In total, 154 items were analysed qualitatively using affinity diagramming [24].

### Findings

The result of affinity diagramming identified 15 opportunities under 6 themes: *content, aesthetic, access, trust, communication,* and *goal-setting*. The first four themes cover different aspects of experience with virtual reward systems, while the other two are the relevant features that interact with a reward system for sustained user engagement.

#### *Content*

Google's Heart Points are given proportionally to the intensity of physical exercise while its Move Minutes represent the amount of activity. Since Heart Points have a direct link to the activity recommendations from the WHO (World Health Organization), it informs how much influence a certain type of physical activity has on health improvement. In our research, virtual rewards were valued highly when they enabled to find a clear connection between effort and the health outcomes (16/154):

*Reflections-in-action for Google Fit, 07/07/2019*

*When I went shopping, I received only a few Heart points for an hour's walk. This was actually fair enough since it was a lower intensity of exercise compared to the walking activities in another day. For this reason, I do care more about how many Heart points I earn rather than the Move minutes, [. . . ].*

It is common for people to find greater value when they are compensated for completing more challenging tasks. Then, what is a challenging task in the context of physical activity tracking? We found it challenging when a task requires to make a constant effort, break the best record, and do a considerable amount of exercise in a day. The virtual rewards awarded for these challenging tasks were more meaningful, and motivating to keep a person engaged in physical activity, creating a sense of achievement and satisfaction (17/154):

*Reflections-in-action for Apple Watch, 17/06/2019*

*After hitting the daily move goal for eight consecutive days, I had finally earned the Longest Move Streak badge. [. . . ] I was motivated to keep hitting the goal and did not want to stop the record. This was because I understand this sort of record requires constant efforts in a long period of time and I have to put more than twice the effort and time if I break this up.*

In line with previous work on gamification [6, 14, 30, 39], the value of virtual rewards was proportional to the degree of personal interest in our study (13/154):

*Retrospective accounts for Fitbit, Time period 2, item 2.6*

*For me, badges for steps or distance were more enjoyable and convincing than climbing floors. [. . . ] I do not care about how many floors I go up and down [whereas I do] sometimes think about how many kilometers I walk in a day. It was hard for me to understand and imagine how difficult to achieve the goals [are] and how rewarding they are.*

#### Aesthetic

In comparison with physical forms of reward, digital rewards have their own pros and cons. Although they cannot bring material benefits to users' real-life, digital rewards can be more dynamic and promptly respond to a user's actions [42]. Also, they can be graphically materialized as realistic as their counterparts. The results showed that utilizing these attributes could affect the playfulness and perception of virtual rewards.

In terms of graphical user interface design, skeuomorphism[6] is distinct since flat design[7] is commonly found as a way of designing digital badges in this context. Our study suggests that a skeuomorphic style may add additional value to badges by appealing to users' emotions. Furthermore, this can be leveraged with interactivity, making digital badges more playful by bringing them beyond just a visual representation of achievement (13/154):

*Reflections-in-action for Apple Watch, 03/06/2019*

*I was able to see the backside of a badge where my name and the date I earned were etched by flipping the badge. Etching [the] name and date makes me treat badges [in a] special [way] and have more attachment to them. Since it is made with [a] high quality of design, I wanted to share and show badges to my friends.*

#### Access

Each activity tracker provides different ways to access its virtual reward system and individual rewards. In addition to the smartphone app, some trackers also allow users to check their rewards from their wrist. Also, in terms of navigation structure, some of the virtual reward systems appear at the top level, whereas others are nested. Results indicate that accessibility predicts the level of awareness about virtual rewards (5/154):

*Retrospective accounts for Fitbit, Time period 1, item 1.1*

*Surprisingly, I have not realized that there is a digital badge system in [the] Fitbit application during this time period even though I received three emails regarding new achievements of badges.*

Moreover, easy access to the reward system can lead to the more immersive user experience of digital rewards (7/154):

*Reflections-in-action for Google Fit, 05/07/2019*

*Setting the watch face with 'Google Fit' theme was the most convenient and easiest way of checking the current progress of activity. [. . . ] Having many access routes to the overview of my activity keeps me more aware of the progress of activities.*

#### Trust

A reward is "a thing given in recognition of service, effort, or achievement" [33]. For rewards to be appropriately accepted, the trust between receivers and givers needs to be built. During the study, three factors that could affect the trust in the reward system were identified: objectivity, consistency, and transparency.

While improper credits for exercise can discourage users from engaging with reward systems, manual input needs to be approached with caution since it may undermine the objectivity of the system, thereby lowering the value of rewards (10/154):

*Reflections-in-action for Google Fit, 10/07/2019*

*Though I am allowed to choose how many points I would get for the activity, it was tricky to decide the right amount of points to represent my effort properly. There was no clue, so the only thing I can rely on was my justification. I could make an assumption with reference to the previous results, but it involves subjectivity, which may result in lowering the credibility of the point system.*

In addition, the lack of detailed information on rules and the incomprehensible mechanism may cause an inconsistent user experience. Thus, making the system more transparent to its users is required for more reliable use of virtual reward systems (15/154):

[6] https://www.interaction-design.org/literature/topics/skeuomorphism
[7] https://www.interaction-design.org/literature/topics/flat-design

*Reflections-in-action for Apple Watch, 07/06/2019*

*I recorded an outdoor walk a couple of times, but I have not received this reward until today. I was wondering why this time. [. . . ] In [no way was I] informed about it. It would be better to get more details of why and how I get a badge.*

#### Communication

All three activity trackers studied use various channels to communicate with their users for many purposes, including for virtual rewards. However, differences exist among the systems in terms of types of communication channels, content in the messages, and the timing of a message.

Given that there are many other applications on smartphones and activity data is mainly tracked through wearable devices, multi-channel communication may not always be good in this context (5/154):

*Retrospective accounts for Fitbit, Time period 2, item 2.1*

*[. . . ] I sometimes felt swamped by notifications including those for the badge achievement. Without careful attention, the notifications for badge achievement were also easily ignored.*

Also, the effectiveness of virtual rewards can be enhanced through appropriate communication. In this study, the effect was more significant when information on progress is provided, and rewards are delivered in real-time on the spot (26/154):

*Reflections-in-action for Apple Watch, 03/06/2019*

*It was great to get notified directly on my wrist as soon as I had earned a new badge, which I did not expect to get. Also, I was [able] to see the badge in the same way as I do on the smartphone even including animations. Seeing a high-quality badge immediately on the spot was an enjoyable experience and I felt a sense of satisfaction.*

#### Goal-setting

As pointed out in the background study, the completion logic of some reward systems is closely intertwined with daily activity goals. As with Apple Watch, if virtual rewards have a close connection with a daily activity goal, the level of engagement with a virtual reward system can be influenced by goal-setting practices while setting an appropriate level of activity goal is challenging in real life (16/154):

*Reflections-in-action for Apple Watch, 17/06/2019*

*[It] was suggested [to me that I] set a daily goal to 720 calories by the Apple watch, which is twice higher than the previous goal. [. . . ] [The] new daily goal became [a] number [that] is too high to be achieved in my routine. I almost gave up trying to achieve the daily goal.*

Unlike digital badges, points are continuously accumulated through physical activity. Providing health-related milestones can add practical value to virtual points by helping users set goals within reach (6/154):

*Reflections-in-action for Google Fit, 09/07/2019*

*I hit this goal in the first two days of the week, which was quite easy to complete. But I was still satisfied with this result and this made me feel healthy because I succeeded to follow the WHO's recommendation, which has public confidence.*

## STUDY 2: ONLINE SURVEY

The autoethnography provided insights into what makes the experience of virtual rewards, how different components influence both the users' perceived value of the virtual rewards and their engagement in physical activity. Nonetheless, all the data came from a single user, which leads to limited generalizability. To complement our qualitative findings with rich information coming from a large population, we conducted an online survey, seeking to inquire into how virtual rewards influence people's physical activity practices in the real world and how they are perceived and valued by their users.

### Method

The questionnaire consisted of three parts: *demographics*, *fitness tracking practices*, and *experiences with virtual rewards*. Demographics included basic personal information, such as gender, age, country of residence, and nationality, as well as the current activity levels of participants. It was followed by questions about fitness tracking practices: duration of use, types of data initially and currently monitored with an activity tracker, and prior and current motivation for activity tracking. After the inquiry into the qualities of participants, the questions focused on how they have perceived and experienced the current virtual reward systems in everyday practice. Open-ended questions covered an overall impression, a memorable experience with virtual rewards, names of valuable and unimportant badges or points, sharing experience of achieved virtual rewards, and suggestions. In addition to free-response questions, we also asked the level of familiarity and satisfaction with current designs of virtual rewards using a five-point Likert scale with the midpoint 'Somewhat familiar' and 'Neither satisfied nor dissatisfied', respectively.

### Participants

Participants were recruited through Amazon Mechanical Turk (MTurk). Initially, 336 persons took part in the survey over three days. Two screening questions at the beginning of the survey asked whether participants currently used one of three activity tracker apps: Apple's Activity, Fitbit, or Google Fit. As a result, 216 participants completed the full questionnaire. Out of those, 80 responses were rejected due to lack of integrity (e.g., duplicate answers or answers that did not match the chosen tracking system). The remaining 136 responses were approved and paid 1.50 USD as compensation, but 23 were excluded due to ambiguity of responses. Thereby, a total of 113 complete responses were further analysed.

Of 113 participants, 69 were male, and 44 were female. Most respondents were from the US (96), followed by India (6) and other countries (11). Also, most of them lived in the US (102), and 6 respondents in India. In terms of age, more than half of participants (61) were between the ages of 25 and 34, followed by the age group between 35 and 44 (28), 18 and 24 (17), and 45 and 64 (7). A higher proportion of the 25 to 34 age group was observed. This can be explained by the fact that people

on MTurk tend to be younger, and 60% of them are born after 1980 [7]. Regarding the current activity level of participants, approximately four-fifths of them were frequently engaging in physical activity in their everyday life: 68 were three to five times a week, and 25 were six to seven times. Nineteen participants reported doing physical activity once or twice a week, and only one participant responded that they rarely do physical exercise.

When it comes to the current use of activity trackers and services, 67 participants reported using a Fitbit smartwatch/tracker and the Fitbit app, while 32 reported using an Apple Watch and the Activity app, and 14 using a Wear OS smartwatch and the Google Fit app. In terms of the length of time since they adopted the current trackers, the study participants were relatively evenly distributed. Twenty-five respondents owned their trackers for three months or less, 33 for four to six months, 25 for seven to 12 months, 18 for one to two years, and 12 for two years or more. Given that the use of activity trackers was abandoned within six months by one-third of users in the US [22], both long-term (55)—seven months or more— and short-term users (58)—six months or less— were almost equally recruited.

### Analysis

Content analysis was iteratively performed with verbatim responses to each open-ended question using ATLAS.ti (Version 8.2.3). Individual responses were included in the analysis, while multiple codes were attached to a single text response to represent every aspect of the content. Codes were initially generated in an inductive way by reading through written responses several times and collecting codes that convey similar higher concepts. This initial open coding was discussed between two researchers. Lastly, a description of each group of codes was formulated and reported with its frequency in the data set.

### Findings

#### *Attitude, Familiarity, and Satisfaction with Virtual Rewards*

Participants' overall attitudes toward the current virtual reward systems were evaluated by carrying out the content analysis of open-ended responses about an overall impression. The majority of participants (72/113) had a positive attitude toward badges or points, stating that they benefited from virtual rewards practically or emotionally. On the other hand, 28 deemed virtual rewards pointless, while 13 were indifferent to them. When it comes to the familiarity and satisfaction of the current designs of virtual rewards, over half of the participants (62/113) were satisfied or very satisfied with their virtual reward systems, while two-thirds (76) showed great familiarity with them (either very or extremely familiar).

#### *Lived Experiences with Virtual Rewards*

Most participants (106/113) reported one or more notable experiences that virtual rewards positively or negatively influenced them in their physical activity practices. Twenty-two of them explicitly stated that achieving virtual rewards gave them a sense of pleasure, and a digital badge system added additional playfulness to activity tracking practices: *"Reaching our goals gives us an energetic and fresh feel. This badging system gives me the pleasure of using the tracker." (P7, Apple Watch)*

Also, twenty-one participants mentioned that they felt a sense of achievement when they earned badges. The results indicated that this mainly comes from 1) accomplishing activity goals, 2) succeeding challenging tasks, such as sticking to a routine, breaking a record, or doing an enormous amount of workout, and 3) appreciating the collection of badges: *"I feel accomplished when I hit one of the big goals. The single dailies don't matter too much, but when I hit a monthly, 300-500% move goal, all three in a day, or a major milestone, I legitimately feel accomplished, and it makes me want to work harder for more." (P26, Apple Watch)* For a few people (9), earning badges and points even made them feel better about themselves: *"Once I realized I was able to walk so many steps in one day, it was really surprising, and I figured that I could do more steps if I spend more time pursuing it." (P92, Fitbit)*

In addition to psychological benefits, some utilitarian benefits were also confirmed. While Both Apple and Fitbit's badge systems seemed to make physical activity more enjoyable, Google's point system offered greater informational value to users concerning their health and daily practices. Some users of digital badge systems (15) were attracted to the badging experience itself. They liked unlocking and collecting badges, which made them stay engaged in physical activity: *"I remember that I was falling behind on a monthly challenge badge where I had to walk a certain distance to acquire the badge. It was the last day of the month, so I forced myself to get up, and I began to walk the last few miles to achieve the badge. I felt like this was extremely positive." (P25, Apple Watch)* Seventeen participants were encouraged to exercise more, and some of them even did the extra workout just for attainable badges when they realized their activity levels were close to the thresholds for those badges: *"I have been close to a goal or badge and since I know I can achieve that, I kept taking steps to get it." (P90, Fitbit)*

Speaking of the more practical contribution of virtual rewards to people's everyday practices, participants (9) deemed digital badges as an alternative activity goal which they can aim at: *"I really like it because it makes me feel like I have something to work towards." (P40, Fitbit)* Also, some participants (8) confirmed that they were making good progress on their fitness routines through the badges or points they earned: *"It creates a nice simple way of feeling like I've crossed into a new stage or met a persistent goal and usually is just a simple way of tracking my goals and feeling like I've met them." (P53, Fitbit)* Furthermore, badges and points could even help people (5) gain a deeper understanding of their activity level and exercise routines: *"I was positively influenced by digital badges when I first learned about it. It actually helped me form a schedule and see how my routine could collect awards." (P4, Apple Watch)*

Nevertheless, not all participants appreciated the current designs of virtual rewards. Two participants pointed out the misalignment between their health-related concerns and virtual rewards: *"As I said, the badges are irrelevant to me. My health is what matters to me, and my fitness progress is what I*

*have measured. This isn't a video game to me." (P98, Fitbit)* Also, some participants (10) reported that they were discouraged or lost their interest due to insufficient credits for their exercise, a limited number of badges, long time intervals between rewards, and unrealistic thresholds: *"During the first couple of weeks, I got a lot of badges. [. . . ] But the more you wear your device - the less badges you get. It can be months without a badge. This feels bad. Not really encouraging." (P48, Fitbit)*

#### Valuable and Unimportant Types of Rewards

Based on the current use of the activity tracker, participants reported both the most and the least appreciated or valuable badge(s)/point(s) with reasons. When it comes to valuable badges, both daily Move Goal badges and Perfect Week badge were named by 6 participants for Apple Watch ($N$=28) while daily steps badges were chosen by 42 participants and lifetime distance badges by 12 for Fitbit ($N$=62). To be specific, the most frequently named Fitbit's daily step badges were Sneakers (9), followed by Urban Boots (6), Hiking Boots (5), High Tops (5). Users can earn these badges by completing 10,000, 15,000, 35,000, and 20,000 steps, respectively. The reasons provided by participants explained their choices. Participants chose them because these badges are challenging and show their enormous effort: *"It showed how committed I was." (P21, Apple Watch)* Also, participants deemed lifetime distance badges informative in that they show how many miles they have walked since they started using their devices: *"To know that I have walked the diameter of the earth will be a great accomplishment. It lets me know that if I could truly walk around the world, I could make it." (P39, Fitbit)*

Regarding unimportant badges, First Workout badges (8) were top on the list, followed by Activity Challenge badges (6) for Apple Watch ($N$=24). The most frequently mentioned badge by Fitbit users ($N$=58) was one of daily steps badges (34), among which two-thirds (23) stated Boat Shoes, which is awarded for completing 5,000 steps. The second highest one was one of daily floors badges (12). Of those 12 participants, seven mentioned Happy Hill, which is given for the completion of ten floors. Both Boat Shoes and Happy Hill are the easiest badges on each badge list. When a badge is too easy to get, people find it pointless: *"I can get 5,000 steps a day with my eyes closed." (P33, Fitbit)* Also, people regarded a badge meaningless when it is not aligned with their interests: *"I am not a fan of climbing, and so it doesn't matter to me much." (P63, Fitbit)*

Compared to the badge systems of Apple Watch and Fitbit, Google's points system has only two options, Move Minutes and Heart Points. Thus, participants ($N$=14) were asked to select the point(s) that they deem valuable from one of four options: Both, Heart Point, Move Minutes, and Neither. Six out of 14 participants chose both, followed by Heart Points (3). Four reported that neither of them was valuable to them. Those who chose at least one of the points stated that points are a good indicator of their activity level and useful for maintaining their health: *"I believe both are vital to one's general well-being." (P101, Google Fit)* Those who selected none of them had no interest in virtual reward systems: *"I just want to track my workouts for me, to make sure I am hitting MY goals. I don't care about points or what Google's AI thinks about my workouts." (P113, Google Fit)*

#### Sharing Experience of Virtual Rewards

Participants were asked a "yes/no"question about whether they had ever shared a virtual reward. As a result, more than three-quarters of participants (87/113) had never shared their rewards with others. Most of them did not feel a need to show their achievements to others: *"I just keep my accomplishments to myself. No sense in telling everyone." (P3, Apple Watch)* The reason behind this seemed that participants regarded activity- or health- tracking as a personal thing: *"I don't want to show others what I have done because I want my fitness level to be improved." (P7, Apple Watch)*

On the other hand, those who answered "yes" were primarily sharing virtual rewards to share their progress with friends, family, and other users or to help others get motivated: *"My wife has the same Fitbit, so from time to time, we discuss the badges - it's some kind of competition for us." (P48, Fitbit)*

#### Suggestions for Virtual Reward Systems

At the end of the survey, we asked participants about how the current designs of the virtual reward system can be improved. In this case, 84 comments from 70 participants were analysed. The results indicated that the demand for the increased practical value of rewards (24) was greatest, including needs for physical rewards (14) and monetary benefit (10): *"Maybe entering high achievers into some sort of sweepstakes to win actual prizes." (P74, Fitbit)* Some wanted to add more meaning to the rewards (9) or customize a badge to fit their activity goals (6): *"Specific customization as to what I want those goals to be, such as naming them myself." (P29, Apple Watch)*

Along with the need for practical use, another great need (16) was a more diversified badging experience by having a greater variety of badges such as having different styles of badges or upgrading badges based on their fitness improvement: *"The badges should be upgraded with next motivational goals." (P51, Fitbit)* Also, a need for aesthetic improvement was also expressed by some (8): *"Maybe make them animated? Like a gif or something." (P2, Apple Watch)*

## DISCUSSION

#### Use and Impact of Virtual Rewards in Real Life

In terms of the psychological and behavioral benefits of virtual rewards in daily practices, most of previous findings were confirmed [10, 40]. Our participants also reported that collecting virtual rewards motivated them to exercise more and helped them stay active while giving a sense of pleasure and achievement. Moreover, badges served as an alternative goal for users, sometimes putting them on an extra workout. In addition to lending credence to the findings of prior research, the study provided new evidence on the informational roles of digital rewards. By earning rewards from the systems, some participants had more confidence in what they were doing or deepened their understanding of the current activity level and fitness routines.

When it comes to sharing experience around virtual rewards, the study revealed that there exists a gap between the expectation of the system designer and actual use in terms of social functionality. Among the three activity trackers studied in this work, Fitbit and Apple Watch offer social functions to users. However, a majority of the study population reported that they had never shared virtual rewards with others. Since users considered activity or health tracking as a personal matter, they did not want to nor felt the need to share their accomplishments with others. Given that a badge's value often comes from a community that adds a value on that badge [3], this personal nature of activity tracking poses a challenge for designers within the context of designing virtual reward systems.

*What Makes Some Virtual Rewards Valuable?*

Antin and Churchill [1] argued that most people find hedonic or behavioral value from only some types of badges. This was also confirmed in both the authoethnography and an online survey. In the former, the first author found greater value from virtual rewards when they 1) recognize the effort and time appropriately, 2) inform the impact of exercise on health, 3) are challenging to get, and 4) align with personal interest and context. Similar were the insights from the survey for both the most and the least appreciated or valuable badge(s)/ point(s). The results suggested that the value of virtual rewards mainly derives from when they 1) provide proof of enormous efforts, 2) challenge the users, 3) are informative, 4) give assurance of users' activity level. On the other hand, the virtual rewards may fail to yield intended outcomes when they are 1) not interesting and meaningful to users, 2) too easy to achieve, 3) repeatedly offered, 4) not suitable for users' ability or context. By comparing and combining the results from both autoethnography and an online survey, it can be concluded that virtual rewards become more valuable to users when they recognize users' effort and time appropriately, inform the impact of the exercise on users' health, and challenge them.

## DESIGN CONSIDERATIONS

In addition to providing a more nuanced understanding of the overall experience of virtual rewards in wild, the findings allowed us to discuss design considerations for a more effective virtual reward system to promote physical activity.

### User-Centered Reward System

*Aesthetic*

Among the study population, there was a need for aesthetic improvement of current designs of badges or the way of visualizing accrued points. On the other hand, a few participants were attracted to the color or animation of badges. Since the preferences for visual design vary from person to person, it is hard to generalize which design is superior or inferior to others. Thus, we suggest a sharper focus on the animation and interactivity of digital badges. Designers could benefit from the dynamic and interactive potential of virtual rewards. One way of taking advantage of a digital object is exemplified in the Apple Watch by making a flipping motion and allowing users to fiddle with badges. Besides that, this can be approached in many ways, and by doing so, digital badges could have their unique value beyond just a visual representation of achievement.

*Accessibility*

The autoethnographic research identified that the current activity trackers provide different levels of accessibility to their virtual reward systems and that easy access to virtual rewards leads to a higher awareness of achievements. Also, the survey participants described that they felt a sense of achievement by appreciating their collections of digital badges, which confirmed they were making good progress since they started their fitness journey. As such, since an easy access to reward systems can lead to higher awareness levels, and provide a good sense of achievement and self-affirmation, higher accessibility to both individual reward and the reward system needs to be provided, such as by allowing alternative routes to access them or by bringing them to the top of the hierarchy.

*Consistency and Transparency*

Nicholson [30] pointed out that for user-centered meaningful gamification, it is critical to make systems more transparent by providing appropriate justification to support users' decision-making process and giving sufficient information on what is going on. In the autoethnography, the first author also reported how the inconsistency of a reward system without proper justification could result in discouraging users and losing their trust in the reward system. For these reasons, it should be reviewed whether the reward system provides users with adequate information about the requirements for a reward as well as appropriate justification for their success or failure to achieve the reward.

### Multi-layered, Meaningful Virtual Reward Experience

*Greater Variety of Virtual Rewards*

Deterding [5] stated that existing gamified systems merely added game design elements and limited themselves to a small set of feedback interface design patterns. Although this statement was made a few years ago, we found this to be still evident through our study. Some participants described that they lost their interest in a digital badge system over time due to a limited number of badges and long-time intervals between rewards, or that they were discouraged by unrealistic requirements for some badges. Also, among the responses to the suggestion for improvement, many participants wanted to have a greater variety of badges. To be specific, some suggested applying a level system to the current badge systems, by which available badges can be upgraded with their fitness levels or goals. High achievers wanted to have some exclusive benefits, while low achievers wanted to have more manageable goals. These point to a need for a more diversified virtual reward experience. Given that users' activity goals and ways of using activity trackers have evolved over time [10, 12], improving the design of virtual reward systems to meet such needs seems to be the appropriate next step.

Also, it seems worthwhile to consider assigning badges a different role. Some participants regarded a badge as an alternative goal for their daily activity, while some deemed a challenging badge as a major milestone in their fitness journey. Thus, providing both options separately with different completion logics can be proposed. For example, a reward system could offer a daily goal badge in return for achieving a number of manually set goals while allowing users to start

challenging goals when they are ready. This suggestion could also deepen and diversify the experience with virtual rewards.

*Health-Related Information*

Several findings pointed to a need for more practical use of virtual rewards. Some survey participants reported that they were indifferent to virtual rewards due to the lack of perceived practical value. Also, a need for practical and meaningful use of virtual rewards was the most frequently found among the suggestions. Though many of them wanted to find monetary value from badges or points, monetary incentives may have a detrimental effect on those who have low self-efficacy [38].

Therefore, as another way to heighten practical value, providing health-related information seems most effective and reasonable. Nicholson [30] claimed that providing relevant information to users' interests helps people find meaningful connections between game design elements, activity, and their goals, which results in a meaningful gamified experience. This theoretical argument is supported by the findings from the autoethnography and the online survey. Some survey participants deemed virtual rewards pointless, criticizing the misalignment between their interest in health and the current content of rewards. On the other hand, many of those who have been using Google Fit appreciated the informational value of both Move and Heart Point, which represent the amount and the intensity of physical activity, respectively. They stated that points are a good indicator of their activity level and useful for maintaining their health. A similar view was also observed in the autoethnographic research. The first author was able to internally link the number of Heart Points to the impact of exercise on health, which led to making Heart Points more meaningful in everyday practice. In this sense, Google Fit seems to have made a step in the right direction, although its effectiveness still needs to be verified with a large population.

*Personalization/Customization*

Another way to enhance the perceived value of a virtual reward system is by adapting the system to changing personal interests and needs. Fritz et al. [10] and Gouveia et al. [12] indicated that the activity goal of users and their engagement with activity trackers have continuously changed with time. By comparing the types of data initially and currently monitored with an activity tracker, the survey revealed that there is a misalignment to some extent between users' concerns and the data types of badges available. Such misalignment can cause users to become indifferent to virtual rewards, as reported in both the autoethnography and the survey. To address this, some participants suggested creating badges tailored to their activity goals. Meanwhile, a recent study on adaptive interventions for increasing physical activity showed the potential of this approach. Korinek et al. [21] developed a smartphone app that personalizes users' step goals and awards points as a reward when users achieved their step goals. The results of a 14-week field trial with 20 participants showed that providing personalized step goals and rewards was useful for increased activity and sustained engagement in physical exercise. Personalization and customization can be complicated, but they can be as simple as allowing users to name themselves or to set their activity goals themselves.

## REFLECTIONS, LIMITATIONS, AND FUTURE WORK

### Reflections on Methodology

Two entirely different approaches were taken in this study: a diary-based autoethnography and an online survey. The results from both were found to be complementary to each other. A total of four months of autoethnography listed in detail many aspects of the virtual reward experience that were difficult to find in surveys or interviews. For example, without first-hand experience and the increased awareness at the point of use, it would have been difficult to reveal how a virtual reward system interacts with other features and how those interactions can affect users' behaviors and attitudes. On the other hand, an online survey provided many stories about users' situated experiences in a short time. All in all, the use of both methods facilitates a more robust and empathetic understanding of users and their experiences.

### Limitations and Future Work

The study also had its limitations. First, the length of the autoethnographic research was relatively short. Given that one-third of users stopped using their activity trackers within 6 months [22], four months of autoethnography can be identified as a short-term use. The use and impact of virtual rewards may change along with the evolving activity goals and practices over time. This kind of long-term use may shed light on different aspects of virtual reward experience. Second, the survey participants were predominantly younger adults (78/113), which was caused by the demographic characteristics of the platform used for recruitment. Since digital rewards are more likely to appeal to younger people [19], this composition of the study population could have influenced the results obtained. Third, a relatively small number of Google Fit users participated in the study. This hinders generalizing the findings derived from these users, although little difference was observed between the result of the autoethnography and their responses in the survey. These limitations should be addressed in future work to further investigate the changing relationship between users and virtual reward systems, the difference in perception and usage pattern between younger and older adults, and the difference in influence and role between points and badge systems.

## CONCLUSION

This study investigated real-life experiences with virtual rewards provided by activity trackers and their effects and value in people's physical activity practices using mixed methods: a diary-based autoethnography with three different virtual reward systems of commercial activity trackers and an online survey with 113 participants. While this work supports findings from previous studies, it also detailed the lived experiences with virtual reward systems in activity trackers and provided rich insights into how people perceive and experience current virtual reward systems. By connecting all the pieces together, the study suggested six considerations for the design of virtual reward systems for promoting physical activity. We believe the study took a step forward to achieve a more user-centric and meaningful virtual reward experience.

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