Incentivizing the Use of Quantified Self Devices: The Cases of Digital Occupational Health Programs and Data-Driven Health Insurance Plans

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Abstract. Initially designed for a use in private settings, smartwatches, activity trackers and other quantified self devices are receiving a growing attention from the organizational environment. Firms and health insurance companies, in particular, are developing digital occupational health programs and data-driven health insurance plans centered around these systems, in the hope of exploiting their potential to improve individual health management, but also to gather large quantities of data. As individual participation in such organizational programs is voluntary, organizations often rely on motivational incentives to prompt engagement. Yet, little is known about the mechanisms employed in organizational settings to incentivize the use of quantified self devices. We therefore seek, in this exploratory paper, to offer a first structured overview of this topic and identify the main motivational incentives in two emblematical cases: digital occupational health programs and data-driven health insurance plans. By doing so, we aim to specify the nature of this new dynamic around the use of quantified self devices and define some of the key lines for further investigation.

Keywords: Motivational Incentives · Quantified Self Devices · Digital Occupational Health Programs · Data-Driven Health Insurance Plans.

1 Introduction

The use of wearable devices that allow individuals to track and monitor their personal health data is starting to become mainstream in industrialized countries [1, 2]. For purposes of individual health, fitness, or well-being [3, 4], interested parties can obtain a myriad of dedicated devices, ranging from low-cost activity trackers to wristbands, smartwatches and more complex biosensors [5]. These provide precise information about one's physical activity (e.g. calories burned, distance covered), health levels (e.g. quality of sleep, blood oxygenation) or personal performance (e.g. evolution in numbers of steps taken).

Engaging in the practice of automatically collecting personal data is generally referred to as quantified self; but also known under analogous terms such as self-tracking, lifelogging or life-hacking [4, 6]. This practice builds upon the assumption that human bodies can be measured and understood through numbers [7] and that the knowledge of these numbers can enable each individual to discover, learn and act upon its attitudes

and behaviors [8]. In the common understanding, quantified self practices are related to an individual use of systems in private settings: lifestyle gadgets and health products are designed for the consumer market and collected data is destined for private use only [9]. Yet, we are witnessing an emergence of third-party entities, such as government bodies, pharmaceutical industries, health insurance companies, healthcare suppliers or employers, that are integrating the relationship between the technology provider and the consumer [10-12]. They start to distribute these systems as part of their own programs; so more and more quantified self devices are embedded into medical programs supporting rehabilitation processes [13], chronic disease management [14], but also integrated into occupational health programs [15-17], or health insurance plans [10, 11, 18]. These new actors are particularly attracted by the potential of quantified self devices in terms of self-care and positive impact on behavior. But they are also interested in the massive amount of detailed data that is generated by this technology [19]. Whereas in healthcare settings, it can be argued that enabling access to such a source of personal health information may be beneficial for the community [20] – as it allows, for example, a better monitoring of diseases or further research on new therapies – in other contexts, the use of quantified self devices may raise questions among users concerning the repurposing of the collected data for commercial or organizational goals. These potential exposures may concern a categorization of habits for marketing purposes [11], an identification of high-risk profiles to determine individualized pricings health premiums [21], or an institutionalization of syndromic surveillance for work productivity [20].

In order to mitigate these concerns, organizations often use motivational incentives, such as bonuses or rewards, to motivate people to participate in programs with quantified self devices [11]. Since participation in such organizational programs relies on a voluntary basis (given that these systems gather information that is potentially sensitive), organizations distributing quantified self devices to their employees and clients seek, through the implementation of incentives, to overcome resistance and increase adoption. Yet, little is known about the procedures that are put in place by these structures, as this represents a new and developing phenomena, both within practice and research [12].

Therefore, in this paper, we present an exploratory study on the mechanisms implemented by organizations to motivate individuals to participate in programs with quantified self devices. In contrast to conclusive studies, exploratory research is typically used as an initial appraisal, to provide a direction for future research and help to elaborate study designs [22]. Concretely, after introducing motivational incentives and their use in the Information Systems (IS) field, we particularly consider two practical cases (1) digital occupational health programs and (2) data-driven health insurance plans. These record a steady increase in use of quantified self devices, as reports indicate that (1) 13 million quantified self devices have been used in occupational health programs by 2018 and that up to 27,5 million are planned to be distributed by 2020 [17, 23]; and that (2) among 221 health insurance companies in the world in 2015 [24], a majority of 60% had the intention to rapidly integrate this technology in their business plan (if not already done). For each case, we present our exploratory research design and provide

the main results. We conclude by discussing these results, outlining the main learnings and proposing avenues for further research.

2 Related Papers

Since the early days of Taylorism at the beginning of the 20th century, incentives have been acknowledged as means to motivate individuals to perform tasks [25]. From the first monetary and financial remunerations, whole segments of research in psychology, organizational studies and behavioral economics have specialized into mechanisms that act on individual motivation. Most of this research builds upon the common division between intrinsic and extrinsic motivation, that refers to the nature of the motivation behind an action. Intrinsic motivation is linked to something inherently interesting or enjoyable, while extrinsic motivation refers to doing something because it leads to a separable outcome [26]. The latter has particularly led to incentive theory, which is one of the main theories of motivation [27]. It stipulates that individual behavior can be guided by external goals, such as recognition, rewards or money [28]. In the IS field, this theory has notably been apprehended through the lens of technology adoption, with Rogers [29] defining a typology of incentives that help individuals to embrace a new technology (and then eventually stick with it). He has notably classified incentives between monetary and non-monetary; immediate versus delayed (i.e. performing a task knowing that a reward will be given later) or positive or negative (i.e. praises, gratifications and rewards or, on the other end, punishments). Number of works have followed this path, with investigations on incentives applied to various fields, such as privacy and security information management (e.g. [30]), corporate performance (e.g. [e.g. 31]), but also for health improvement (e.g. [e.g. 32]).

Precisely, within the domain of quantified self devices, De Ridder, Kim, Jing, Khadra and Nanan [33] have conducted a systematic review of incentives for motivating people to use quantified self devices in the context of chronic disease self-management. Even though this work is rooted in a medical perspective (i.e. the user chose to use the device as part of a disease self-management), it offers a good basis for an examination of incentives offered by some types of organizations/institutions. In particular, it shows how organizations can build on the characteristics of quantified self devices (i.e. portability, connectivity, real-time reporting) to provide dialogue support to their users, i.e. evaluation of the use/performance (feedback); notice to engage with the use (reminder) or warning if there is a problematic element during the process (alert). Similarly, it associates social elements to connect users (social) as well as educational principles to provide information/training to prompt the use (education). Also, based on assumption that humans are attracted by playfulness and games in general [34], it can include fun components to make the use more enjoyable and entertaining (gamification). Finally, financial rewards can be added to provide an external source of motivation to engage in the use of quantified self devices (financial). Table 1 details these motivational incentives, as well as their general mechanisms and some concrete examples of application.

Table 1. Typology of motivational incentives for quantified self devices, derived from [33].

Motivational incentives	Incentive mechanisms	Application examples
Feedback	Informing the user about his quantified self-practice	Personalized messages, individual counselling sessions
Reminder	Systematically notifying the user to engage in the quantified self practice	SMS, push notifications
Alert	Warning the user about possible issues related to his quantified self practice	SMS, notices
Social	Connecting users between them	Forums, peer support networks, peer messages
Education	Providing the user with instructions, information and training	Online notes, leaflets, process guidelines
Gamification	Adding a fun component to the quantified self practice	Leaderboards, badges, avatars
Financial	Providing a financial remuneration for the quantified self practice	Cashback, value points, vouchers

3 Case 1: Incentives in Digital Occupational Health Programs

3.1 Research Design

Firms are considered to be very early adopters of quantified self devices in the organizational environment: they have started since the 2010s to examine the capacity of quantified self devices to tackle one of their largest cost factor, employees' health and safety, while providing an opportunity to gather information on their workforce [20]. Accordingly, we decided to look at the published academic literature to gain some insights on the current state of research. We thus conducted a scoping literature review of the incentives that are employed by firms to motivate employees to participate in programs with quantified self devices. This form of literature review serves as a preliminary assessment of the state-of-the-art, while remaining transparent, methodical and replicable [35]. The mechanisms are similar to systematic reviews, as we methodically searched academic articles in relevant electronic databases. In our case, we determined the following search string "quantified self" OR "self-tracking" OR physiolytics OR lifelogging OR wearable health device OR fitness tracker OR activity tracker AND corporat* OR work* OR organization* AND incentiv* OR motivation* OR reward and applied it to title, abstract and keywords screening in the principal databases for IS literature (AISeL), computing and information technology (ACM), as well as in one of the main cross-disciplinary databases (Web of knowledge).We specifically

targeted empirical papers (journal and full conference papers) and limited our research to publications which were published in English. Finally, we excluded studies that had no direct link with quantified self devices and digital occupational health programs. By means of our database search, we identified 86 records from AISeL, 17 from ACM, and 80 from Web of knowledge. After removing duplicates, screening titles, abstracts and keywords, and applying our inclusion/exclusion criteria, we obtained a list of 12 publications which met our above-mentioned requirements (cf. Table 2).

3.2 Results

One of the striking elements is the prevalence of feedback incentives in our selected studies. Arguably, due to the design of quantified self devices, a form of feedback incentive is essentially present in every program based on these systems (i.e. the user can see the data provided by the device), yet all of the identified occupational programs also propose a form of interactive feedback [e.g. 36] or individual counselling sessions [e.g. 37]. These are commonly associated with other motivational incentives, primarily with financial remuneration or gamification, but also with education (to support the communication, advices and problem-solving). In fact, out of these 12 selected studies, 6 included a form of financial incentive that provides cash rewards or vouchers (if defined goals regarding physical activity are attained). These goals generally take the form of daily objectives (e.g. averaging a certain number of steps a day) or improved biometric levels (e.g. Body Mass Index under a certain figure). Also, such incentive schemes are often associated to virtual value points, creating an intermediary currency between physical activity and its economic value. Their aim is to make it easier for participants to understand, follow and measure their progress and achievements. In terms of effectiveness, all studies reported positive results for financial incentives in promoting a participation in the beginning of the digital occupational health program, although this effect is sometimes marginal [e.g. 38]. Yet, two studies [39, 40] questioned the effects of financial incentives on the individual long-term participation (more than 6 months) as well as the durability of this approach in a digital occupational health program. Another popular motivational incentive consisted in relying on gamification, with a third of our selected publications applying such a mechanism. Virtual points also constituted a key element in the structure of these incentives: they translate users' physical activity into a metric, that is used, in this case, for leaderboards and classifications. Building on a competitive spirit of participants, these leaderboards aim to increase users' appeal to play and leverage a dynamic participation. As for incentives, gamification is found to have a positive effect on the engagement in the first phases, but there are still interrogations about the sustainability of this approach [e.g. 41]. A brief review of the retained studies can be found in Table 2.

Table 2. Selected studies for review.

Publications	Study sample and duration	Motivational incentives	Incentive mechanisms	Incentive evaluations
Chung et al. (2017) [39]	504 participants, 12 months	Feedback, Financial	Virtual points are given according to users' physical activity levels (1 step = 1 point) or if activity goals are attained in a given time (e.g. averaging 7,000 steps per day). These virtual points can be exchanged for cash rewards, gift cards or insurance discounts.	Effectively motivate users in the first phases to motivate users, sustainability has to be investigated.
Coffeng et al. (2017) [42]	750 participants, 30 months	Education, Feedback	Coaching feedback sessions	To be determined
Gilson et al. (2016) [43]	19 participants, 20 weeks	Feedback, Financial	Virtual points are given if physical activity goals are attained (e.g. averaging a number of steps per day). These virtual points can be transformed in vouchers.	Small positive changes for a majority of users
Gomez-Carmona and al. (2017) [36]	4 participants, 1 week.	Feedback, Gamification.	Motivational advice related to physical performance, leaderboards.	Effectively motivate users in the first phases
Hunter et al. (2016) [40]	853 participants, 13 months.	Feedback, Financial	Virtual points are given according minutes of physical activity (1 min of activity recorded= 1 point). These virtual points can be exchanged for vouchers.	Effective after 4 weeks, after 6 months no significant differences with the control group
Jelsma et al. (2019) [37]	250 participants, 12 months	Feedback, Education	Face to face sessions, individual counselling, self-help program leaflet	To be determined

Publications	Study sample and duration	Motivational incentives	Incentive mechanisms	Incentive evaluations
Kim et al. (2016) [41]	455341 participants, 12 months	Feedback, Financial, Gamification	Various challenges regarding physical activity, rewards platform where gains can be collected	Difficult to prove the role of incentives, although participation is enhanced
Lin et al. (2006) [44]	19 participants, 14 weeks	Feedback, Gamification, Social	Daily users' steps are related to the growth of an animated virtual character	Effective as users have established new routines with positive impact on their physical activity and health levels
Lee et al. (2019) [45]	79 participants, 12 weeks	Feedback, Reminder	Daily motivational text messaging, biweekly counseling and a specifically designed workbook for 12 weeks	Counseling and tailored text messaging are effective for physically inactive users
Patel et al. (2016) [46]	304 participants, 26 weeks	Financial	Various challenges regarding physical activity. Individual and team performance are rewarded by cash prizes	Effective in increasing physical activity
Vyas et al. (2015) [15]	17 participants, 100 days	Feedback Gamification	Through a step counting mechanisms, participants can unlock trophies, leaderboards	Positive results, motivation enhanced
Yu et al. (2019) [38]	1,436 participants, between 2011 and 2014	Feedback, Financial	Achieving certain health standards based on biometric screening values (e.g., Body Mass Index of 18.5–27.5) is rewarded by cash prizes	Statistically little impact

4 Case 2: Incentives in Data-Driven Health Insurance Plans

4.1 Research Design

In liberal healthcare markets such as Germany, the Netherlands or Australia, health insurance companies have just begun to propose additional health plans that include quantified self devices [47]. Consequently, there is little academic evidence which can be assessed based on a literature analysis. Therefore, we decided to review offerings from major health insurance companies. The idea was to explore if plans with quantified self devices are proposed and if so, reference what kind of incentives are included. We decided to focus on Switzerland, as it has a liberal market with a high competition between health insurance companies: permanent residents can enroll in extra health insurance plans (such as data-driven health plans) in addition to a standard insurance plan that covers basic healthcare costs, i.e. examination and treatment of a medical condition and its consequences. There are therefore expectations with respect to choice options for the side of consumers, particularly as Swiss are often well-equipped in terms of Information Technology, financially well-off and generally early adopter of consumer technology. To review offerings, we based our research on the official directory of health insurance companies made by the Federal Office of Public Health[1]. We concentrate on the five biggest health insurance companies (> 500'000 clients), which account for two thirds of the Swiss market share and therefore offer a representative picture of what type of data-driven insurance plans individuals may obtain in Switzerland.

4.2 Results

Out of the 5 major Swiss health insurance companies (*Assura, CSS, Helsana, Swica, Concordia*), 3 offer plans with quantified self devices (i.e. CSS, Helsana, Swica). They display similar practices by offering to participants to link a quantified self device to their dedicated app and therefore open the possibility for a financial gain on healthcare costs and premiums. Concretely, through its program *myStep,* CSS compensates with CHF 0.20 (¢20) each day when users do between 7500 steps and 9999 steps, and with CHF 0.40 (¢40) each day when they do more than 10000 steps [48]. Similarly, Helsana offers to consumers to connect with a Garmin or a Fitbit to their app *Helsana+* in order to collect so-called *Plus points*. A plus point is commonly obtained if users attain during the day one of the following values: 10000 steps, a pulse rate of 110 per minute for 30 minutes or 150 calories burned in 30 minutes [49]. These points may then be converted into cashback, reductions or gifts, allowing consumers to earn/save up to CHF 300 ($300) a year. Finally, Swica offers through its *Benevita* program a possibility to automatically gather quantified self data and complete an online form with health/lifestyle related questions to gather bonus points in order to save up to 15% of the premium [50]. It also proposes lifestyle challenges and fun games that users can share with other users,

[1] Statistique de l'assurance maladie 2019, URL : https://www.bag.admin.ch/bag/fr/home/zahlen-und-statistiken/statistiken-zur-krankenversicherung.html

as well as possibilities to retrieve educational content (regarding, for instance, physical exercises or nutrition).

Table 3. Selected plans for review.

Health insurance companies	Motivational incentives	Incentive mechanisms
CSS [48]	Financial	Amount of money is credited each time a defined goal is achieved.
Helsana [49]	Feedback, Financial, Gamification	Points are collected each time a defined goal/challenge is achieved. Points can be transformed into discounts or vouchers.
Swica [50]	Education, Financial, Gamification, Social	Points are collected each time a defined goal/challenge is achieved. Challenges can be shared with other participants. Through the app, clients can retrieve informative leaflets on nutrition or physical activity. Points can be transformed into discounts or vouchers.

5 Discussion and Key Implications for Future Research

The starting point of this explorative study is that organizations, such as firms and health insurance companies, increasingly include quantified self devices in their operations and often resort to motivational incentives to incite individuals to adopt and return to their quantified self solution [33]. Our findings show that similarities exist between digital occupational health programs and data-driven health plans in how they encourage users to participate in their respective programs. First, drawing on the design and capabilities of quantified self devices (i.e. enabling automatic flows of information about one's health levels), organizations commonly provide a feedback loop to assist participants in their tracking. This is particularly prevalent in workplace settings where firms often propose individual counselling or personalized messages as part of their digital occupational health program. This may be explained by the necessity for firms to communicate through the whole process: they need to reassure employees or clients regarding their engagement to improve their health behavior. As we have seen, quantified self devices may create a tension between leisure and work contexts as they gather, independently of context, data about one's physical activity and lifestyle [7]. So, it is essential for firms to show to their employees the added value such devices provide as well as offer help in interpreting and understanding the collected data and what is further done with it. Simultaneously, it offers to firms a way to monitor the effectiveness of the occupational program and refine the global picture regarding workforce health levels.

Our results also indicate that feedback mechanisms are commonly associated with other incentives, especially financial incentives and gamification. The extensive use of

financial incentives reveals that organizations consider that existing benefits (promises that the user may improve his health levels) are still not sufficient to prompt individuals to use quantified self devices in organizational programs [11]. They therefore build their motivational strategies on external rewards, which are typically used when the barriers to adoption are perceived as high, or when the defined objectives are considered difficult to be achieved [51]. Our exploratory study suggests that, in workplace settings, financial incentives have a positive effect in the first phases of engagement with quantified self devices, although the sustainability of this approach remains questionable on the long run. This is in line with reports (e.g. [52]) that showed that financial incentives potentially reduce intrinsic motivation (even if the interest is initially high) and undermine performance once the incentive is removed or lowered. Yet, a long-term use of quantified self devices is crucial in organizational programs, both for organizations and for participants. It ensures that enough data is gathered and that this data can be used for meaningful analyses and feedback. In this way, it may raise awareness regarding health levels and potentially support an individual behavior change (which is generally a lasting process). In consequence, for digital occupational health programs, further research may focus on unveiling the long-term effectiveness of financial incentives, in order to clearly assess the scope of (positive) impact of this incentive. For data-driven health plans, the systematic use of financial incentives demonstrates the high importance given by health insurance companies to this particular mechanism. Further analysis may therefore be oriented to thoughtfully consider the ramifications of this motivational incentive: does it increase individuals' participation? If so, is there a population group that is more prone to subscribe to such plan? What are the implications in terms of participants' privacy? And, as for digital occupational health programs, do financial incentives foster a long-term engagement in data-driven health plans?

Finally, our review indicates that gamification also represents a frequent motivational incentive. This is in line with the popularity of gamification as a design approach to address motivational issues for commercial and medical purposes [34]. Its implementation in organizations mainly consists in easing the execution of actions that are associated with a positive lifestyle (e.g. points-based scheme that translate the number of steps per day) and promoting the consistent of quantified-devices (e.g. extra points if performed on consecutive days) [53]. Nonetheless, gamification, as a motivational incentive, encounters similar challenges as financial incentives: evidence shows that it may have a positive impact on the use of quantified self devices in the first weeks, but its long-term impact is still not evident. In fact, some figures and numbers suggest that gamified interactive systems for health behavior change are considered as successful in merely 50% of the cases [54]. It seems therefore important to further assess the capacity of gamification to foster long-term engagement with quantified self devices, and then consider its application in organizational environments.

In sum, quantified self devices are emerging in organizational environments and lots of opportunities for research are arising with them. Various perspectives (e.g. organizational vs. individual) and approaches (e.g. utilitarian vs. hedonic) can be adopted and developed. So, we hope that, through this explorative study, we have indicated some of the paths worth investigating; and that these paths may ultimately lead to the

development of effective digital programs for organizations as well as harmonious environments for individual health.

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