

Personalization Revisited: A Reflective Approach Helps People Better Personalize Health Services and Motivates Them To Increase Physical Activity

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ABSTRACT

Current approaches to personalization either presuppose people's needs and automatically tailor services or provide formulaic options for people to customize. We propose a complementary approach to personalization: a reflective strategy that helps people realize what matters to them and enables them to better personalize services themselves. To design this strategy, we first studied the practices of eight personal health service providers. We then tested the strategy's efficacy by building a Fitbit Plan website that encouraged Fitbit users to customize a plan or accept an automatically tailored plan. For one group of users, the website used the reflective strategy to assist in the plan set-up process. A two-week between-subjects field experiment showed that the reflective strategy helped motivate users to carry out their plans, increasing their average daily steps by 2,425 steps. Without the reflective strategy, users either set easy goals or failed to carry out system-created plans, ultimately showing no change in their average daily steps. This work suggests that helping people reflect on and connect with their own goals in using a personalized service could advance the effectiveness of the service.

Author Keywords

Reflective personalization; service; behavior change; health; fitness; personal informatics; activity tracker

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Personalization has become an integral part of technology-based services, with an ever-growing influence on the decisions that people make and the content and services

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they access. Social media feeds on Facebook, advertisements on Amazon, search results on Google, physical activity goals on the Apple Watch, and even interactions at Disney parks are automatically personalized based on people's behavior traces, including browsing, purchasing, and communication records physical activity levels, and locations [2, 6, 13, 40, 62]. In addition to this system-driven personalization, many technologies allow people to directly customize service features [5, 47] or the user models on which personalization is based [63], making the personalization process user-driven. Prior research has shown that personalization in general offers many benefits: reduced cognitive and physical overloads, faster task completion, and increased persuasion, satisfaction, and loyalty to services [4, 5, 19, 26, 27, 30, 34, 59]. However, we argue that personalization can be further improved.

In system-driven personalization, systems infer what users want and need based on the assumption that their user models accurately represent real users. However, this assumption is often false as the models are based on specific, limited instances and treat users as objects of algorithmic optimization [32, 40]. The limitations of the user models can result in irrelevant or even offensive personalization outcomes [11]. The automatic—and thus often imperceptible—implementation of system-driven personalization exacerbates the problem. The hidden assumptions of user models may unconsciously bias decision-making [55], habituate people to follow directions mindlessly [7, 48], or make them focus only on things they already like [44, 58].

User-driven personalization (also known as customization) offers alternatives for people to choose from and tailor. However, the choices are often formulaic and superficial; previous research reveals many reasons why people may not be able to customize or tailor options to best satisfy their needs [46, 53]. People may feel overwhelmed or even experience decreased satisfaction when presented with too many choices [23].

We propose an alternative approach to personalization, which helps people to better personalize services *themselves*. Rather than assuming what will work best for people or presenting them with options from which to choose, our approach prompts people to reflect on their

goals and priorities, so that they can focus on what is most important to them when using and modifying services. We envision personalization as a form of empowerment, helping people realize what outcomes matter to them and giving them the agency to prioritize those outcomes.

In this paper, we designed a reflective personalization approach informed by interviews with personal service providers. We tested the efficacy of the reflective approach using Fitbit [14], a fitness service that tracks steps. Among many services that could benefit from the reflective approach, we focused on goal setting as it is a ubiquitous feature in technology services with a cascading effect in later service use. We chose a personal health service because health is one of the domains where personalization is increasingly seen as a transformative factor.

We built Fitbit Plan, a website that let Fitbit users set step goals and track their progress. Fitbit Plan allowed users to either create their own goals or follow suggested plans based on their performance over the previous two weeks. The reflective strategy was used during the set-up process to encourage some users to think deeply about why they wanted to increase their daily steps. We conducted a 2 (Reflective vs. Non-reflective strategy) x 2 (User-driven vs. System-driven personalization) field experiment for two weeks to test the reflective strategy. The results show that adding the reflective strategy motivated users to increase their daily steps by 2,425 steps on average over two weeks. Without the reflective strategy, users either set easy goals or failed to carry out the plans that the system suggested, ultimately showing no change in their average daily steps.

This paper makes two contributions. First, we introduce a new approach to personalization that broadens the design space. Second, we demonstrate the efficacy of this approach in a field study and discuss design implications for both reflective service personalization and future research on personalization and behavior change in HCI.

REFLECTIVE APPROACHES IN HCI

There is a long history of HCI research on how more active user participation and reflection play out in such domains as office technology design [10], end-user programming and development [15], computer-supported learning [42], reflective design [3, 51], slow technology [18], online discussion participation [28], sustainability [60], and personal health [21, 38, 49]. Collectively, this work reveals the benefits of empowering users by giving them the freedom to interpret technologies and to appropriate them for their own use. Yet, this line of work has not influenced how personalization has been conceptualized and implemented in the fields of HCI, business, or computer science. Drawing from this body of work, we explore a reflective approach to personalization, in which users are given opportunities to think about what matters to them with the guidance of technology-based services. When given this agency, people may be better able to create personalized services that work best for them.

EXPLORING THE PERSONALIZATION STRATEGIES OF HUMAN SERVICE PROVIDERS

To create our model for personalization technology, we studied personal service providers. Services were being personalized long before computers were invented. Service roles such as aide-de-camp, court jester, tutor, and butler existed centuries ago for high-status and wealthy people. Today, personal service providers perform a myriad of personalized services at many levels of society. In this paper, we ask how personal service providers have navigated the problems of determining and adapting to people's preferences. Prior work suggests that practitioners use principled approaches to understand unique problem situations and optimize solutions for each problem [50].

Method

We interviewed eight personal service providers (five women) who offered expert services to improve clients' physical and mental wellbeing in an Eastern city in the U.S. The providers included two personal trainers, two physical therapists, a chiropractor, a counselor, a massage therapist and a personal tutor. They had worked in their occupations for 15.6 years on average. We recruited them using referrals from clients and snowball sampling. We also directly contacted professionals whose business contact information was publicly available. We aimed to recruit providers with experience, as experts are reported to provide better care than novices [24].

Interview protocol

The hour-long interview began with questions about the professionals' work contexts and services, their typical relationships with clients, and whether any of their work was tailored to different individuals. Further questions probed what information the professionals needed to do a good job with their clients, how they listened to feedback and observed cues in their clients' behavior, and how they handled breakdowns in interactions with their clients.

Analysis

The interview recordings were transcribed for analysis. We grouped personalization instances into three coding categories, based on how service providers collected information about a client, tailored services to the client, and evaluated their services and used client feedback [13]. We also added codes that described details of how providers personalized their services and the reasons they gave for doing so [56]. We re-grouped lower-level codes into clusters that reflected themes of personalization across the three stages, and used the themes to consider current practices of technology-based personalization.

Results

Two key results informed the design of our reflective strategy.

Providers act as catalysts for reflective service processes

When clients lacked knowledge and expertise about a service domain, service providers played active roles in personalizing the service. The clients provided information

about their goals and motivations, but it was the provider's role to devise a program with specific tasks. For example, a physical therapist created a simple storefront mockup for a client who wanted to return to her cashier job in a bakery after her injury. Together, they practiced sales interactions and monitored the client's progress in managing the demands of the job. After the therapist understood the client's goals, the client's initial preferences regarding the service played a comparatively insignificant role in determining the ultimate nature of the service.

Providers help clients realize deeper goals and motivations

The success of the services that we studied depended on clients' presence and active participation. Providers explained that understanding clients' goals was critical for eliciting and maintaining engagement over time. Sometimes, however, clients did not think about or initially share their deeper motivations with service providers. Here, providers guided clients to think more deeply about their goals and motivations, so that they could personalize their interactions and sustain client motivation over time. For example, a personal trainer said he tried to understand the deeper motivations of his clients, even when they initially appeared to have well-defined goals:

(My clients) may say that their goal is to lose ten pounds, or lower their BMI, blood pressure or to be more fit or healthy; these are very generic goals, and are not what truly motivates them. For example... they have known that they may die early if they do not change their lifestyles, but this did not prompt or motivate them to change and come here. There is always something more emotional and motivating for different individuals, even though it may not be related to their biggest problem (threats to their health). So I keep asking 'why' to truly understand that motivation. At the end, they say it is to fit into their jeans that they used to wear when they were young... or look better to their husband, or get over the break-up.

What is noteworthy here is that the service provider's role is to repeatedly ask questions to get at hidden motivations. Providers used this information to tailor service offerings and interactions. For example, the personal trainer used this information to personalize his exercise programs and his feedback to clients, so that he could support the goals that clients cared most about. A personal tutor used his understanding of a student's goal of going to pharmacy school in tailoring examples that he used to explain math and chemistry concepts. These shared experiences made the client-provider relationship more collaborative and caring.

DESIGNING REFLECTIVE PERSONALIZATION

Our study of human service providers shows that service providers seek to understand clients' deeper goals and motivations, and use this knowledge to create personalized plans and maintain motivation through tailored feedback. What is critical in this process is the very first step in which providers guide their clients to reflect on and articulate what motivates them, so that clients can orient themselves

to their underlying needs and goals. This focus contrasts starkly with how computer-based services are currently personalized. Most current technology services, such as online shopping and education websites, product and news recommendations, and health management tools do not help users determine their goals. Instead, they either prescribe services that systems think will work best for users, or allow users to personalize the solution spaces of their services on the assumption that the users' goals at the time of personalization are fully realized. This insight played a key role in designing the reflective strategy, which prompts users to think more deeply about their goals through a series of questions.

How questions facilitate reflective personalization

The reflective strategies and processes that human service providers use are greatly nuanced. These processes include rapport and trust creation through shared goals, and interactive, dialogue-based goal and reflection elicitation. We distilled these processes into open-ended questions, focusing particularly on the "why" question, to translate human conversational strategies into computational ones. The simplicity and feasibility of open-ended questions allow for the flexible application of the strategy in a wide array of tasks and domains. We then turned to the literature on reflection in order to gain insights into the effects of reflection beyond those we observed in our interview study.

Why "why" works

Previous research suggests that asking reflective questions can help people articulate their underlying needs and goals and increase their motivation to use a service. The reflective strategy may elicit contemplative [25] or metacognitive [16] thinking, allowing people to think about their needs and wants beyond the first answers that come to mind. Research suggests that asking people their reasons for doing an activity triggers their underlying motivations and leads them to focus on higher-level goals [8, 61]. This reasoning can help people overcome potential decision biases [41] and give people opportunities to personalize service features to better satisfy their underlying needs and goals.

Reflective strategies may encourage people to focus on the long-term consequences of their choices and make decisions that are more in line with their ideal selves. In one study, people who were asked to think about why they eat snacks before making a choice were more likely to choose healthy options [17]. In another study, people exerted greater self-control tolerating physical discomfort when they were reminded of the purpose of the activity [17, 61]. This suggests that a reflective strategy can be particularly useful for services in which people might benefit from orienting themselves to long-term, deeper goals.

Greater awareness of underlying needs and goals attached to ideal selves can increase people's motivation for using a service. Research shows that people are motivated to satisfy their own needs [39] and to work on tasks that match their identities [1, 52]. In the absence of the reflective strategy,

people may not consider their individual motivations and goals when personalizing services.

How to ask “why” to elicit reflection

The success of reflective questions depends on whether they elicit deeper reflection. When service providers interact with clients, they often ask follow-up questions. There is also social pressure for clients to cooperate with the providers. Without the dialogue and social pressure, people may be less inclined to comply with computer-based services, and provide only superficial answers to questions. In order to address these challenges, we reviewed previous research in which reflective techniques were used successfully and adopted several of these in our design. These included asking “why” questions twice [17], instructing clients to take more time to think about the question, and asking clients to write longer answers than they usually would do [54].

Goal-setting and planning in personal health tracking

We evaluated the efficacy of the reflective strategy in the task of creating personalized plans for health. We built the Fitbit Plan website, where Fitbit users could set up personalized two-week plans for increasing their daily steps with the reflective strategy.

Goal-setting and planning

Among the many service aspects that can be personalized, we focused on goal-setting and planning. Goal-setting and planning are widely-used service features in a number of domains [37]. They are only a small part of the larger service process, generally taking place once at the start of a service, but they are a critical part of the service process. They can have a cascading effect; once people set their goals, they tend not to change the settings over the duration of the usage [48, 58]. In addition, allowing for goal-setting and planning has been shown to improve people’s service adherence and motivation [37].

The domain of personal health tracking

Many digital technologies are currently changing how people manage their health by offering aggregated sensor data and tools to document and manage health-related

behavior. Much HCI research has investigated different ways to use digital technologies to improve how people manage their health [9, 12, 19, 20, 29, 36, 38, 43, 49].

We used Fitbit [14], a physical activity tracker, as the basis for our personalized service design. Walking is a critical activity in personal health, as walking 10,000 steps or more daily has been shown to offer many health benefits [22]. The Fitbit website offers both user-driven and system-driven personalization features for goal setting and planning. Fitbit users can set up a single goal for their activity by typing in the number of steps they desire to achieve. If Fitbit users want to set up a plan to increase their daily steps, they can enroll in a “personal trainer” service with a yearly subscription fee. This feature presents a plan in which daily step goals increase from a current baseline. Users can follow the plan to increase physical activity.

Fitbit Plan Website

On the Fitbit Plan website, Fitbit users could set up a two-week goal and track their progress (Figure 1). The Fitbit Plan was built on Google App Engine using Fitbit Developer API. Highcharts JS was used to visualize users’ progress, and a portion of back-end implementation was adopted from [12]. Once users signed up to the website and gave their consent, Fitbit Plan automatically retrieved users’ daily step data from their Fitbit accounts. Fitbit Plan asked six reflective questions designed to guide people in thinking about their underlying motivations and goals, and to discover easy ways to implement them and remove any barriers to healthier lifestyles. Users could then create personalized two-week plans. Alternatively, Fitbit Plan recommended a personalized plan based on baseline steps and recommended guidelines.

EVALUATING REFLECTIVE PERSONALIZATION

We conducted a 2x2 between-subjects field experiment. The effect of the reflective strategy was evaluated with two main personalization methods – user-driven and system-driven personalization. Recruitment and administration of the study took place entirely online through email and on the Fitbit Plan website.

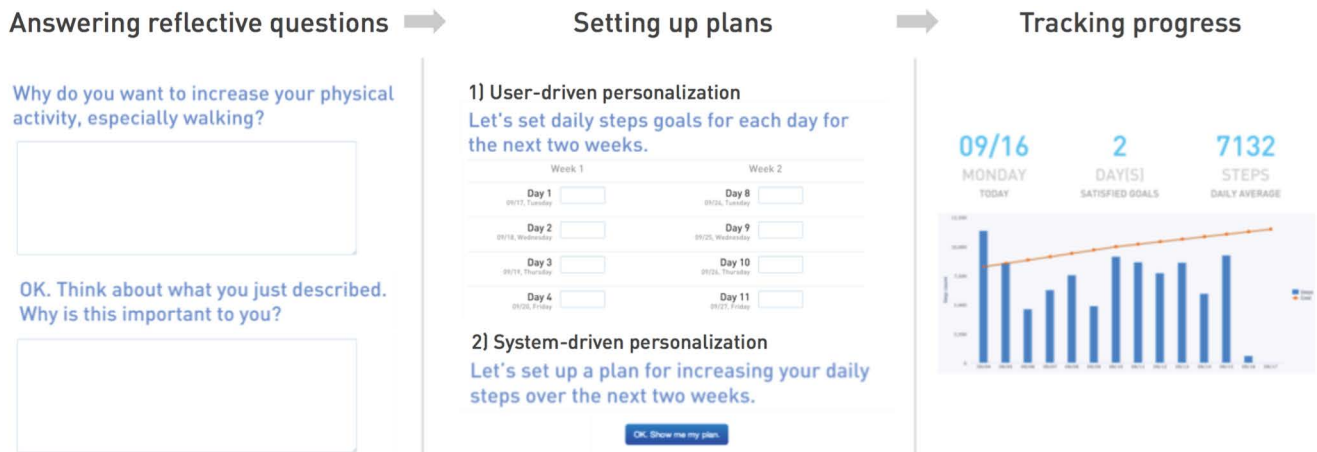


Figure 1. ©Min Kyung Lee. Fitbit Plan website

Hypotheses

Based on our goals of articulating needs and increasing motivation to use a personalized service, we explored the following hypotheses in the study:

Hypothesis 1. The reflective strategy will help people articulate their underlying needs, goals and motivations for increasing physical activities.

Hypothesis 2. People will be more motivated to carry out the personalized health plan by a technology system that employs the reflective strategy than by one that does not.

Participants

We recruited Fitbit users who wanted to increase their daily steps and try a daily-steps planning website. We posted a call for research participation on online Fitbit community boards, and on Facebook, Craigslist, and Twitter using the Fitbit hashtag. We used a pre-survey to limit participation to those who were older than 18 years, resided in US, were not pregnant, were proficient English speakers, self-reported that they wore their Fitbit almost everyday, and intended to increase their daily steps. In total, we recruited 62 Fitbit users (74% female, age ranges from 19.5 to 68 ($M=38.7$ ($SE=1.62$)). 37 were Caucasian, 9 were Asian American, 2 were Hispanic, 2 were of mixed origins, 1 was African American, and the rest did not wish to report. On average, participants had used Fitbit for 8 months ($SE=1.44$ month). Participants who completed the two-week long study were compensated with a \$10 Amazon gift card.

Experimental conditions

The experiment manipulated whether or not participants answered reflective questions and who personalized the two-week plan, the user or the system (Table 1).

	Reflective	Non-reflective
User-driven	N=15 (11)	N=14 (11)
System-driven	N=17 (11)	N=16 (7)

Table 1. Field experiment conditions and participant numbers. The first numbers indicate participants who set up their plans and filled out the Day 0 survey. The numbers in parentheses indicate participants who used Fitbit Plan and filled out the Day 14 survey.

Reflective strategy conditions

Six reflective questions were presented right before participants were asked to construct their plans. The first question asked why they wanted to increase their daily steps. The second question asked them to elaborate on their first answers (“OK. Think about what you just described. Why is this important to you?”). We encouraged them to think about this question for at least one minute, but we did not force them using a timer. The next questions asked about easy ways to start moving toward their goal, expected barriers, and their plans for addressing those barriers, in order to help them think about realistic goals. Finally, we asked how many minutes they could spend walking without disrupting their routines. Participants’ answers to these

questions were displayed on the page along with a graph of their goals and progress.

Personalization conditions

In the user-driven condition, Fitbit Plan asked users to type in daily step goals for two weeks. As a baseline and a reference, the page showed their average steps during the previous two weeks. We asked them to create a plan that was challenging (more than their baseline), yet realistic (achievable without requiring major effort). To encourage success, we also told them to try to accommodate their schedules. Once they typed in their goals, the goals were presented as a graph on the next page.

In the system-driven condition, Fitbit Plan devised a personalized two-week plan by following US Health agency recommendations, as well as guidelines for walking programs used in academic research and suggested by popular health information resource sites such as Mayo Clinic. Fitbit Plan used the participant’s average number of steps for the previous two weeks as a baseline. We told participants that we followed US Health agency recommendations to create a challenging yet realistic plan. The system gradually increased their daily steps, raising their baselines by 2,000 additional steps by the end of the first week and by an additional 1,500 by the end of the second week. This resulted in a 3,500 daily step increase on the last day of the two weeks, with an average daily step increase of 2,000 during that time – approximately equivalent to an additional 20 minutes of walking each day.

Once participants set up a two-week plan, they could track their progress in relation to their goals on Fitbit Plan. They were not able to modify the plan during the two-week period. We made this choice intentionally; the two-week plan is a good way for participants to explore their limits. If they wanted to continue to increase their daily steps or maintain their increased steps, they could make changes after two weeks. This also allowed us to control the experimental manipulation.

Procedure

People who contacted the study organizer were asked to fill out a pre-survey. Qualified participants were randomly assigned to one of the four conditions. We created four versions of Fitbit Plan, in order to satisfy each condition. The study organizer sent each participant an email with a link to an online consent form and the instructions on how to set up a two-week long plan to increase daily steps on Fitbit Plan. Then participants were asked to fill out the Day 0 survey. After two weeks of using Fitbit Plan, participants were asked to fill out the Day 14 survey, and compensated. No reminders were sent to the participants during the two weeks of the study period.

Data sources and measures

We collected behavioral and subjective data from the website’s plan and daily step logs and from the surveys.

Two-week plan and daily step logs

We used daily step logs on Fitbit Plan to understand how well the participants carried out their plans. To calculate changes in daily steps, we compared their daily average over two weeks of study participation with their baseline, which was their daily average from the two weeks before the study. There were no differences in the baseline numbers of daily steps across the conditions (Daily $M=9,801$ ($SD=5,541$)). To calculate each participant's plan completion rate, we averaged the ratio of the step goal in the plan with the actual steps that the participant walked for each day over two weeks. For participants who created their own plans (user-driven), we analyzed the goals that they set for two weeks by calculating how many daily steps, on average, participants planned to increase over two weeks.

Answers to reflective questions

We examined participants' answers to the reflective questions to see whether the questions elicited reflection on their underlying motivations and goals. We then categorized their answers by the types of reasons that participants provided, how they felt their goals contributed to their identities, and whether their reasoning was based on emotion, past experience, or knowledge. We also calculated the length of the answers.

Surveys

We conducted an initial Day 0 survey right after participants set up their plan, and an exit Day 14 survey after their two-week usage. We asked the same question sets as repeated measures to detect changes. All questions used 7-point Likert-type scales, unless noted otherwise.

Initial survey (Day 0). We asked about participants' experiences of setting up the plan.

Perceived control over the personalization process. Two items asked whether people felt that they had an appropriate level of control over the process (Cronbach's $\alpha=.8$): "I felt that I had an appropriate level of control over the process of setting up the plan" and "I felt that I could influence the process and outcome of setting up the plan."

Engagement with the personalization process: Two items measured how engaged people were in creating the plan (Cronbach's $\alpha=.8$): "I was highly motivated to pay close attention to this plan," and "While creating this plan, I could have worked harder on it."

Motivation to carry out the personalized plan: Five items adopted from [57] measured how motivated participants were to follow the plan that they created at the moment of creation (Cronbach's $\alpha=.7$): "Doing well on this plan is important to me," "I will put in good effort throughout following this plan," "I am not concerned about how successfully I will carry out this plan," "I will put forward my best effort in carrying out this plan," and "While following this plan, I will persist to completion of the plan."

Perception of services being personalized: Two items asked how personalized the participants felt their plans were [27] (Cronbach $\alpha=.82$): "The plan is personalized for me and my context," and "This plan accommodates what I want."

Perceived difficulty of and satisfaction with the plan: One question asked how much effort participants would need to put into completing the plan. We also asked how satisfied participants were with the plan.

Manipulation checks: We asked how helpful Fitbit Plan had been in guiding participants to think about their goals and constraints, and how evenly participants felt the work of setting up the plan had been divided between themselves and the Fitbit Plan website.

Exit survey (Day 14). The questions in the Day 0 survey—motivation to carry out the plan, perceived level of personalization and difficulty, and satisfaction with the plan—were rephrased to measure how participants felt while carrying out their plan rather than at the moment of creation. Additional questions asked how often they had remembered their daily goals, how much they enjoyed following the plan, and whether they wanted to decrease, maintain or increase their daily steps going forward.

Results

The study evaluated the effects of adding a reflective strategy to prevalent personalization strategies – user-driven and system-driven personalization. Both of our hypotheses were supported, suggesting that the reflective strategy can help users of personalized services achieve their goals.

Manipulation check

Our manipulations were successful. Participants in the reflective conditions felt that Fitbit Plan helped them think about their motivations and goals before setting up their plans (Reflective= 4.78 ($SE=.26$), Non-reflective= 3.1 ($SE=.27$), $F(1,60)=20.17$, $p<.0001$). Participants in the system-driven conditions felt that Fitbit Plan did most of the work (User-driven= 2.28 ($SE=.3$), System-driven= 5.33 ($SE=.28$), $F(1, 60)=55.8$, $p<.0001$; 1="I did the most work" and 7="Fitbit Plan did the most work.")

Effects of reflective personalization on thinking about goals

Participants in the reflective condition gave a variety of reasons for wanting to increase their daily steps which were consistent with previous research [45]. When asked "Why do you want to increase your physical activity, especially walking?" participants gave short and generic answers using a few phrases ($M=14.7$ words ($SD=13$)). The most commonly-mentioned reasons were "weight loss" ($N=16$) and "improved health" ($N=13$), followed by "improved mood or energy" ($N=9$), "fitness ($N=5$)," and other smaller categories.

Asking the why question again—"Ok. Think about what you just described. Why is this important to you?"—was effective in encouraging participants to think about their motivations more deeply. Participants were asked to

elaborate on their reasons by giving three examples, which resulted in an average of 111.6 words (SD=57) in total. Each reason fell into at least one of three categories based on whether it concerned the participant’s individual, social, or environmental self. Most frequently, participants mentioned that they wanted to improve their work productivity, athletic ability, mindfulness, self-confidence based on appearance, feelings of achievement, or longevity. Some participants mentioned social reasons, such as becoming better parents or having good times with friends. A few participants mentioned experiencing their cities and becoming closer to nature.

More interesting, however, was the richness and uniqueness of each participant’s response, which is lost in categorization. Many participants described very personal contexts, experiences, and emotions. The quotes below exemplify how participants expanded their initial answers, such as weight loss or improved health, to elaborate what they wanted to achieve by being physically active:

Better relationships - I feel that people judge me because I'm so skinny without being athletic. I almost feel more unathletic than the majority of my peers and that worries me; I get anxious if I get invited to any athletic event and I want that to stop. (P30)

I'm 49 years old and I can feel my memory and as a result my cognition slowly declining. I want to do everything I can to make it through my 80s with most of my marbles -- I especially don't want my kids to have to be burdened with taking care of me if I have Alzheimer's or other senility. I would like to be strong and playing with my grandkids! (P3)

Being connected with nature is also important to me, because I spend all too much time indoors with my day job. Having a moment to reconnect with the outdoors helps me to be a more grounded, centered person with the proper perspective on life. Whether outdoors near the lake or in the garden, having that perspective really helps me stay sane. (P31)

When I have more energy I can be productive at work. I can think clearer and have better ideas, and not just go through a day supported by caffeine. (P16)

Being more active will help [me] keep up with my son. He is a very active boy and there are days I cannot keep up with him. I want him to be proud of me. (P8)

While most participants described what they wanted to achieve, some participants’ sought to avoid potential negative consequences of not being physically active. For example, P13 said: *A close family member recently had a heart attack and passed away. He never took super good care of himself, and I'd really like to avoid that.*

P15 said: *My family has a pretty bad health history: high blood pressure, lots of cancer. I don't want to be like them and getting more activity may help.*

A few participants described scientific, mechanical, or numeric views of their goals. For example, P6 explained: *by moving more I burn more calories during the day and so can sustain a greater amount of food intake (and I like to eat).* P22 wanted to increase physical activity to “lower my cholesterol which is extremely high,” and P29 hoped “my heart rate and blood pressure will drop.”

Some participants reflected on their personal observations and on lessons learned from past experiences. For example, P18 said: *I find that I can wake up early on any day and in a good mood after I sleep well, which in turn correlates with how much physical exercise I did the preceding day.*

P5 said: *If I don't exercise for a while, I feel weak and might gasp after just [a few minutes'] walk. Also, if I sit or stay motionless for [a] long time, I feel sleepy.*

A few participants also mentioned plans for change. For example, P11 said: *I know working out, especially walking outdoors, always improves my mood. Why is it then, that days can go by when I lack motivation and don't walk? Inertia sets in. I really need to have a daily plan.*

Effects of reflective personalization on the experience of plan creation

The analysis of the initial Day 0 survey suggests that the reflective strategy mitigated some negative impacts of system-driven personalization on how participants felt about their plans. The reflective strategy increased the extent to which participants felt that the system-generated plans had been personalized for them and how satisfied they were with the system-generated plans (Table 2).

	Reflective	Non-reflective
Perceived level of personalization	5.32(.34)	4.25(.35) ^{*1}
Satisfaction	5.29(.31)	4.38(.32) ^{*2}

Table 2. Effect of reflective, system-driven personalization on a) perceived level of personalization of the plan and b) satisfaction with the plan (The numbers show the least squared means and the standard error in parentheses. *p < .05, ¹F(1,31) = 4.75, ²F(1,31) = 4.21)

	User-driven		System-driven	
	Reflective	Non-reflective	Reflective	Non-reflective
Perceived control	5.07(.33)	6.14(.34) ^{*1}	4.82(.31)	3.06(.31) ^{***2}

Table 3. Effect of reflective, system-driven personalization on perceived control (The numbers show the least squared means and the standard error in parentheses. *p < .05, ***p < .001, ¹F(1,58) = 5.2, ²F(1,58) = 15.84)

There was an interaction effect (F(3, 58)=15.35, p<.001) between the use of the reflective strategy and the type of personalization on perceived control over the set-up process (Table 3). With the system-generated plans, participants reported perceiving very limited control over the set-up process. However, answering reflective questions before receiving the plan significantly increased participants’ sense of control throughout the process. The opposite effect was observed with the user-created plans. Participants reported

perceiving greater control when they did not answer reflective questions than when they did. This suggests that participants may have felt the questions were guiding their thoughts and plan creation experiences.

However, neither the reflective strategy nor the type of personalization had any impact on how motivated participants felt to follow their plans at the moment of creation. Participants in all conditions were highly motivated ($M=5.9$ ($SE=.1$)). There were also no statistical differences in the perceived difficulty of successfully carrying out the plan ($M=3.74$ ($SE=.18$)) or engagement with the personalization process ($M=4.53$ ($SE=.15$)).

Effects of reflective personalization on plan creation

In the system-driven personalization condition, the plan was created to help participants increase 2,000 steps on average. In the user-driven personalization condition, those who answered reflective questions aimed to increase their steps by a marginally greater amount than did those who did not answer reflective questions (Reflective & User-driven= $3,198$ ($SE=738$), Non-reflective & User-driven= $1,133$ ($SE=764$), $F(1,27)=3.77$, $p=.06$) (Figure 2a).

Effects of reflective personalization on plan completion

22 participants stopped logging into the Fitbit Plan website, but the number of dropouts did not significantly differ across conditions (Table 1). The following analysis was done with the remaining 40 participants. The average number of daily steps for this sample was 9,311 ($SE=700$).

To examine whether the reflective strategy helped participants increase their daily steps, we conducted a MANOVA that compared each participant's baseline number of daily steps to their average number of daily steps over two weeks in each condition. The results suggest that the reflective strategy effectively motivated participants to walk more (Figure 2b). Participants who answered reflective questions before they set up their plans significantly took more steps compared to their baseline on average, regardless of whether they customized their plans themselves (Reflective & User-driven: Baseline= $10,589$ ($SE=1,830$), Two-week $M=12,543$ ($SE=1,741$), $F(1,10)=14.49$, $p=.004$) or received their plans from the system (Reflective & System-driven: Baseline= $8,666$

($SE=1,159$), Two-week $M=11,564$ ($SE=1,022$), $F(1,10)=10.12$, $p<.01$). Participants who did not answer the reflective questions showed no significant changes in their average daily steps as compared to baseline (Non-reflective & User-driven: Baseline= $9,733$ ($SE=1,241$), Two-week $M=10,420$ ($SE=1,335$), $p=n.s.$; Non-reflective & System-driven: Baseline= $7,652$ ($SE=916$), Two-week $M=8,556$ ($SE=847$), $p=n.s.$).

All participants completed their goals fairly well. In the user-driven conditions, participants who answered the reflective questions walked 93% ($SE=7.23\%$) of their daily goals on average, while those who did not answer questions walked 95.26% ($SE=5.86\%$) of their goals. In the system-driven conditions, participants who answered the reflective questions actually exceeded their goals (123.3% ($SE=17.7\%$)), whereas those who did not answer the questions walked 92.8% ($SE=8.09\%$) of their goals.

Effects of reflective personalization on the experience of carrying out the plan

We ran a regression analysis of the Day 14 survey to understand participants' experiences of carrying out their plans across the different conditions. All participants equally reported that they remembered their goals and plan often ($M=4.45$ ($SE=.27$), 4="often", 5="very often"), and wanted to maintain or increase their daily steps after the study ($M=2.42$ ($SE=.1$), 2="maintain my current daily steps," 3="further increase my daily steps").

We used MANOVA to analyze the repeated measures in both the Day 0 and Day 14 surveys, in order to compare participants' expectations about their plans to their actual experiences. The results suggest that participants in the reflective conditions found their plans more difficult, and felt that it had taken them more effort to successfully complete their plans than they had initially thought (Table 4a). When no reflective strategy was used, participants' expectations and actual experiences of the difficulty of their plans did not differ. Consistent with this perceived difficulty, participants in the reflective conditions reported less enjoyment in the experience of carrying out their plans in the Day 14 survey (Reflective= 4.7 ($SE=.27$), Non-reflective= 5.53 ($SE=.3$), $F(1, 37) = 4.59$, $p=.04$).

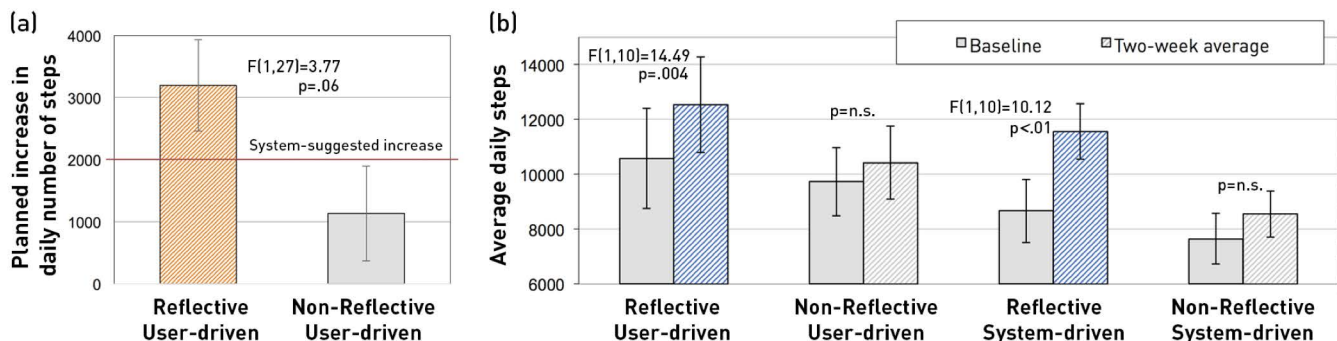


Figure 2. a) The effect of reflective personalization on the goals that participants set up in the user-driven personalization. b) The effects of reflective personalization on how participants carried out their plans.

	User-driven				System-driven			
	Reflective		Non-reflective		Reflective		Non-reflective	
	Day 0	Day 14	Day 0	Day 14	Day 0	Day 14	Day 0	Day 14
a) Difficulty	4.18(.3)	5.1(.43) ^{*1}	3.8(.33)	4.4(.44)	3.54(.6)	4.8(.41) ¹²	3.57(.57)	4.1(.52)
b) Motivation	5.66(.2)	4.66(.37) ^{***3}	5.8(.18)	5.38(.37)	5.87(.2)	5.23(.36) ^{*4}	6.2(.2)	5.4(.45) ^{*5}

Table 4. a) Perceived (Day 0) vs actual (Day 14) effort required to carry out the plan, b) Participant motivation at the time of the plan creation (Day 0) vs while carrying out the plan (Day 14) (The numbers show the least squared means and the standard error in parentheses. $p < .1$, $*p < .05$, $***p < .001$, ¹F(1,9) = 7.5, ²F(1,10) = 4.43, ³F(1,9) = 25, ⁴F(1,10) = 7.75, ⁵F(1,6) = 9.6)

Most participants, with the exception of those in the non-reflective, user-driven condition, reported that they were less motivated than they anticipated right after they set up the plans (Table 4b). Only participants in the non-reflective user-driven condition, who set easier goals, felt that they were as motivated to successfully carry out their plans as they had expected to be. Participants' satisfaction with the plans and the extent to which they felt the plans had been personalized did not change over time and did not differ across conditions (Satisfaction=4.8 (SE=.26); Perceived personalization=4.89 (SE=.26)).

Discussion

How reflective personalization worked

The results suggest that the reflective personalization increased people's daily walking with both user-driven and system-driven personalized plans. Participants spent fewer than 10 minutes answering questions before setting up the two-week plan, yet the simple reflection strategy seemed to have an impact on participants' later behaviors.

When participants customized their plans, the reflective strategy influenced them to set ambitious goals, and they successfully completed, on average, 93% of these goals. Without the reflective strategy, participants created easier and less ambitious plans than did those using the reflective strategy or those using plans created by Fitbit Plan, which were based on physical activity guidelines. Even though these participants completed 95% of their goals, their daily activity did not significantly increase as they aimed small.

When the service personalized plans for participants, the reflective strategy caused them to overachieve and actually walk more than the system had suggested. Without the reflective strategy, participants completed 93% of their goals on average, which did not result in a statistically significant increase in their daily steps.

Consistent with the literature on reflection presented in the beginning of the paper, we believe that participants' reflection on their underlying goals improved their motivation to set up and carry out their ambitious plans, and even to walk more than system-generated plan suggested.

Although reflective personalization was successful in increasing participants' daily steps, the survey results suggest that participants in the reflective condition felt their plans were more difficult than they had expected. They enjoyed following the plans less than those in the non-reflective condition did. Except for the participants in the

non-reflective, user-driven condition, who set easier goals, participants felt that they were less motivated when carrying out their plans than they had initially anticipated. We believe that system-created and reflection-based goals were more challenging than the goals that participants created without reflection. These goals therefore required participants to put in more effort than they had expected, and led them to feel less motivated to complete their goals. Nevertheless, participants in the reflective condition successfully increased their daily steps, and were just as likely as other participants to want to maintain or increase their daily steps after the study.

No effect of user vs. system-driven personalization

The type of personalization did not significantly influence participants' motivations to carry out their plans. This is consistent with previous research on goal-setting, which shows that while having a goal matters, whether people create the goal or have the goal assigned makes little difference in terms of motivation [37].

Reflecting with technology vs. with human service providers

We translated a human-human interaction strategy into a self-guided, reflective process. Unlike the human service providers in our interview studies, Fitbit Plan did not offer opportunities to create rapport, bond over shared goals, or hold participants accountable through social pressure and encouragement. While this translation sacrificed the human aspects of the reflective strategy, reflection guided by the website may have helped people be more honest with their answers and prompted self-reflection, thus improving their motivation to follow their plans.

LIMITATIONS

The experiment only lasted two weeks and was conducted with a small sample of existing Fitbit users with different levels of physical activity. The reflective strategy was successful in motivating these relatively active participants. It is unknown whether the strategy can effectively modify the behaviors of more sedentary populations. While the two-week long trial offers initial evidence that the reflective strategy can prompt behavior change, it is unclear whether the effect can be sustained beyond the two weeks. It is possible that the reflective questions would need to be asked multiple times in order to achieve a longer-lasting effect. The results of our study therefore need to be validated through a longer-term study with a larger and more general sample. The dropout rate was higher in our study than in most other studies in which the experimenter interacted with participants face-to-face or distributed

devices. We attribute this higher dropout rate to the fact that the study was administered entirely through email and the Fitbit Plan website, that no reminders were used during the study, and that participants used their own Fitbit devices. The lack of interaction with the experimenter or liability for the device may have caused participants to feel less committed to the study. This dropout rate also suggests that the reflective strategy might be more effective with people with stronger motivation for behavior change.

IMPLICATIONS

Empowering people to better personalize

Our work broadens the current scope and focus of personalization. We are not arguing that reflective personalization should replace current ways of technology of personalization; rather, we argue that the reflective strategy can be used to complement and strengthen existing methods of personalization. While automatically personalizing digital environments and goals and providing options for users to customize is a good start, it is equally important to empower people to better understand themselves. This is an element of personalization that digital behavior traces cannot capture. As a community, we in HCI must think about how we can empower people to personalize for themselves. The work presented in this paper offers one such methods of personalization, and the results of our field study suggest that this strategy can work effectively in combination with other methods of personalization as well.

Designing for motivation and reflection

Our work offers a reflective strategy that can be used in many areas where individuals' motivation and goal-setting matter for the success of the service, such as education, health, sustainability, and finance. For example, our work suggests that Fitbit's current Personal Trainer feature may become more effective if it guides people to write down why tracking daily steps matters to them, and displays these motivations as a reminder. Asking students in a MOOC or users of Mint, a personal finance management app, to reflect on their goals and then choose how they create the curriculum or savings plan may improve their motivation to learn and finish the program. Our work suggests that, rather than lists of pre-defined, generic goals that users can choose from, services should offer a space for individuals to write down the unique significance that achieving a chosen goal would have for them. Personal informatics can also benefit from the reflective strategy. Previous research has shown that reflecting on collected data is just as important as collecting data itself for the success of personal informatics tools [33]. "Why" questions can be used to improve people's adherence to data collection or to elicit deeper understanding of their collected data.

Modeling human practices as a design approach

Modeling human behaviors is a common way of inspiring nascent computing applications, as with the early desktop metaphor for GUI and robots [31]. It is less common for

more mature computing applications such as apps and websites. Designers for these applications study human practices to create tools that support those practices, but not to use them as design inspiration. This work suggests that, even for technology with well-established design patterns, human practices can serve as the bases of new and effective design interventions.

FUTURE WORK

Our work points to many open spaces for future research. In our study, the reflective strategy was used at the initial goal-setting and planning stage. However, there are many other points of intervention in service, such as while people are carrying out their plans, or when they become disengaged and lose motivation. Future work could explore how reflective questions can improve these different stages of service. In our work, we explored motivation and behavior change as the main service outcomes to improve. Future research can explore whether and how reflective questions can be used to improve other outcomes, tackling issues such as anchoring biases or the "filter bubble" effect [35]. In addition, with advancement in natural language understanding, further work can explore how interactive dialogues such as ELIZA [64], rather than self-guided processes, can be used to elicit deep reflection in users.

CONCLUSION

Personalization is a pervasive, integral part of people's lives, with an ever-growing influence on the decisions that people make and the content and services that people access. We envision personalization as a form of empowerment, helping people realize what matters to them and giving them the agency to prioritize it. In this paper, we have presented a reflective personalization strategy with the goal of helping people better personalize services themselves through reflection. We interviewed human health service providers as one model of such personalization and adapted their strategies to technology-based services. To evaluate the reflective strategy, we built Fitbit Plan, where Fitbit users could set up a personalized two-week plan to gradually increase their daily steps. The two-week field experiment suggests that the reflective strategy motivated users to increase their daily steps, regardless of who (user or system) personalized the plan. These results suggest that we may benefit from broadening the focus and implementation of personalization. We hope this study will influence the ways in which we design personalized environments, so that people are not treated as mere recipients of services, but rather as active participants who can best realize their own needs, goals, and problems, and have the power to create their own solutions.

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REFERENCES

1. Akerlof, G. A., & Kranton, R. (2010). Identity economics. *The Economists' Voice*, 7(2).
2. Balabanovic, M. & Shoham, Y. (1997). Fab: content-based, collaborative recommendation. *Commun. ACM* 40, 66-72.
3. Baumer, E. P., Khovanskaya, V., Matthews, M., ... & Gay, G. K. (2014). Reviewing Reflection: On the Use of Reflection in Interactive System Design. In *Proc. of DIS'14*, 93-102.
4. Berkovsky, S., Freyne, J., & Oinas-Kukkonen, H. (2012). Influencing individually: Fusing persuasion and personalization. *ACM TiiS*. 2(2), 9-16.
5. Blom, J. & Monk, A. F. (2003). Theory of personalization of appearance: Why users personalize their PCs and mobile phones. *Human-Computer Interaction*, 18(3), 193-228.
6. Brusilovsky, P., Kobsa, A., & Nejdl, W. (2007). *The adaptive web: Methods and strategies of web personalization*. (Vol. 4321) Springer Science & Business Media.
7. Carr, N. (2014). *The glass cage: automation and us*. WW Norton & Company.
8. Carver, C. S., & Scheier, M. F. (2000). Autonomy and self-regulation. *Psychological Inquiry*, 11, 284-290.
9. Consolvo, S., Klasnja, P., McDonald, D. W., ... & Landay, J. A. (2008). Flowers or a robot army?: Encouraging awareness & activity with personal, mobile displays. In *Proc. of Ubicomp'10*, 54-63.
10. Dourish, P. (1997). Accounting for system behaviour: Representation, reflection and resourceful action. *Computers and Design in Context*, MIT Press, Cambridge, MA, USA, 145-170.
11. "Facebook apologizes for highlighting painful memories with 'Year in Review' feature" on CBC news blogs, <http://www.cbc.ca/newsblogs/yourcommunity/2014/12/facebook-apologizes-for-highlighting-painful-memories-with-year-in-review-feature.html>, retrieved in July, 2015.
12. Fan, C., Forlizzi, J., & Dey, A. K. (2012). A spark of activity: Exploring informative art as visualization for physical activity. In *Proc. of Ubicomp'12*, 81-84.
13. Fan, H., & Poole, M. S. (2006). What is personalization? Perspectives on the design and implementation of personalization in information systems. *Journal of Org. Computing and Electronic Commerce*, 16(3-4), 179-202.
14. Fitbit. <http://www.fitbit.com>
15. Fischer, G., Giaccardi, E., Ye, Y., Sutcliffe, A.G. & Mehandjiev, N. (2004) Meta-design: a manifesto for end-user development. *Commun. ACM*, 47, 33-37.
16. Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American psychologist*, 34(10), 906-911.
17. Fujita, K., & Han, A. (2009). Moving beyond deliberative control of impulses: The effect of construal levels on evaluative associations in self-control conflicts. *Psychological Science*, 20, 799-804.
18. Hallnäs, L., & Redström, J. (2001). Slow technology—designing for reflection. *Personal and ubiquitous computing*, 5(3), 201-212.
19. Halko, S., & Kientz, J. A. (2010). Personality and persuasive technology: an exploratory study on health-promoting mobile applications. In *Proc. of Persuasive'10*, 150-161.
20. Hsieh, G., Munson, S. A., Kaptein, M. C., ... & Nov, O. (2014). Personalizing behavior change technologies. In *Proc. of CHI'14 Extended Abstracts*, 107-110.
21. Isaacs, E., Konrad, A., Walendowski, A., ... & Whittaker, S. (2013). Echoes from the past: how technology mediated reflection improves well-being. In *Proc. of CHI'13*, 1071-1080.
22. Iwane, M., Arita, M., ... & Nishio, I. (2000). Walking 10,000 steps/day or more reduces blood pressure and sympathetic nerve activity in mild essential hypertension. *Hypertension research: official journal of the Japanese Society of Hypertension*, 23(6), 573-580.
23. Iyengar, S. S., & Lepper, M. R. (2000). When choice is demotivating: Can one desire too much of a good thing?. *Journal of personality and social psychology*, 79(6), 995-1006.
24. Jensen, G. M., Gwyer, J., Shepard, K. F., & Hack, L. M. (2000). Expert practice in physical therapy. *Physical Therapy*, 80(1), 28-43.
25. Kahneman, D. (2003). Maps of bounded rationality: Psychology for behavioral economics. *The American Economic Review*, 93(5), 1449-1475.
26. Kaptein, M., Ruyter, B. D., Markopoulos, P., & Aarts, E. (2012). Adaptive persuasive systems: A study of tailored persuasive text messages to reduce snacking. *ACM TiiS*, 2(2), 10-34.
27. Komiak, S. Y., & Benbasat, I. (2006). The effects of personalization and familiarity on trust and adoption of recommendation agents. *Mis Quarterly*, 941-960.
28. Kriplean, T., Toomim, M., Morgan, J., Borning, A., & Ko, A. (2012). Is this what you meant?: promoting listening on the web with reflect. In *Proc. of CHI'12*, 1559-1568.
29. Lacroix, J., Saini, P., & Goris, A. (2009). Understanding user cognitions to guide the tailoring of persuasive technology-based physical activity interventions. In *Proc. of Persuasive'09*, 9.
30. Lee, M. K., Forlizzi, J., Kiesler, S., ... & Savetsila, S. (2012). Personalization in HRI: A longitudinal field experiment. In *Proc. of HRI'12*, 319-326.
31. Lee, M. K., Forlizzi, J., ... & Kiesler, S. (2009). The snackbot: documenting the design of a robot for long-term human-robot interaction. In *Proc. of HRI'09*, 7-14.

32. Lee, M. K., Kusbit, D., Metsky, E., & Dabbish, L. (2015). Working with machines: The impact of algorithmic and data-driven management on human workers. In *Proc. of CHI'15*, 1603-1612.
33. Li, I., Dey, A.K., & Forlizzi, J. (2010). A stage-based model of personal informatics systems. In *Proc. of CHI'10*, 557-566.
34. Liang, T-P., Lai, H-J., & Ku, Y-C. (2006). Personalized content recommendation and user satisfaction: Theoretical synthesis and empirical findings. *Journal of Management of Information Systems*, 23(3), 45-70.
35. Liao, Q. V., & Fu, W. T. (2014). Can you hear me now?: Mitigating the echo chamber effect by source position indicators. In *Proc. of CSCW'14*, 184-196.
36. Lin, J. J., Mamykina, L., ... & Strub, H. B. (2006). Fish'n'Steps: Encouraging physical activity with an interactive computer game. In *Proc. of Ubicomp'06*.
37. Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American psychologist*, 57(9), 705-717.
38. Mamykina, L., Mynatt, E., Davidson, P., & Greenblatt, D. (2008). MAHI: Investigation of social scaffolding for reflective thinking in diabetes management. In *Proc. of CHI'08*, 477-486.
39. Maslow, A. H. (1943). A theory of human motivation. *Psychological review*, 50(4), 370-396.
40. Mayor-Schonberger, V., & Cukier, K. (2013). *Big Data: A Revolution That Will Transform How We Live, Work, and Think*. Eamon Dolan / Houghton Mifflin.
41. Milkman, K. L., Chugh, D., & Bazerman, M. H. (2009). How can decision making be improved?. *Perspectives on Psychological Science*, 4(4), 379-383.
42. Miyake, N. (2007). Computer supported collaborative learning. *The SAGE handbook of e-learning research*, 248-265.
43. Munson, S. A., & Consolvo, S. (2012). Exploring goal-setting, rewards, self-monitoring, and sharing to motivate physical activity. In *Proc. of PervasiveHealth'12*, 25-32.
44. Pariser, E. (2011). *The filter bubble: How the new personalized web is changing what we read and how we think*. NY, USA: Penguin Group.
45. Richard, M., Christina, M. F., Deborah, L. S., ... & Kennon, M. S. (1997). Intrinsic motivation and exercise adherence. *Int J Sport Psychology*, 28, 335-354.
46. Riquelme, H. (2001). Do consumers know what they want? *Journal of Consumer Marketing*, 18(5), 437-448.
47. Saari, T. & Turpeinen, M. (2004). Towards psychological customization of information for individuals and social groups. In *Designing Personalized User Experiences in eCommerce*, 19-37.
48. Samuelson, W., & Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of risk and uncertainty*, 1(1), 7-59.
49. Sanches, P., Höök, K., Vaara, E., ... & Sjölander, M. (2010). Mind the body!: Designing a mobile stress management application encouraging personal reflection. In *Proc. of DIS'10*, 47-56.
50. Schon, D. A. (1982). *The Reflective Practitioner*.
51. Sengers, P., Boehner, K., David, S., & Kaye, J. J. (2005). Reflective design. In *Proc. of the 4th decennial conference on Critical computing: between sense and sensibility*, 49-58.
52. Sheldon, K. M. (2014). Becoming Oneself: The central role of self-concordant goal selection. *Personality and Social Psychology Review*, 349-365.
53. Simonson, I. (2005). Determinants of customers' responses to customized offers: Conceptual framework and research propositions. *Journal of Marketing*, 32-45.
54. Spalding, E., Wilson, A., & Mewborn, D. (2002). Demystifying reflection: A study of pedagogical strategies that encourage reflective journal writing. *The Teachers College Record*, 104(7), 1393-1421.
55. Strack, F., & Mussweiler, T. (1997). Explaining the enigmatic anchoring effect: Mechanisms of selective accessibility. *Journal of Personality and Social Psychology*, 73(3), 437-446.
56. Strauss, A., & Corbin, J. M. (1990). *Basics of qualitative research: grounded theory procedures and techniques*.
57. Sundre, D. L., & Moore, D. L. (2002). The Student Opinion Scale: A measure of examinee motivation. *Assessment Update*, 14(1), 8-9.
58. Sunstein, C. R. (2009). *Republic.com 2.0*.
59. Teevan, J., Dumais, S., & Horvitz, E. (2010). Potential for personalization. *ACM TOCHI*, 17(1), 1-31.
60. Thieme, A., Comber, R., Miebach, J., ... & Olivier, P. (2012). We've bin watching you: Designing for reflection and social persuasion to promote sustainable lifestyles. In *Proc. of CHI'12*, 2337-2346.
61. Trope, Y. & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review*, 440-463.
62. Tuzhilin, A. (2009). Personalization: The state of the art and future directions. In Admavicius, G. & Gupta, A. (Eds.) *Business Computing* (pp. 3-43).
63. Wasinger, R., Wallbank, J., Pizzato, L., ... & Kruger, A. (2013). Scrutable user models and personalised item recommendation in mobile lifestyle applications. In *User Modeling, Adaptation and Personalization*, 77-88.
64. Weizenbaum, J. (1966). ELIZA—a computer program for the study of natural language communication between man and machine. *Comm. of the ACM*, 36-45.