Five Strategies for Supporting Healthy Behavior Change

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Abstract
There is an ongoing search for theoretical foundations and design principles for interactive systems that support healthy behavior change. In this work-in-progress, we present several behavior change strategies that are currently used in effective health self-management interventions. We then discuss how these strategies can be used in applications that support behavior change in the health/wellness domain.

Keywords
Behavior change, design, health self-management

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Human Factors.

Positive Behavior Change
There is substantial interest in the HCI research community for building applications that support individuals in improving their health and wellness through *healthy behavior change*—improved diet, increased exercise, and/or other positive changes in lifestyle and everyday behaviors. Researchers have designed and evaluated many computational systems that attempt to accomplish this goal (e.g. [5,8,12]).

There is an ongoing search for theoretical foundations and effective design principles for computational systems that support healthy behavior change. Consolvo, McDonald and Landay have proposed a set of design guidelines for goal-oriented, persuasive systems [4]. Mamykina et al. presented design implications for supporting sensemaking and reflective practice [12]. Campbell, Ngo and Fogarty have suggested a set of design principles for everyday fitness games [3]. A thorough review of this subject is outside the scope of this work-in-progress.

Health Self-management Programs

In our work as designers of health and wellness applications, we are constantly looking for effective theoretical and practical guidelines to assist with the development of applications that support healthy behavior change. In this paper, we present a set of design principles distilled from the research literature on health-based educational programs for individuals living with chronic illness (health self-management interventions) [2,10]. These interventions have been shown to help participants realize improved health outcomes and an increased quality of life through behavior change around nutrition, exercise, medication management and other factors (e.g. [2,6,7,9]). Our goal is to identify the effective behavior change strategies used in these interventions, so that they may be leveraged in computational systems.

So far, technology has not been utilized heavily to support health self-management (HSM) interventions. The programs are traditionally led by an instructor or facilitator, and technology is used for the purpose of distributing educational materials, not as a means of supporting behavior change [11]. We believe that interactive applications could be used to support existing HSM interventions and practices, as well as to make some of the benefits of these interventions available to a broader population of users. Thus, in this work-in-progress, we aim to:

1. Highlight effective strategies for encouraging healthy behavior change that are used in health self-management programs.
2. Initiate a discussion about how these strategies can be effectively incorporated into computing applications that support behavior change.

Strategy Selection Procedure

To identify the set of strategies we present here, we performed a review of published research evaluating the effectiveness of health self-management programs. We reviewed a total of eleven meta-analyses evaluating the effectiveness of various HSM interventions, two books targeted at health professionals involved with HSM programs, and twelve additional research papers describing individual clinical studies of HSM programs. From this set, we selected those programs that have been shown to have a significant effect on the behavior and health outcomes of their participants. We then reviewed these programs, identifying the specific healthy behavior change strategies they use. In creating our list of strategies, we focused on strategies that met the following requirements:

- Apparent relationship between the strategy and the success of the health self-management intervention
- Potential for the strategy to be applied broadly across the health and wellness domain
- Potential to leverage the strategy in interactive computer applications

Because interventions are generally evaluated holistically, we looked to the discussion and recommendations provided by study authors to help us understand whether and how a strategy impacted the success of the intervention. We judged a strategy's generality based on the variety of health conditions to which the interventions that incorporate the strategy have been applied, and based on the generality of the strategy's psychological foundation. We evaluated a strategy's potential for use in an interactive application by looking to existing work in the field and based on our own experiences as developers and designers. Notably, none of the strategies presented in this work-in-progress require specialized training, the existence of a social cohort or a trained facilitator. We present broad strategies that can be used by a single individual and integrated into even relatively simple applications.

Five Strategies for Positive Behavior Change

In this section, we describe the five strategies which are the result of the selection process described above. For each strategy, we identify the evidence for its inclusion, describe how it is integrated into existing HSM programs and discuss how it may be leveraged in interactive systems that support behavior change.

Action Plans

Three strategies are related to *action plans*, which have been identified as a factor shared by a majority of successful health self-management interventions [2,7]. An action plan is a short-term goal agreed upon by an individual and her healthcare provider, and which the individual feels confident she can achieve [2,10].

STRATEGY 1: SET SPECIFIC, SHORT-TERM GOALS

The first component of an action plan is a specific, short-term goal. The goal should be quantifiable, as opposed to a "do your best" goal, and the recommended timeframe for realizing it is between one and two weeks [2,10]. Specific, short-term goals help individuals build self-confidence about the ability to execute a new behavior (such as exercising). These kinds of goals embody a clear distinction between success and failure, in contrast to a non-specific, "do your best" goal, which relies on the individual to judge whether she performed satisfactorily. Realizing a specific goal, even if it is not very challenging, builds self-confidence and encourages continued effort to realize more challenging goals [1].

Interactive applications that make use of goals to facilitate healthy behavior change should encourage users to set short-term goals—one or two weeks into the future. The goals should be specific, such as a concrete number of steps to walk, a specific reduction in the amount of calories consumed daily, etc. If an application allows broader or more abstract goals to be set, they should be split into short-term, specific components that can be achieved individually.

STRATEGY 2: SET ACTIONABLE GOALS

The second component of an effective action plan in health self-management programs is an emphasis on actionable goals. An *actionable* goal is one tied to a behavior over which the individual has direct control [2,10]. Examples of actionable goals include reducing the amount of sodium in one's diet or engaging in exercise. In contrast, goals that are *not* actionable include those related to body weight, blood pressure or other physiological measures. While managing these

Strategy Cheat Sheet

1. Set specific, short-term goals.
2. Set actionable goals.
3. Set goals the user is confident she can attain.
4. Use cues-to-action to trigger positive behaviors.
5. Allow users to increase their self-understanding through small-scale experiments.

non-actionable factors is frequently the ultimate objective of healthy behavior change, this outcome is best viewed as the result of specific, direct actions [10].

Setting a specific, but not actionable, goal creates an opening for failure and loss of self-confidence. Failing to achieve such a goal does not provide an individual with feedback as to what went wrong. Thus, interactive applications that support healthy behavior change should promote actionable goals. If a user is allowed to set a non-actionable goal, such as a body weight target, it should be paired with related, actionable goals such as minutes of exercise or daily calorie intake. The metric underlying the non-actionable goal can then be used as a reference for whether achieving the actionable goals is having the intended effect.

STRATEGY 3: SET GOALS THE USER IS CONFIDENT SHE CAN ATTAIN

The third behavior change strategy embodied in action plans is that an individual should only set goals that she is confident she can realize. Realizing such a goal raises the individual's self-confidence about her ability to successfully perform the behaviors needed for this goal (or even a more challenging one) in the future [1]. In some health self-management interventions, this requirement is operationalized by asking participants to rate their confidence of realizing a goal on a scale of 0 to 10 [2]. If the individual's confidence is below 7, the goal should be revised so that the individual more strongly feels that she can perform successfully.

To leverage this strategy, interactive applications should gauge the user's expectations of success before allowing her to set a goal. This can be done via a simple interface that asks the user to rate her perceived likelihood of success using the method described above. Additionally, an application can utilize this strategy to encourage the user to challenge herself by progressively adjusting the goal target. By allowing the user to rate her likelihood of success at each increment, it is possible to ensure that the goal is adjusted at a reasonable pace. This can allow designers to create applications that challenge users, but also mitigate the chance that excessively difficult goals will lead to failure, and thus potentially decrease the user's self-confidence or engagement with the system.

STRATEGY 4: USE CUES-TO-ACTION TO TRIGGER BEHAVIORS

The basis for the fourth strategy is *cues-to-action*, a component of the Health Beliefs Model. "Cues to action…can be thought of as including any event or stimulus that triggers patients to perform the targeted behaviors" [10:30]. They are used broadly in HSM interventions, and may be as simple as sending participants reminders to take part in some activity. However, cues can also be internal to an individual, such as experiencing pain or measuring an abnormal physiological measurement like elevated blood glucose. HSM interventions can help individuals reinterpret these internal cues to trigger positive target behaviors. Over time, this supports the user in developing a feeling of control over these internal cues, rather than ignoring or fearing them [10].

Monitoring applications are best suited to leverage cues-to-action. A system that monitors a user's physiological metrics can use abnormal readings as cues to encourage target actions that the individual is using to mitigate the problem. This may be an in-the-moment action, such as a reminder to take medication, or a broader behavior, such as offering to guide the user through a set of physical exercises or stretches.

STRATEGY 5: ALLOW USERS TO INCREASE THEIR SELF-UNDERSTANDING THROUGH SMALL-SCALE EXPERIMENTS

The final strategy we highlight is the use of small-scale experiments to increase self-understanding. This strategy is a key component of the Blood Glucose Awareness Training (BGAT) program, a health self-management intervention that has been shown to be effective in improving the health outcomes of individuals with diabetes [6]. The BGAT program encourages individuals to conduct small-scale experiments to directly observe the effect of stimuli (e.g. 30 minutes of exercise) on blood glucose levels. Through these experiments, individuals are able to more thoroughly understand their health condition and how it is affected by different actions and events. An individual with diabetes who has a better understanding of her body's responses to diet and exercise is able to anticipate blood sugar level fluctuations [6].

The ability to run small-scale experiments can be integrated into applications that help individuals take steps toward healthy behavior change. In addition to the diabetes management example above, systems that support users in increasing physical activity through step count goals can allow users to investigate the number of steps involved in common activities—taking the stairs, walking around the block, etc. By helping the user build a better model of how different activities contribute to her goal, the user may be able to more effectively structure her day to include the desired behaviors.

Discussion

We now turn to a discussion of open challenges to effectively integrating the above strategies into interactive applications. We focus on the operationalization of goal management strategies in systems, and on the need for systems that support small-scale experimentation.

Operationalizing goal setting strategies

Strategies 1, 2 and 3 presented in this paper are frequently used together in the construction of action plans in the health self-management interventions we reviewed. This union seems to provide the most beneficial and coherent goal-management experience for the interventions' participants. Effectively using these three strategies requires that behavior change support systems be able to work with users to set short-term, actionable and confidence-building goals.

Operationalizing these three goal properties into computational systems that allow users to define and manage their own goals is an open challenge. One contribution of this work-in-progress is highlighting how confidence-building goals are operationalized in HSM interventions. Namely, this is done simply by having the participant choose how confident she feels about realizing the goal on a scale from 0 to 10 [2]. It is also necessary to ensure that goals are both specific and actionable within the user's context. One way to establish whether a goal has these properties is to have the user annotate her goals with simple semantic metadata. Another way is to have the system include a human facilitator in the loop. The facilitator would be able to help the user set meaningful, specific and actionable goals related to her objective.

Supporting small-scale experimentation

Most behavior change applications described in HCI research literature do not support small-scale experimentation by their users. Instead, users are shown aggregates, such as daily or weekly activity levels. However, it may be useful for users to see the effects of individual activities in isolation. For example, an application that supports users in increasing their physical activity could allow users to compare the effect of particular, individual actions (e.g. calories burned by jogging in the morning vs. calories burned by always taking the stairs). This might help individuals plan their day better than would be possible if users have to rely on estimates of the activities' effects.

A challenge for such systems is to allow for data collection at a useful conceptual and temporal granularity, which may need to be context-specific and flexible. For example, Mamykina et al. reported that users of their MAHI system experimented with different meals to manage blood glucose levels [12]. However, there was a delay between making a dietary choice and seeing its effect on the blood glucose levels, which lasted between one and several hours. Small-scale experimentation systems need to be able to collect and present data on a time scale appropriate to the context. Additionally, systems that support small-scale experimentation need to allow users to analyze their collected data. In many instances, repeated measures are necessary to understand the effect of a stimulus. This analysis is currently most likely to happen with a human facilitator in the loop (as is the case in MAHI). However, there is also design space for automated or semi-automated sense-making interfaces that could support users in such an endeavor.

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