The Learning Model of Smartphone Feedback Applications in the Field of E-Health Applied to the Step Counter

Arie Dijkstra[1] and Elvira Kooy[1]

[1]University of Groningen, the Netherlands
arie.dijkstra@rug.nl

Abstract. An increasing number of technological devices provides people with personal feedback on indicators of their physical health, and many are applied to stimulate and support health behavior change. However, while in most cases the health effects depend on continued healthy behavior change, the individual use of feedback devices is mostly temporary. In this article this phenomenon is explained using the Learning model of Smartphone Feedback Applications (LSFA) which claims that people learn from the feedback: While initially the device provides the knowledge on the health indicator, people learn each time they become aware of the feedback, and after a while the source of this information is transferred to their memory, making the devices useless. This analyses has consequences for the development and positioning of feedback devices. In this article, LSFA is applied to the pedometer or step counter (SC).

Keywords: Personalized feedback, pedometer, learning, behavior change

1 Introduction

1.1 Feedback devices

An increasing number of technological devices provides people with personal feedback on indicators of their physical health, and many are applied to stimulate and support health behavior change. For example, people can receive feedback about their heart rate, alertness, skin conductance, body posture, level of stress, dietary intake, and number of steps taken. Often a sensor or scanner is needed and a displaying device (in smartwatch or smartphone). However, while in most cases the health effects of behavior depend on continued healthy behavior change, the individual use of feedback devices is mostly temporary. In this article this phenomenon is explained using the Learning model of Smartphone Feedback Applications (LSFA). Below the LSFA will be described and applied to the use of the Step Counter or pedometer to support people's long term physical exercise. It is argued that the SC should be embedded in an application that boosts learning and that supports long term behavior change.

In: R. Orji, M. Reisinger, M. Busch, A. Dijkstra, M. Kaptein, E. Mattheiss (eds.): Proceedings of the Personalization in Persuasive Technology Workshop, Persuasive Technology 2017, Amsterdam, The Netherlands, 04-04-2017, published at http://ceur-ws.org

1.2 Starting the use

Knowledge about one's number of steps (or any other physical parameter) is inert in itself, it has to be given meaning. People are only motivated to use an SC (or any device that provides feedback on physical parameters) when the use is related to something people value and a goal people have set that will lead to positive expected outcomes [1,2]. In addition, people must understand and accept that the SC will contribute to approach their goal. Below, a sequence of statements is presented that each refer to a certain psychological state of mind. Only when these psychological states are installed in a person, he or she will seriously start using the SC.

- "I value a good physical stamina and a lower risk on serious diseases" (Value)
- "Physical exercise will give me a good physical stamina and a lower risk on serious diseases" (Expected outcome)
- "I have set the goal to engage in more physical exercise" (Goal)
- "Taking steps is a relevant form of physical exercise" (Knowledge)
- "The SC helps me to take more steps" (Response Efficacy)

1.3 Actually using

When the SC is actually used, the following factors come into play. People get step feedback from their SC and compare the number of steps to standards that are related to their personal goal. These standards give meaning to the number of steps [3]: Whether it is positive or negative. Positive means that their number of steps have contributed directly or indirectly to accomplishing the goal, negative means that they did not, or not up to the standard. Both types of meaning can have positive effects on goal engagement: Positive feedback may mean that the person is on the right track, thereby motivating continued action. Negative feedback may signal that more effort or self-control action is needed but this will only motivate increased action when people think that it will be effective and that they are able to do so. Below, again a sequence of statements is presented that each refer to a certain psychological state of mind.

- "I know from the SC how many steps I have been taking" (Knowledge)
- "I compare the number of steps to the goal standard" (Comparison)
- "I understand the comparison: it is positive or negative feedback" (Evaluating)
- "I can take action on the basis of the feedback" (Self-Efficacy)

2 The Learning model of Smartphone Feedback Applications

As long as the SC is perceived as useful, as contributing to reach a valued goal, it will be used. When people start using the SC they may feel that the SC actually contributes to their health increased stamina or lowered risk for diseases. However, it is not the SC that contributes to this through feedback, but the awareness of the now known number of steps people take; it is the information on the number of steps that can motivate people to take more steps. The SC is the source of this information. However, when

people have used the SC for a while, they learn from it. The principal psychological or cognitive change that is taking place is the source transition; the information came from the SC but now from long term memory.

People live, behave, and step in a limited number of settings; they have their fixed routes and routines, most of the time. They walk from their bed to the kitchen, from the kitchen to the garage, from the car to their working place, from their working chair to the printer, etc. Normally, most people will not be aware of the number of steps they take, although when asked they might make an estimate of the distance they walk and compute their steps. The SC provides a precise number of steps; 316 from their work to the supermarket, 2309 around the block to the mall, etc. The SC provides people with new information that they can compare to the standards of their personal goal, thereby potentially motivating them to take enough or more steps. However, after several weeks or months of SC use they know about what their number of steps will be in their fixed routines, but also beyond that, because they learn. SC users can learn in at least two ways. Primary learning refers to changes in the users' knowledge about the number of steps that well-known and specified routes take. Secondary learning refers to changes in the users' knowledge about the number of steps that new or unknown routes take. These learning effects will probably be moderated by different factors: The novelty and abstractness of the feedback parameter, the frequency of the feedback, the person's foreknowledge on feedback and what it indicates, and many more.

The learning may take place more or less automatically: People learn about their environment in terms of steps independent of whether they want, or deliberately. In designing and positioning the SC (and all other devices that provide feedback), the learning effect must be taken into account anyway.

3 Implications

3.1 Supporting the learning

Instead of leaving the learning about steps to how it spontaneously takes place and develops, the SC might be presented and used in a learning protocol: Users may receive questions or assignments and feedback on their learning. For example, concerning primary learning, users may be asked to list the most important routes in their environment and assess how many steps they take (e.g., "From home to the mall: 2790 steps"). Concerning secondary learning, users may be presented with maps of routes that are not in their daily routine, or a video on a route, or a distance in kilometers, and they may be asked to estimate the number of steps it would take them. Users may receive feedback on their learning, possibly containing social comparisons and competition ("Compared to your friends you are learning great!"). Gaming elements may be included to support the use of these learning facilities.

3.2 Positioning the SC

The SC can be framed to the user as a learning tool. Instead of presenting it to be used to "stimulate and support physical activity" without mentioning for how long, the SC may be presented as "to learn about your personal environment and the opportunities it gives to increase physical activity". It is essential to realize that taking steps as physical activity is useful only when people do this for years. A brief period of physical exercise may have beneficial effects but these vaporize readily when the exercise stops. However, given that only very few people will use the SC for years, a realistic goal of the use of the SC may not be "permanent use" but "learning about step opportunities in one's environment and beyond". The latter goal may lead to the position that the SC is no longer needed because it does not provide new knowledge. Ceasing to use the SC then indicates finishing learning, instead of just losing interest.

3.3 Embedding the SC for long term effects

The challenge is to stimulate people to make sufficient steps on the long term, not to make people use the SC on the long term. Given the above, a SC should be embedded in a smartphone application that also provides: 1) information needed to boost the learning, and; 2) information that is needed to keep on making steps, independent of the SC. Such an application should heavily take into account state-of-the-art knowledge on behavior and behavior change. Besides the above mentioned psychological principles on starting the use and the actual use, theories on behavioral maintenance should be operationalized in such an application. For example, the Barrier Approach of physical exercise [4] provides a broader coaching framework around setting the right goal in context of perceptions of barriers that might inhibit long term maintenance. Furthermore, the motivation to keep on making steps is explained in the Learning Abstinence Theory [5]. Maintaining a behavior is, firstly, a function of person's perception on the progress towards one's goal, for example, living longer, having a good physical stamina, or making 10.000 steps a day. As long as people value the goal and feel they are "on the right track", they will keep on working on goal attainment. Secondly, the motivation to keep on making steps depends on what people experience. From their experiences they can learn that making steps: 1) has benefits; 2) has minor disadvantages; 3) is within their behavioral repertoire; 4) is a satisfactory addition to one's life. When the experience with making steps contributes to learning that these outcomes occur the motivational basis for long term maintenance is developed.

4 Studying the use and the effects of the SC

The above learning perspective on SC use is novel and scientific research data should be gathered to verify and develop it. Firstly, the learning processes might be studied in an experimental design: Ask participants to walk a number of fixed routes, while halve of them wears the SC (feedback versus no feedback), and again halve of them is in-

structed to learn about the number of steps the route takes (active learning versus automatic learning). The dependent measure might be the estimated number of steps a presented new route might take them. Such data will show whether receiving feedback improves step estimates and whether active learning works better or faster than automatic learning. Secondly, momentary assessments can provide scientific data: SC users may be asked on their subjective learning experiences ("does the SC help you to learn about your physical activity/number of steps you take?") on a daily or weekly basis over a three months period. These data may show whether, when and how fast the subjective learning process takes place: For example, after how many weeks do people feel that the SC no longer provides new feedback (which is a measure of source transition). Thirdly, in a field experimental design the practical question of whether embedding a SC in a mobile application that is designed to boost learning and support maintenance of taking steps, is more effective in stimulating long term step taking than a standalone SC. These are only a few possible useful scientific designs that will support progress in the effective use of feedback devices.

5 General conclusion

To optimize the health effects of the SC, it is recommended to present it in the context of an application designed to: 1) learn about one's steps, and; 2) maintain taking steps on the long term. Indeed, this might be the most effective for all types of feedback on indicators of behavioral or physical states that are related to long term health. Carefully monitoring the cognitive, motivational and behavioral changes that SC users undergo when they use the SC, will provide the data to further develop the present perspective of learning, and develop technology that is even more effective for humans because it is tailored to humans.

References

1. Bandura, A.: Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall, Inc. (1986)
2. Carver, C.S., Scheier, M.F.: Origins and functions of positive and negative affect: a control-process view. Psych. Rev. 97, 19-35 (1990)
3. Kluger, A. N., DeNisi, A.: The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. Psych. Bull. 119, 254-284 (1996)
4. Bouma, A. J., van Wilgen, P., Dijkstra, A.: The barrier-belief approach in the counseling of physical activity. Pat. Educ. Couns. 98, 129-136 (2015)
5. Menninga, K.M.: Exploring Learning Abstinence Theory. A new theoretical perspective on continued abstinence in smoking cessation. PhD thesis. A. Dijkstra and W. Gebhardt. University of Groningen, Faculty of Social and Behavioral Sciences. (2012)