Supporting Self-Assembly: The IKEA Effect on Mobile Health Persuasive Technology

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ABSTRACT

In this paper, we propose the idea of examining the effect of self-assembly on the success of mobile health persuasive technology. The IKEA effect shows that individuals evaluate products assembled by themselves more positively than pre-assembled products. The IKEA effect has been proven in several domains, e.g., in human robot interaction, where participants who assembled the robot evaluated the robot and the interaction with the robot more favorably than participants who did not assemble the robot themselves. We propose that the IKEA effect exists in the context of mobile health persuasive technology and has high potential for improving users' engagement and long-term user experience of mobile health persuasive applications. In this paper, we describe the IKEA effect and its potential for mobile health applications. In addition, we propose an experimental design to analyze the effect of self-assembly on user engagement and satisfaction.

CCS Concepts

• Human-centered computing~HCI design and evaluation methods

Keywords

The IKEA Effect; Self-Assembly; Mobile Health; Persuasive Technology

1. INTRODUCTION

According to the County Health Rankings [4], variation in health can be accounted for by health behaviors (30%), clinical care (20%), social and economic factors (40%), and physical environment (10%). Thus, we can see that health behaviors play an important role in people's health, including diet, exercise, sleeping, smoking, and so on. Some diseases or unhealthy conditions are caused by long-term improper behaviors or habits, e.g., unhealthy diet, sedentary lifestyle, etc.

Mobile devices (e.g., smartphones and smartwatches) and mobile applications have been widely used in our daily life, enabling not only pervasive, health related data sensing and collection but also mobile health intervention. Because many chronic diseases are negatively influenced by insufficient daily exercise, abundant fitness trackers (e.g., Fitbit, Garmin, and Misfit), mobile applications (e.g., MyFitnessPal, Google Fit, and Apple Health), and prototypes (e.g., interactive chair [11]) are designed to promote users' physical activity.

One of the most challenging tasks for mobile health persuasive applications is to sustain users' engagement. In a 10-month study of an activity tracker [6], 62% of the users quit within the first week. Another survey [8] found that over a third of owners of commercial physical-activity trackers discarded them within six months. Some work has been done to analyze why users quit [5] and how to maintain users' engagement [13]. Karapanos [8] describes three strategies to sustain users' engagement, including creating checking habits by constantly updating textual feedback, employing social influence, and supporting action by explicit activity suggestion. Stawarz et al. [13] suggest supporting trigger events to help users to foster habits. In addition, the huge success of gamification in social network applications has encouraged researchers to explore the impact of social influence and gamification on behavior change. Hamiri and Koivisto [7] found that social influence, positive recognition and reciprocity have a positive effect on the amount of exercise that people are willing to do.

The IKEA effect was derived by MI Norton and his colleagues [10] with a series of experiments, which showed that individuals tend to value the products assembled by themselves higher than the pre-assembled ones. Sun et al. [15] investigated the IKEA effect in the context of human robot interaction. Results show that participants who assembled the robot evaluated both the robot and the interaction process more positively. Ananthanarayan et al. [1] also report the positive effect of craft on users' evaluation and engagement with wearables.

In this paper, we want to discuss whether the IKEA effect also occurs when working with mobile health persuasive applications. We apply self-assembly to a mobile health persuasive application to evaluate if the IKEA effect occurs, and if it can help to improve users' engagement and adoption of mobile health persuasive technology. We are especially interested in whether a higher engagement and evaluation of the application can positively influence users' long-term use.

2. BACKGROUND

In the following section, we first describe the IKEA effect in more detail and justify why we think that it is transferrable into the domain of mobile health persuasive systems. Based on this, we describe a user scenario that illustrates the positive influence of self-assembly on the usage of the mobile health application.

2.1 The IKEA Effect

The IKEA effect describes a person's cognitive bias where they value the products assembled with their own labor more than pre-assembled products that did not require any of their own effort to create. This is even the case if the self-assembled products are of worse quality than the pre-assembled ones. In the first experiments

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of the IKEA effect conducted by Norton et al. [10], the authors illustrated the core of the IKEA effect: labor leads to love. In other words, people are willing to pay a higher price for their own creations. Therefore, the IKEA effect has huge potential for marketing and related domains. In the context of human machine interaction, however, does the IKEA effect still stand? Would people evaluate self-assembled interactive products created with their own labor more positively than pre-assembled ones?

We get positive answers to the above questions from the work of Sun et al. [15], where they used robots as objects of the experiment. To further reveal the theoretical mechanism underlying the IKEA effect on human robot interaction, they propose three mediators, which are the *sense of ownership*, *accomplishment*, and the *perceived process costs*. In their experiment, it was found that the effect is positively mediated by a sense of ownership and a sense of accomplishment, and negatively mediated by perceived process costs of assembly [15]. To be more precise, the impact of the sense of ownership and accomplishment is stronger than that of perceived process cost.

Similarly, Ananthanarayan et al. [1] report that craft can benefit health technologies because health technologies can be more meaningful to an individual and encourage higher appropriation when merged with craft. In their pilot test, they asked their participants to craft their own personalized wearable devices and then use them for a week. They argue that combined with craft technologies, health management can be enhanced with personal expressiveness and customization.

Based on these related works, we believe that in the context of mobile health persuasive applications, the IKEA effect should also exist. Self-assembly can also bring richer personal expressiveness and customization. The labor should impact the users' adoption and maintenance of mobile health persuasive applications.

2.2 Mobile Health Persuasive Technology

The mobile health persuasive technology is applying persuasive theory to promote healthy behavior through the mobile devices and applications. The purpose of mobile health persuasive applications is to help users to be healthier, always through self-monitoring and goal-setting. During the use of the persuasive technology, a healthy habit is expected to be fostered or an unhealthy habit is expected to be changed.

Sustaining users' engagement is one of the most challenging tasks for mobile health persuasive applications. In some work [3, 5], researchers have investigated why people abandon mobile health devices or applications, and provide design implications on how to maintain users' long-term engagement. Encouraging personal routines, employing proactive feedback at meaningful moments, and supporting changes are frequently mentioned as important factors in persuasive technology for health behavior.

With the increase of commercial smart devices and mobile health applications, more and more health related data and services are available to share data and services between applications. This makes it possible to allow users to assemble the data and services that they need to create customized functions in mobile applications. This enables self-assembly in mobile health persuasive applications.

Concerning the IKEA effect, all the related work we mentioned was deployed with physical products. Compared to those experiments, our target object is mobile applications, but not physical products. In mobile applications, we refer to self-assembling as choosing different functions, modules, or services provided within the app to create customized functionality or a user interface for the app. For example, a user may automatically record his gym attendance in his calendar using the services of Google Maps and Calendar, or a user may automatically mute his private smartphone when he arrives at the office using the Wi-Fi connection as the event trigger. Self-assembly in mobile applications requires more mental labor rather than manual labor. Will this difference affect the occurrence of the IKEA effect? If self-assembly can lead to a more positive evaluation, then what is the relationship between users' evaluation and adoption of the application? Will the better evaluation benefits the initial and long-term adoption? Will the effect dissipate along with time? In our work, we aim to address these questions.

3. SCENARIO

To better illustrate how self-assembly should work in mobile health persuasive applications, we apply it to a use case and propose the following scenario:

Cindy is a university student, who takes 4 lectures and 3 seminars this semester. Every day she spends most of her time in the university, i.e., attending lectures in the classroom, having lunch in the cafeteria, and studying in the library. She wants to make use of free time slots to become more physically active. To this end, she has an idea. Then she takes out her smartphone and opens an app called "HealthMe". She first presses the new function button. Then following the instruction, she creates a reminder to prompt notifications telling her to take the stairs instead of the elevator while at the university, after she arrives at the university. From then on, every day when Cindy arrives at the university, she receives a notification saying "Just take the stairs, that is simple and you can do it!" Most of the time when she is going to take an elevator, she will think of the notification and turn to the stairs. Two weeks later, she thinks it would be good for her to do yoga every evening. So she adds another reminder to tell her to do yoga when she arrives home every evening. Cindy likes the fact that she can decide by herself when she wants to be reminded and what the notification is about. She knows that whenever her life routine changes, she can adapt the reminders accordingly. Cindy thinks that this app can help her in ways she expects.

This scenario illustrates the features of self-assembly in our system design, which are self-defined events (e.g., "arriving home"), self-defined feedback (e.g., notifications), and supporting changes (i.e., adding or modifying the functions of the app).

4. EXPERIMENT PLAN

4.1 Hypotheses

The purpose of this work is to test if the IKEA effect exists on mobile health persuasive applications and how it affects user's engagement and adoption of the application. We have three hypotheses as listed below.

H1: Individuals will evaluate a mobile health application more positively when they set up the application by themselves.

H2: Individuals will have more engagement (e.g. add more functions or adjust the current function) with the application when they set up the application by themselves.

H3: Individuals will use the application for a longer time when they set up the application by themselves.

We illustrate the hypotheses in Figure 1. In our experiment, we contrast the condition of self-assembly to a condition that gives the users the exact same functionality, but the assembly is done by the experimenter and they receive the application pre-assembled.

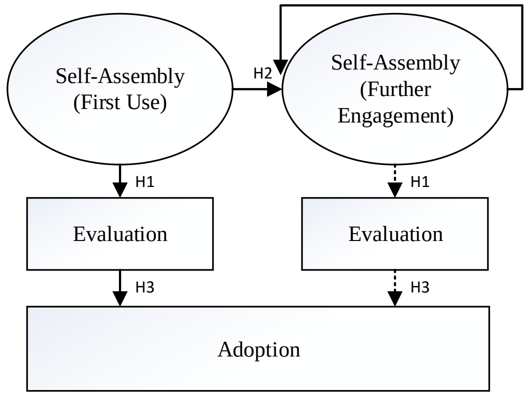

Figure 1. The hypothesized relationships.

4.2 Methods

4.2.1 *Research Design*

In order to test the proposed hypotheses, we plan to conduct a between-subjects (self-assembly group vs. control group) experiment. We utilize the IF[1] mobile application (see Figure 2) as our tool, which allows users to assemble the functions within the application.

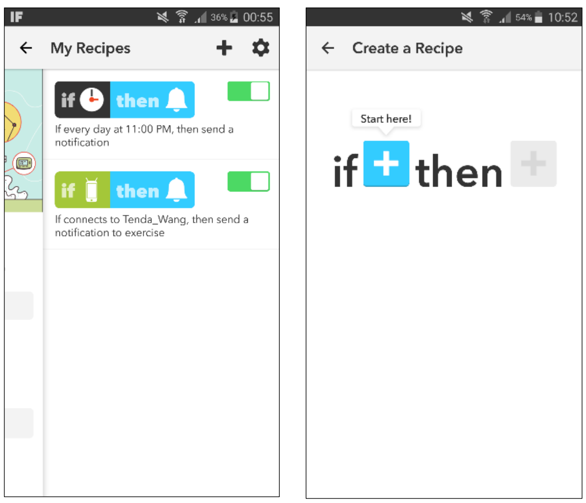

Figure 2. The interface of IF application

In the IF app, a recipe is used as a metaphor for a function, which can be described as "if THIS then THAT." "THIS" is an event, e.g., entering a specific area, connecting to a specific Wi-Fi, rain in a weather forecast and so on, while "THAT" refers to an expected feedback, e.g., notifications.

After a pre-study, we decided to provide participants a list of options of events ("if THIS then THAT"), notification content (e.g. "the yoga will refresh you", and "more small steps will lead to a big step for your health"), and exercise. To avoid too much burden on the participants or too much impact on behavior change caused by the exercise, we made the exercise suggestion list in cooperation with sports professionals. The exercise list contains some exercises that can be finished within 8-15 minutes. We also provide instructions to guide the participants in the self-assembly group to complete the assembling task.

4.2.2 *Participants*

We conduct the experiment with 20 participants [2]. Before the experiment, we introduce the experiment to the candidates by saying it is to promote daily exercise to promote healthy behavior. We only take the candidates who are willing to do the daily exercise. According to the behavior change theory [12], there are five stages when people make a behavior change, which are pre-contemplation, contemplation, preparation, action, and maintenance. We assume users' stage of behavior change will impact the evaluation. To ascertain a participant's current state for performing the exercise, we use the *stage of change questionnaire* [9].

4.2.3 *Measures*

We adopt the perceived pragmatic and hedonic quality as part of our measures to test the user evaluation. The *user experience questionnaire*[2] (UEQ) is used in our experiment.

Users' burden was reported as a high negative factor leading to users' quitting. Suh et al. [14] developed a model of user burden, which consists of six constructs of user burden (difficulty of use burden, physical burden, social and time burden, mental and emotional burden, privacy burden, and financial burden). They argue that each of these types of burden makes it difficult for people to initially adopt or continue to use a system. Inspired by this work, we also take the user burden as a measure in this experiment, for which we use the *user burden scale* (UBS).

The questionnaire we adapted from [15] is also deployed to measure the users' sense of ownership, accomplishment, and the perceived process costs in this experiment. We use the *sense of agency questionnaire* (SAQ) to refer to this questionnaire in the rest of this paper.

4.2.4 *Procedure*

4.2.4.1 *Session One*

All the participants are asked to fill the *stage of change questionnaire* first.

For the self-assembly condition, we first ask the participants to select an exercise from the provided list or to think of another one that they would like to do. Then they need to describe the meaningful moment when to get a notification, and design the content of the notification. Then the participants will be asked to install the IF mobile application on their own smartphones and create the reminder by themselves according to their own design. The participants are asked to use this app for a week, and told that they can change the reminder during the experiment week. We also ask the participants to use a diary to log their exercise.

In control condition, we also first ask the participants to select an exercise from the provided list or to think of another one which they would like to do. As with the self-assembly group, we provide suggestions about the reminder they may like and let them choose their favorite ones. This is to minimize their mental labor, while keeping the app's customizable feature. Then we ask them to install the IF application by themselves, after which the experimenter will create the reminder for them. The participants are asked to use this app for a week, and told that they can contact the experimenter to change the reminder if they want. We also ask the participants to use a diary to log their exercise.

At the end of session one, we ask the participants to fill the UEQ and SAQ the first time.

[1] https://ifttt.com/recipes

[2] http://www.ueq-online.org/

4.2.4.2 Session Two

After one week's use of the application, during the second session, the participants will be asked to answer the UEQ and the SAQ again, to fill the UBS questionnaire for the first time, and to take an interview with the experimenter. The participants are told that they can continue to use the app but do not have to.

4.2.4.3 Session Three

Four weeks later, the experimenter will send an email to all the participants to ask about their engagement with the app and ask them to fill the UEQ, the SAQ, and the UBS again, if they are still using the app.

4.2.5 Data Analysis

The results of the UEQ and SAQ address H1. The participants' diary and their interaction with the application address H2. The interview in session two, the participants' adoption in session three, and the results of the UBS will provide insights to address H3.

5. CONCLUSION

In this work, we aim to reveal if IKEA effect occurs in the domain of mobile health persuasive technology and its impact on users' engagement and adoption of the application.

We introduce the IKEA effect and analyze its potential on mobile health persuasive applications. We describe the scenario of applying self-assembly to a mobile health persuasive application. Three hypotheses are proposed, based on which we show the planned experiment.

By this work, we provide a novel perspective on designing the interaction of mobile health persuasive applications for the application designers and researchers in the domain of persuasive technologies. We believe that self-assembly and its application deserve more attention and discussion, and have high potential in the domain of mobile health persuasive technologies.

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