

Persuasive Strategies for Motivating Elders to Exercise

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Abstract— Several strategies have been identified for designing effective persuasive technologies that encourage people to adopt healthy lifestyle habits. However, there are no general guidelines for implementing these strategies to motivate elders to exercise, neither they have been evaluated to determine how effective they are for the elderly. To design appropriate persuasive technology prone to be adopted by elders, we are following a user-centered approach. In this paper, we report the design and evaluation of an ambient information system for mobile phones, which supports the following strategies for persuasion: abstraction, historical information and reflection, triggers for exercising, and positive and playful reinforcement.

Keywords—ambient information system, elders, motivating exercising

I. INTRODUCTION

According to studies on exercise psychology, encouraging people to develop positive attitudes about exercise, and promoting long-term exercise has been a major challenge over the years [1]. Strategies, based on psychological and behavioral theories, have been identified for designing effective persuasive technology that encourages people to adopt healthy lifestyle habits [2, 3]. Some of these strategies are: providing positive reinforcements to encourage change, providing awareness of the impact of their behavior on their health, and addressing the aesthetic aspect of the technology that has to support the user's personal style. In order to implement these design strategies to motivate elders to exercise through persuasive technology, we need to take into account the needs and problems they have for exercising, and the factors that negatively and positively may impact on their motivation. To reach this end, we carried out 40-minute semi-structured interviews with ten (10) non-frail adults (aged from 55 to 77 years old). Some of the findings identified from these interviewed show that passive elders (5 participants who do not regularly exercise) have reasons related to not being able to exercise on a regular basis, such as: for some of them it is difficult to get the habit of exercising, in addition that they do not like to walk alone. On the other side, staying healthy is the main motivation of active elders (5/10) for not quitting their exercise routines. Finally, we identified that exercising impacts positively on the elders' social life. All active elders have a more extended social network than passive elders since they are prone to carry out activities that enable them to interact with relatives and friends; while passive elders participate in activities in which mainly their relatives are involved. Implementing persuasive technology for mobile

phones may be appropriate, since most of the active participants (4/5) stated that they carry mobile phones while taking a walk. Additionally, the persuasive potential of mobile phones [3] has been envisioned through applications that provide timed information to nudge their users toward specific actions. Therefore, we propose Ambient Information Systems (AIS) for mobile phones to implement persuasion strategies that motivate elders to exercise. More details about the design and implementation of the system are presented in [4]. AISs are aesthetically pleasing applications that provide representations of valuable information that are easy to comprehend [5,6]. An AIS can work as i) Peripheral Displays if they are out of the focus of attention and allow users to monitor information without distracting or burdening them; and as ii) Notification Systems if they are used in a divided-attention, multitasking situation, attempting to deliver valuable information without introducing unwanted interruptions to a primary task [7]. Thus, with the aim to identify how the persuasion strategies for exercising should be adapted for the elderly, we designed and evaluated an AIS for mobile phones that by requiring minimal attention and cognitive effort from older adults, makes them aware of relevant information that motivates them to exercise.

The following Section presents some of the systems that provide evidence of the effectiveness of different persuasion strategies that have been evaluated in different contexts. Section III presents the persuasion strategies we incorporated into the design of our AIS, while Section IV presents its design. Section V describes the formative evaluation we carried out to validate the persuasion strategies. And finally, section VI concludes and presents our plans for future work.

II. RELATED WORK

Several AISs have been proposed to encourage people to exercise by using psychological strategies oriented to cause a positive behavioral change in users, such as providing representations of the compliance of the physical activity routines [8,9,10], providing rewards as incentives for positive behavior [8,9,11], or by punishing negative behavior [8], and games in which players compete to reach healthy goals [8,11]. For instance, "Play, Mate!" is a game-based application to encourage children to exercise; its design is based on a behavioral theory that conditions a high probability activity (playing with video games) on a low probability activity (physical activity) [11]. "Fish'n'Step" is also a game-based system that symbolizes the repercussions of exercising (or not) on the players' health through the growth and emotional state

of virtual pets. The results of the evaluation carried out with adults younger than 63 years of age, proved that the system increases users' awareness of their levels of physical activity and increases their motivation to exercise, which was determined by using the Transtheoretical Model of Behavioral Change [8]. In a similar way, "UbiFit Garden" is a mobile glanceable display that uses the metaphor of a garden that blooms throughout the week as a user performs his exercise routines. By means of a three-months evaluation with young-adults (25 to 35 years old), it was found that participants that use the system maintained their weekly activity duration on average throughout the three-months, while the activity duration for those who did not have the system went down over time. Additionally, the qualitative data collected during this evaluation was used to identify a set of design strategies for developing persuasive technologies [2,9]. Finally, the "Flowie" system is an interactive information display for providing seniors with general feedback on their activity progress in relation to the proposed goals, that is, the number of steps proposed to walk during a day. A preliminary evaluation with two older adults proved that providing elders with a system that enables them to easily monitor their activity progress is well accepted [10]. Thus, some of the above-mentioned works have carried out evaluations that report how the used strategies encourage target users to exercise. However, to the best of our knowledge, these strategies have not been evaluated with older adults. We have incorporated some of the proposed and validated strategies into a mobile Ambient Information System to motivate older adults to exercise.

III. PERSUASION STRATEGIES

In this section we present how we adapted some of the strategies and theories for designing persuasive technologies presented in [1,2,3], to the design of an AIS for the elderly:

- *Abstraction.* The effectiveness of personal displays that provide abstract representations based on metaphors to increase the users consciousness about the impact of adopting healthy habits has been already shown [8,9,10]. Thus, we propose to use metaphors to represent the elders' exercising compliance and to make them aware about the different benefits of exercising for their health.
- *Trigger the physical activity.* A trigger is defined as an alert that should be presented to users at a moment when they can perform the behavior [3]. It can be designed: i) to inspire the desirable behavior by including motivational elements (i.e. images representing the positive effects of performing the behavior), ii) to make users aware that the behavior is easy to do (for persons who lack abilities for executing the behavior), and/or iii) to provide reminders (since if a user is highly motivated, he may just need to be reminded to take action) [3]. As we are designing for elders who are able to exercise, we decided to provide the following timed-notifications as triggers to encourage elders to achieve their exercising goals: i) reminders for exercising, and ii) notifications to encourage them to finish the physical activity; that is, while they are exercising, they will be aware of how close they are to reach the proposed exercising goal.
- *Historical information and reflection.* According to the interpretation and adaptation of the Cognitive Dissonance Theory, persuasive technology should be design to help the individual to remain focused on his commitment to change by providing him with awareness of his past behavior as it relates to his/her goals [2]. Therefore, providing representations, of the progress of their short-term goals, ensures sustainable exercise and improves persons' perceived efficacy of the activity (Reflection) [10]. Additionally, in [12] it is reported that enabling users to occasionally check their habits through dynamic content accessible on their mobile phones, encourages them to adopt a good behavior. Our aim is providing elders with information of their behavior for promoting reflection, in the sense, the elders will realize how committed they are in order for them to improve their future behavior.
- *Positive and playful reinforcement.* If users perform the desired behavior, they should be rewarded; on the contrary, they should not receive rewards or information that makes them feel punished [9]. To adapt this strategy to the elderly, we decided to use the metaphor of rewarding elders with virtual coins, which could be used to play their favorite games for a period of time, as they would do using their real money in a slot machine at a casino. In the following section, we explain the design of an AIS that uses this metaphor for addressing the four strategies we have presented.

IV. SYSTEM DESIGN

We designed the CAMMInA (Calm Application for Motivating elders to Move by Interacting with their Age group) system for mobile phones to provide elders with notifications and representations of their physical activity performance. We propose to provide (virtual) coins of different value as a metaphor for encouraging elders to achieve their goals (triggers) and for representing the elders' exercising compliance (abstraction for encourage reflection). Thus, elders obtain a copper coin for setting a goal, a silver coin for exercising half of the scheduled time, and a gold coin for a reached goal. Additionally, elders' social interactions are represented with a diamond, which also enables them to obtain rewards based on access time for playing. To explain how this metaphor was used to provide triggers for the physical activity, we present and explain some of the users interfaces of CAMMInA. The system provides audible and textual notifications for reminding her to go for a walk. When she starts exercising, the system presents a copper coin including the time proposed for exercising (see Fig. 1a). As she walks, the system updates the time she has been exercising. When she partially reaches her goal (walking half of the proposed time), the system provides an audible notification associated with the silver coin presented on the display; similarly, it provides an audible notification and a gold coin when the goal is reached.

To promote elders' reflection of past and future behavior, we decided to provide a three-week representation of the complied, current and planned exercising goals through a calendar that presents the coins earned during the past, current and next week, either for pursuing their goals or just for proposing goals. Additionally, it represents the elders' social

interactions experienced during exercising, which according to our case study is one of the major benefits obtained by active elders. When the elder finishes her work out, the system updates the three-week representation of the compliance with her exercising goals. This is a calendar presented as wallpaper on their mobile phones. For instance, Fig. 1b shows a calendar indicating that: today (10th day of the month), the elder reached her goal (gold coin) and had social interactions while exercising (diamond); she did not exercise on the 1st day of the month as proposed (copper coin), and she partially reached her goal on the 5th day (silver coin); for the next week she has already set her goals for exercising on the 15th, 17th, and 19th days of the month (copper coins). The CAMMInA system provides elders with different accessing levels that limit the time for playing a set of games that they in advance associate with this application on their mobile phones. We identified up to five levels of benefits (rewards) that elders might get based on their motivation for exercising while using the system. These levels can be inferred by interpreting the three-week calendar. The benefits include providing limited time (level 0) up to providing unlimited time (level 5) for playing games. For instance, based on the first week of the calendar, the CAMMInA system determines that the elder is partially motivated (level 3), and grants the corresponding benefits based on time for accessing games.

V. EVALUATION

We carried out a usability evaluation to identify how elders perceived the system persuasion strategies. In particular, we evaluated the users interruption, reaction and comprehension when the system provides the different triggers for encouraging them to reach their exercising goals. According to McCrickard, et al [7], these are critical aspects that enable designers to measure the effectiveness of ambient notification systems. Fifteen (15) persons, ranging in age from 63 to 86 years old, used the system one day while they exercised at a Senior Center of the Mexican Institute of Social Security. The evaluation consisted of one session with all the participants for introducing the aim of the system; afterwards, we scheduled a second session to train each participant and to enable him (or her) to use the system during his workout (an hour approximately). At the end of the exercising session, we interviewed participants to gather information regarding the

system aspects they considered were (or were not) easy to use, useful, that they liked most, and the ones that disliked most. We also assessed the process they followed to be aware of the notifications (perceiving, reacting and comprehending).

A. Results

The data gathered during the evaluation enabled us to understand how to improve the persuasion strategies of CAMMInA:

- *Abstraction.* The metaphor used, based on providing coins to represent the compliance of their exercise routine, was well accepted by the elderly. They commented that the functionalities they enjoyed most were: being able to track their goals and monitor the duration of their exercise routine (commented by 6/15 elders); realizing when they get “gold coins or diamonds” (said by 6/15); and wearing the device, which “[it] is modern” (3/15). On the other side, some of them also commented about the functionalities that they enjoyed the least. For three of them (3/15), the rewarding approach based on time for playing games was not interesting, and another said that they did not like to see a “copper coin when they did not exercise”.
- *Historical information and reflection.* Most of the participants (11/15) emphasized that the calendar was useful, since it helps them realize if they pursued their goals or if they have proposed goals, which may improve their motivation for continuing exercising:

“... I would like to get just gold coins.... Realizing that I did not exercise one day, it would guide me to make an effort for the next day”.

However, visualizing the goals (copper coins) that were not pursued during the past days (copper coins) were perceived by the elders (2/15) that have less than 6 months exercising, as a factor that may negatively impact their motivation:

“[I would like the system to] eliminate copper coins, since they are negative...”; “... copper coins”;

“...I would like to see just gold coins”.

Furthermore, some participants (5/15) also suggested that the system should present specific information regarding

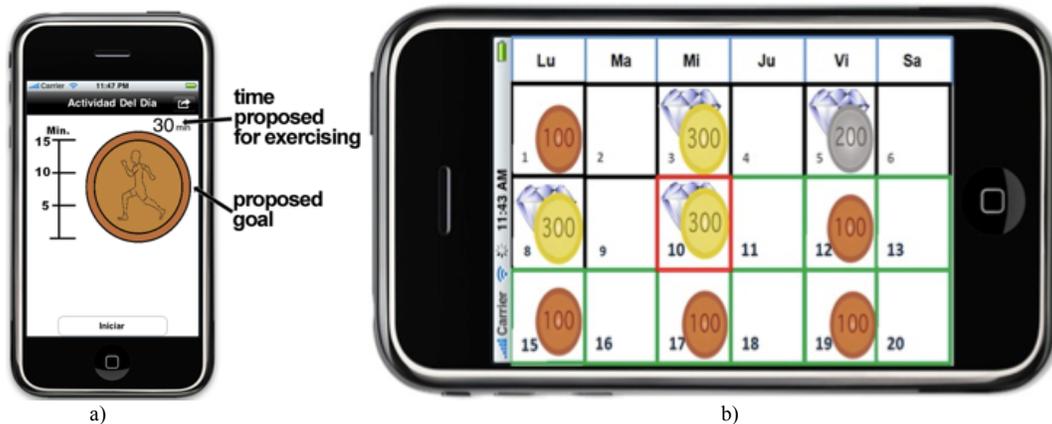


Fig. 1. Interfaces of CAMMInA: a) presenting the progress of the physical activity; b) representing the elders’ exercising goals

their exercising routine, such as, calories burned, the type of exercise that they carried out (i.e. walking, jogging) and the time spent on it:

“.... emphasizing the time that I exercised and when I performed high or low intensity workout.

“indicating which type of exercise I have to do and how it helps me [for my health]”

From the abovementioned comments, we conclude that active elders need information that enables them to reflect on the intrinsic benefits they may get, that is: how they are performing their exercising routine for improving their health, and how their exercising goals evolve over time to improve their health and fitness. While passive elders or those that have less time of adopting an exercise routine, will need information that enables them to become aware of the extrinsic benefits of exercising, such as extending their social network, as suggested by the results of our case study presented in section 3, and by the following comment of a participant who had worked out just for a week and a half (at the time of the evaluation):

“....considering going out of home and take a walk, I feel good when I made plans to walk”.

- *Trigger physical activity.* We asked participants about their perception, reaction and comprehension of the notifications sent by the system during the exercising session. All participants perceived the audible notification indicating to initiate the physical activity. Regarding the notification of the partially achieved goal, approximately half of the participants (8/15) perceived it, most of them (6/8) comprehended the notification when it was perceived, and the other two (2/8) observed the display to comprehend the message. Similarly, the notification indicating that the goal was pursued was perceived by almost half of the participants (8/15); three of the seven (3/7) participants that did not perceive the audible notification, indicated that this was due to their carrying the mobile phone in a waist bag, instead of in an arm bag as the rest of them. The other participants (4/7) stated that they were listening to the trainer instructions. However, we observed that some participants (7/15) showed interest in the system, since they observed it while exercising.
- *Positive and playful reinforcement.* Nine of the elders considered that receiving access time to play games would be a useful reward for motivating them to maintain their exercise routine, since this may enable them to have fun. Furthermore, some of them stated that they are interested in learning to play games. However, most of the participants suggested using other type of rewards. These proposals could be categorized as:

i) Suggestions for healthy eating, including permission to consume food restricted by their medical doctors, as suggested by five (5/15) participants:

“I would like to get permission to eat food restricted to me by my physician”; “...a desert”;

“a free consultation with a nutritionist”

ii) Rewards that promote socialization out of their homes. It was interesting to hear the elders' (7/15) suggestions that show their need of receiving rewards that in different ways promote their social interaction:

“...Improving my quality of life is my main motivation.... But I would like to win trips as rewards”

“... going out or a meeting with friends”

VI. CONCLUSIONS AND FUTURE WORK

The case study and the system evaluation enabled us to validate some of the system's design issues and to identify new ones in order for the persuasive strategies to meet the needs of the elders. We understood that one of the main motivators for exercising is that they have the opportunity, and are willing to extend their current social network. They perceived that providing representations of the compliance of their short-term goals was useful; however, they perceived as negative feedback to be informed about the proposed goals that were not pursued. As future work, we plan to evaluate the efficacy CAMMIInA's persuasive strategies to influence on the elder's motivation levels. To reach this end, we will redesign CAMMIInA by considering that elders need a persuasive system that not only rises their awareness of the benefits they may get for exercising, but also that provides social support for exercising, which has been considered as a key barrier among older adults for adopting a physical activity routine [12].

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