Agile Life: Addressing Knowledge and Social Motivations for Active Aging

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ABSTRACT
Despite the inter-relationship between physical, cognitive and social factors for older people, the frequency of physical activity typically decreases with age. In this paper, we focus on two specific issues related to physical activity and older people - overcoming the knowledge barrier and promoting social motivation. We develop a tablet-based prototype called *Agile Life* that provides 'Physical Activity Information Chunks' (PAICs) and also promotes awareness of friends' activities and opportunities to join in. The results of a user study, including a think-aloud walkthrough and an adapted technology probe, suggest that the social engagement with friends is a strong motivator but that the content of information chunks need to be carefully tailored to the participant. We provide suggestions for further developing an activity application for this age group.

Author Keywords
Active Aging, Exercise, Older adults. Persuasive technology, Physical activity, Tablet, Technology Probe, User-centered design.

ACM Classification Keywords
H.5.2 [User Interfaces]: Graphical user interfaces (GUI), Prototyping, User-centered design

INTRODUCTION
Three major challenges faced by people as they age are cognitive loss; physical decline; and social isolation These challenges are not discrete or separate, but are often interweaved into the fabric of aging life for many older adults. For example, low levels of social connections and infrequent participation in social activities affects the risk of cognitive decline (Zunzunegui et al., 2003). Conversely, physical activity helps to improve cognitive performance (Voelcker-Rehage et al., 2011). Physical activity in particular is significant for overall well being of older adults. "*Participation in regular physical activity is recognized as one of the most important health behaviors associated with the prevention of chronic disease and the promotion of health and well-being among the elderly*." (Brassington et al., 2002, p.80). Despite the importance of physical activity, the frequency of activity typically decreases with age. Schutzer et al., (2004) identify five different barriers that prevent older adults from doing exercise: poor health, environment (resources for physical activity), lack of physician intervention, having been forced to do activities in childhood, and the lack of knowledge about the benefits of physical activity.

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Here we focus on two specific issues to do with physical activity and older people: the "knowledge barrier" identified by Schutzer et al (2004) as an obstacle to physical activity; and social motivation, recognising the inter-relationship between physical, cognitive and social factors for older people. We do this through a prototype called *Agile Life* that runs on a tablet computer and aims to encourage physical activity. We address the lack of knowledge about the positive influence of exercise on health by providing 'Physical Activity Information Chunks' (PAICs). We link physical activities with a co-motivational social factor, acknowledging the significant relationship between social support and exercise adherence in the elderly (Schutzer et al., 2004) but also noting the importance of social relationships (Pedell et al 2010) and the preference of many older adults to nurture existing close relationships rather than forge new ones (Lindley et al., 2008).

In this paper, we describe the iterative user-centered development of *Agile Life*. We then report on a user study with seven participants, where we conduct a walkthrough with the interactive prototype and also leave them with a paper 'technology probe' version to encourage further reflections. To our knowledge, and as indicated in the literature review to follow, this is the first prototype to explicitly explore the knowledge barrier issue for older adults and to do so in a contextually relevant way with complementary social support

Relevant prior research
We draw upon knowledge and experiences across a number of projects that seek to encourage physical activity. For example, *Fish'n'steps* (Lin et al, 2006) is a computer game that uses an avatar in the shape of a fish in a tank to encourage exercise. The number of a player's footsteps is linked to the virtual fish. Both competition and cooperation are used as motivation for exercise. Positive reinforcement (happy, growing fish) is used when users are active and negative reinforcement (small, crying fish) when they are not.

Activator (Romero et al., 2010) is a touch display for visualizing upcoming events for older people in a care facility. Activator provides feedback in terms of sociality

and physical activity using a star scheme to increase activity levels. Positive reinforcement is also provided in *UbiFit* (Consolvo et al., 2008) where a background garden display is populated with flowers, trees and butterflies to reflect activity levels and goals achieved.

These projects aim to promote exercise using persuasive techniques and social connections. However none explicitly address the knowledge barrier issue (Schutzer et al., 2004) or nurture existing friendships (Lindley et al., 2008), both of which are significant for older adults.

AGILE LIFE

We developed *Agile Life*, a prototype tailored for older adults and their close friends to encourage physical activity together. *Agile Life* does this by addressing three dimensions (i) the lack of knowledge about the benefits of physical activity in older adults through PAICs (Physical Activity Information Chunks), (ii) older adults' desire to cultivate small circles of emotionally meaningful social relationships as mutual motivator by making the activities of others visible and providing a way to coordinate activities together, and (iii) positive reinforcement only, to avoid possible frustration and rejection associated with negative reinforcement (Lin et al., 2008).

Following an iterative user-centered design approach, we implemented the *Agile Life* prototype software application on an Android tablet computer. We chose a tablet computer because it tends to have fewer age-related usability issues for pointing tasks (Murata et al., 2005).

We first conducted preliminary interviews with five older adults (aged 61 and over) to learn out about their use of technology, their social network, their attitude to cognitive training and their physical activity habits. We found that (i) there was a reluctance to spend too much time at the PC; (ii) personal communication and meetings with their long lasting friends were very important (confirming Lindley et al., 2008); (iii) physical activity – mostly walking – was preferably done outdoors and in company and iv) there was no desire to undertake any form of "cognitive training".

We then developed low fidelity (LoFi) paper-pencil and presentation slide prototypes integrating the requirements from the interviews and literature. These were presented to the target group and feedback gathered. Following this, we implemented a medium fidelity (MidFi) prototype as a GUI application on an Android tablet PC. The prototype included a Physical Activity Information Chunk (PAIC), a facility to view and create upcoming activities for participants and their friends, and a 'trophy room' for completed activities. We then took the prototype to usability experts for feedback. We found that (i) the PAIC should be new/surprising and concrete (consistent with Schutzer et al., 2004); (ii) the trophy room should be designed to avoid frustration; and (iii) activities and activity creation should be more prominent in the display.

Taking into account all feedback, we developed an interactive prototype for the user study (Figure 1). At the top of the screen, there is a short PAIC about a benefit of physical exercise, followed by a provocative suggestion to prompt the user to take action and simple images matching the PAIC's content to reinforce the message's effect. The lower section of the screen provides a facility to create a new activity. The older person can see their own and their friends' next activities. In the background of the activities list is a positive reinforcement image in the style of the *UbiFit* garden (Consolvo et al., 2008). The application is designed to remain unobtrusive and be used in a stationary location, similar to a calendar on the wall.

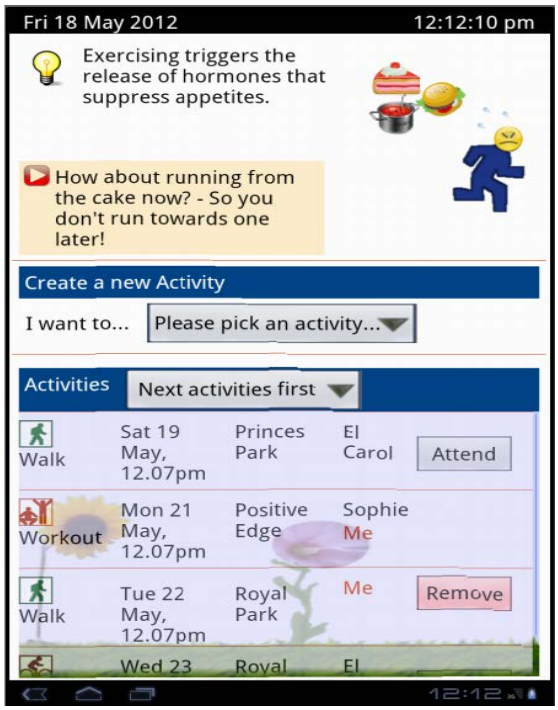

Figure 1: Agile Life final prototype

USER STUDY

The subsequent user study focused on how older people might imagine using *Agile Life* to promote physical activity. In particular we were interested in their responses to the PAIC, the social aspects and the reward system of the application. We conducted an exploratory study with seven participants with two aims:

(1): evaluate the overall concept and interactivity of the *Agile Life* prototype,

(2): provoke new ideas about how older adults might use and live with a device like the *Agile Life*.

Participants

Seven participants from the metropolitan Melbourne area were recruited, aged 64 to 89 years (median age 71 years) comprising four females and three males. All participants were physically and mentally healthy; and 5 of the 7 had a post-graduate education. Their level of physical activity was neither completely sedentary nor athletic; no special level of computer literacy was expected. None of the participants had participated in previous iterations. We offered to visit the participants in their homes for the study, however, two preferred to come to the university lab. Each participant agreed to be audio-recorded.

Methodology

For the first aim, we conducted a think-aloud

walkthrough with the prototype, using example content with the names and activities of their own friends (elicited on recruitment). For the second aim we adapted the technology probe approach using paper printouts of personalised *Agile Life* screens.

Prototype think-aloud walkthrough: After some minutes of familiarizing themselves with the tablet PC, the participant was given a list of tasks to perform on the prototype and asked to think aloud while performing them. The tasks included: sorting the activities in the list; attending an activity created by a friend; canceling attendance at an activity; and creating an activity. After the walkthrough the users were asked to reflect about the positive/negative features, what their thoughts were about the PAICs, friends' activities and the flower garden. All seven participants participated in this phase.

Technology probe: The technology probe approach was used to help people imagine what 'living with' the technology at home might be like. While a technology probe usually involves a functional prototype, we used a paper prototype of *Agile Life* instead. The paper prototypes consisted of seven color screenshots of the *Agile Life* tablet application, each of them displaying different states and each individually tailored to include the names of their own friends and their preferred activities. The paper facsimiles were placed in a picture frame to enhance the similarity to a tablet PC. The participant was asked to change the paper sheet daily so the appropriate screenshot of the day, with updated content, would be visible. They were asked to look at the probe each day for one week and answer questions in a diary about their thoughts on the "information of the day" and how they respond to seeing their friends' activities, and to note any other ideas they have. We returned after the week for a final interview about their experiences. Five of the seven users participated in this phase.

Analysis: The audio-recordings of the prototype interviews and the diary discussions were transcribed and analyzed inductively using Open Coding (Burnard, 1991). The tasks of the prototype walkthrough were graded 0 – Cannot do the task, ½ – Can do the task after a while/with help, 1 – Can do the task without problems.

RESULTS

In general, the participants found the *Agile Life* application approach useful and provided helpful suggestions for how the prototype could be improved, with more specific feedback on the PAIC, the social element and the feedback display as discussed below.

Prototype walkthrough

In the prototype walkthrough, participants found that the activities-sorting task caused most difficulties whereas attending and cancelling an activity were more easily performed. The younger participants (with the higher technology literacy) had the least problems in carrying out the tasks. Task completion scores were lowest for older participants with relatively low technology literacy.

Positive features noted about the prototype included its visual appearance (readability, attractiveness), that it was interactive, that it implemented on a touch-panel, and that it was simple and clear. Some of the suggested additional features included integrating the application with a calendar and adding a messaging feature.

The PAIC was characterized by participants as more of a signpost or reminder than as providing new knowledge. Often its trustworthiness was questioned and many wanted a link to more scientific background information.

Seeing the list of activities of friends was rated by most as motivating. This was due to a desire to keep in touch with friends and a way of socially catching-up. For example *User 4* spoke of one friend in particular and said: "*My friend X had a lot of health problems, I ... said you have to do something [physical] ... I am pleased he is actually there [in the activities list] ... cause he could have died any day!"*. The two oldest participants however noted that they had no one to use the application with because, as noted by User 1 "*all my older friends are gone and the others, well I don't think they could [use the technology]*" .

Most did not like the flower garden because it was hard to recognize it in the background of the activities list.

'Technology' Probe

After 'living' with the technology probe for a week, we received important positive feedback. Many users found the PAICs thought provoking, making them reflect on its content and many were perceived as interesting, surprising or enforcing their good behavior. On a few occasions the PAIC even triggered an action or intention of an action towards a behavior change. However, many participants also became very critical about the PAICs: the lack of scientific integrity; that the PAIC was often inapplicable to them; that it lacked concreteness; or that the participants were simply not agreeing with or motivated by the PAIC. This may reflect the educational level of this particular cohort of participants.

The social component was also positively received as a strong motivational element, in that physical activity was motivated by meeting a friend. They felt they were more likely to adhere to an exercise regime or take up a new activity when it was interlinked with friends. In contrast, and different to the findings of Consolvo et al (2008), the self-monitoring/reward system of the flower garden played very little of a motivating role. The participants considered that seeing the positive results of a real activity, such gardening, would be much more motivating and more likely to promote successful adherence than seeing the virtual garden.

The probe also inspired further ideas, including: 'hybrid travel' – one part of the way driving and walking the rest; 'purpose-driven walking' – walking to some destination to fulfill a purpose, e.g. walking to the club meeting and back instead of driving; combining different types of physical activities. It also caused them to reflect on ways in which they could make use of friends to increase the likelihood of them continuing to do more activity, such as: joining a friend who is already a regular exerciser because that might increase the probability of also being adherent; introducing an activity that is new for both people so both are learning together; adding in a new

activity with a friend and linking this with an existing activity; competing with a friend; helping each other learn or improve skills.

DISCUSSION

In this paper, we set out to explore if and how an interactive application specifically designed for and with older people could promote physical activity while also contributing to their cognitive and social needs. In particular we investigated the potential acceptability and effectiveness of 'Physical Activity Information Chunks' (PAICs). We also demonstrated that the social and reward elements may encourage physical activity.

Overall, the participants found the *Agile Life* application approach useful. In summarizing the experience, *User 6* said "*Just focusing on my activity motivated me to make sure I take adequate exercise. ... The fact that I reflect on it motivates me*".

However, adequately addressing the barrier to knowledge about physical activity is non-trivial. The findings here suggest that the content of the PAICs is critical. It determines whether users perceive the information as trustworthy, applicable and useful. These findings have consequences for how the application as a whole is perceived. The PAICs have to be tailored well to the target group to provide a high degree of integrity., It should not be not perceived as either too trivial and patronizing on the one hand, or too complex or irrelevant on the other. Ideally the PAIC should be tailored to the particular individual so as to address their personal situation and issues. The subsequent suggestion related to the PAIC also needs to be more concrete and specific if it is to serve as an effective prompt to action.

The approach to motivating activity through social engagement (e.g., as suggested by Romero et al., 2010) was perceived far more positively, with strong indications that this would have resulted in higher activity levels in real use. A key factor was the way in which the list promoted awareness of friends' physical activities and provided opportunities to join in or create their own activity that friends could join. The strong social motivation is reflected in the participants' own ideas as discussed previously, many of which explored different ways to make use of having a peer partner in physical activity. Simply spending time together with a friend doing the activity provided pleasant anticipation.

The stage-of-life of the older adult must also be considered when assessing the relevance of *Agile Life*. The older participants had difficulties with the prototype walkthrough. The two oldest participants noted their lack of peer partners with whom they could share physical activity. This suggests that *Agile Life* is perhaps more suitable for a younger target group (65 - 79 yo) than for older users (>80 yo). In addition the different responses to the background garden between the older and younger participants in the UbiFit project and other related application studies also suggest a need to re-think reward strategies for this group.

In summary, the findings from the design iterations and the user study of the *Agile Life* prototype suggest that an approach to promote physical activity for older people by using social motivators to engage with close friends, is promising. Furthermore the tablet as a platform was mostly well received and easy to interact with. The study also shows that an adapted technology probe approach using paper prototypes can be useful for stimulating further ideas and reflections. Future work is needed to consider how to better address the knowledge barrier and to provide more relevant reward structures. We also recognize that these are preliminary results with a paper prototype and plan to carry out a full deployment study to determine if participants' imagined use translates into actual increased exercise.

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