A New Model to Study ICT Adoption in Connection with Physical Activity – The TAMPA-Model

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Abstract. Physical inactivity is one of the leading risks for mortality worldwide. One of future main drivers for physical activity could be information and communication technology (ICT) gadgets and services that support active way of living. This study is the first attempt to model ICT adaption and awareness matrix to motivate and use ICT to support daily physical activity. This is important for individuals and also for information society and healthcare organizations to cope with physical inactivity challenge. They urgently require new approaches and to reshape their customers' inactive lifestyle. End-user experience data for this research was collected with semi-structured questionnaire from subjects who used pedometers for a three-month- period. In the questionnaire there were questions related to motivation, awareness and also use of information technology connected to physical activity. Based on the results, usage habits and patterns of pedometers, this paper classifies the end-users into four distinctive groups. This classification is called TAMPA-model (Technology Adaption Matrix for Physical Activity -model).

Keywords: ICT supported physical activity, pedometer, end-user experience, TAMPA-model.

1 Introduction

A sedentary and unfit lifestyle increases the risk of many chronic diseases and conditions and even decreases longevity [1]. In addition, physical inactivity is globally the fourth highest leading risk for mortality [2]. Physical inactivity and sedentary way of life are modern rising risk factors and they occur worldwide in high, as well as in low income countries.

Physical activity (PA) has many scientifically proven health enhancing effects and PA is also effective in preventing and treating specifically lifestyle connected

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diseases. Interestingly studies also confirm that long-term physical activity e.g. brisk walking is associated with significantly better cognitive function and reduced risk of dementia [3, 4].

In many countries PA has been promoted by recommendations. These recommendations vary from country to country. The recommendations for youth, adults and older adults in USA are probably the most well-known [5]. The Finnish recommendations for PA are in line with these recommendations: For substantial health benefits, adults should accumulate weekly at least two hours and thirty minutes of moderate-intensity exercise, or one hour and fifteen minutes vigorous physical activity. Aerobic activity should be performed in episodes of at least 10-15 minutes. Activity should be spread throughout the week. Adults should also do muscle-strengthening activities (eight to 10 strength-training exercises, eight to 12 repetitions of each exercise) twice a week.

Despite many benefits of the PA, initiation and maintenance rates of PA in the general population have been rather disappointing [6]. The sedentary lifestyle is a growing phenomenon of our modern society. The latest Finnish survey reveals that less than half of Finns fulfill physical activity recommendations [7]. Increasing PA requires a change in people's everyday lifestyle and habits. Indeed, a newly published data in Finland indicate that a physical fitness is an emerging factor of social divide in Finland [8]. The data shows that people who perform some kind of PA at least three times a week are more satisfied with their well-being and social life than those who engage PA less than once a week.

To become physically more active is challenging as today there are several new attractive leisure time competitors like social media, computers and console games. As new gadgets and innovations are penetrating the society into deeper levels, the need for studying their usefulness to increase PA and wellness becomes imperative.

PA is a widely studied in medicine and sports. More than two hundred high impact studies report new technology used to improve encouragement to achieving recommended PA levels [9]. To really increase PA in different populations we have to understand how normal subjects use information and communication technology (ICT) to support their PA.

Technology acceptance and the intention to use information systems are widely studied in information systems since the technology acceptance model (TAM) was published [10]. Usefulness and ease of use are the key factors of acceptance of technology. Individual adoption of innovation like ICT gadgets and services (pedometers, accelerometers, mobile in-built accelerometers, heart rate monitors, social networking, sport gaming and computer based counseling systems, global positioning technologies, and mobile entertainment electronics) can be divided into 5 categories. The categories are: innovators, early adopters, early majority, late majority and laggards [11, 12]. This segmentation is called the DOI-model (Diffusion of Innovation). It seems that pedometers are already at least in the "early majority" -phase and therefore can reveal more on ICT adaption in PA. User acceptance of IT has been thoroughly studied in UTAUT-model (Unified Theory of Acceptance and Use of Technology) [13]. Performance expectancy, effort expectancy, social influence, and facilitating conditions are direct determinants of usage intention and behavior; Gender, age, experience, and voluntariness of use moderate the impact of the four key constructs on usage intention and behavior [13].

In chapter two we discuss ICT devices that can be used to support PA with special focus on pedometer. The study design and data analysis are described in the next chapters. The paper ends in presenting the Technology Adaption Matrix for Physical Activity (TAMPA).

2 Use of Pedometers for Physical Activity in Information Society

ICT has penetrated into the society to a level where it has started to show collective impact on the physical and mental state of people throughout the world. This challenges us to reshape our habits. This requires also society and healthcare organizations to reshape their structure and function. Technology along with effective decision making combining motivational and environmental factors may definitely improve the health level of the people. Future important drivers for increasing PA will be ICT gadgets and services like pedometer.

A pedometer is a step counting device, usually portable and electronic or electro-mechanical. It counts each step taken by movement detection. The advantage of pedometer is their low cost and easy use. More advanced pedometers can even estimate e.g. walking distance and burned daily calories.

Pedometers can have a motivation impact for subjects wanting to increase PA. Even a target of daily 10 000 steps is universally known originating from Japan in the early 90’s [14]. A more detailed step data for PA estimation is [15]:

- Less than 5000 daily steps suggest physical inactivity.
- 5.000-7.499 daily steps are typical for of normal daily activity excluding sports or exercise.
- 7.500-9.999 steps likely include some exercise or additional walking and/or a job that requires more walking and thereby classify individuals somewhat active.
- 10.000-12.000 daily steps express a physically active way of living.
- Individuals who take more than 12.500 daily steps are physically highly active.

The daily steps have been studied [9, 16].

3 Research Design

This study aims to model ICT gadgets and services adaption and awareness matrix to motivate and use ICT to support daily physical activity. This model developing was carried out in a Step-Shape project which aims to study end-user experience of ICT gadgets and services that support active way of living. The data collection is described in detail on the recent article on Step-Shape project where the focus was on pedometers increasing PA [17].

Briefly, the subjects were recruited via K5 www-page during January - February 2010. K5 is a special Fun Run event for females and it has also over twenty year's tradition of promoting PA on local level. Participants of the study may download a special sheet to report daily steps with instructions. The subjects were asked to report their daily steps and the sheet itself counted the daily mean, weekly mean, weekend mean, monthly mean, maximal daily steps and the cumulative step number. The sheet also calculated the change of direction in weekly total steps as well as the absolute weekly change in total steps.

The step data collection occurred during three months from February to April. Simultaneously a semi-structured self-reported questionnaire on pedometer use was used. The questionnaire was team designed together with experts in physical activity, sports and exercise medicine and information systems. The information systems questions were influenced on TAM-, DOI- and UTAUT-models. The questionnaire was pilot-tested in a small group of physically active females. After the pilot test some questions were reshaped and few questions were added.

The questionnaire included 26 questions; seven were focused on the use of pedometer, twelve questions were related to motivational, environmental and actual PA change issues. The questionnaire contained also four open and feedback comments. The remaining three questions focused on different kind of step results achieved during the project. At the end of step collection period the participants could open the web-questionnaire from the same page where they had downloaded the step-table. The open comments were analyzed by the main author with special focus on the interrelations of ICT and PA. The numerical data was analyzed by the Webrobol-program (http://w3.webropol.com).

4 Data Analysis

Altogether 66 persons opened the questionnaire. Finally ten persons participated this study. Nine of them were women. Mean age was 42 years. All the participants used their own Omron walking style II pedometer (Omron Healthcare Co., Ltd., Kyoto, Japan). On average they had 3.4 years pedometer use experience. The participants reported that pedometer was user-friendly and easy to use. Instructions to use the pedometer had been clear. The pedometer was like a "part of the body". The biggest challenge was to remember to take it with in the morning. Nine participants fulfilled the step table with computer; two of them did it on daily basis, seven at least once a week. The computers were either own computers or workplace computers.

Five out of ten subjects reported that they fulfilled the PA recommendations before start while during the Step-Shape project nine out of ten fulfilled the recommendations. The mean step number showed an increasing trend during the project (Table 1).

The user experience issues were organized to 1) ease of use and useful issues (questions 1-6) 2) neighborhood and traffic issues (#7-10) 3) motivational issues (#11-19) 4) lifestyle issues (#20-21) and 5) attitude issues (#22-26) (Table 2). User experience was reported with the following options: 1 = strongly agree, 2 = agree, 3 = no effect, 4 = disagree, 5 = strongly disagree.

Table 1. Steps taken during the 12 week Step-Shape project

	Step count
Mon-Fri daily mean (12 wk)	8879
Sat-Sun daily mean (12 wk)	7964
Daily mean steps	8326
February daily median	8570
March daily median	7964
April daily median	8493
Maximal individual daily steps	28.000
Median daily steps	7575

Table 2. Self-reported user experience (as mean value) during the 3 month Step-Shape project

#	Value	**Ease of use and useful**
1	1.1	The pedometer was easy to use.
2	1.2	The step-table was easy to use.
3	1.3	The use of pedometer did not require any special thinking.
4	1.3	The use of the step-table did not require any special thinking.
5	1.4	The pedometer was useful.
6	1.8	The step-table was useful.
		Neighbourhood and traffic
7	1.6	I prefer PA in sunny weather.
8	1.4	I am engaged to PA in my neighbourhood in the evening.
9	1.2	I am engaged to PA in my neighbourhood at daylight.
10	2.1	Traffic in the neighbourhood is safe.
		Motivation
11	1.6	The use of pedometer motivated me walking more often.
12	1.7	I wanted to know the amount of my daily steps.
13	2.2	The use of the step-table motivated me to walk more often.
14	2.4	Other reasons e.g. I have activated my family members. I am going to continue step collection, this in fun. I take stairs always as possible.
15	2.1	The use of pedometer helped to go for a walk.
16	2.6	The use of the step-table helped to go for a walk.
17	2.4	I wanted to change my lifestyle.
18	2.4	I wanted to become physically more fit for the summer.
19	2.4	I want to lose some body weight.
		Lifestyle
20	2.4	I feel physically more fit.
21	2.4	I am physically more active.
		Attitude
22	3.6	The Step-Shape project was unfair because some activities do not provide steps.
23	4.4	The Step-Shape project was boring.
24	1.6	The Step-Shape project was interesting.
25	1.8	The Step-Shape project motivated and inspired me.
26	2.3	The Step-Shape project was innovative.

Ease of use got the highest values among users. All in all, in 24 out of 26 questions the response was classified as positive (mean value < 3).

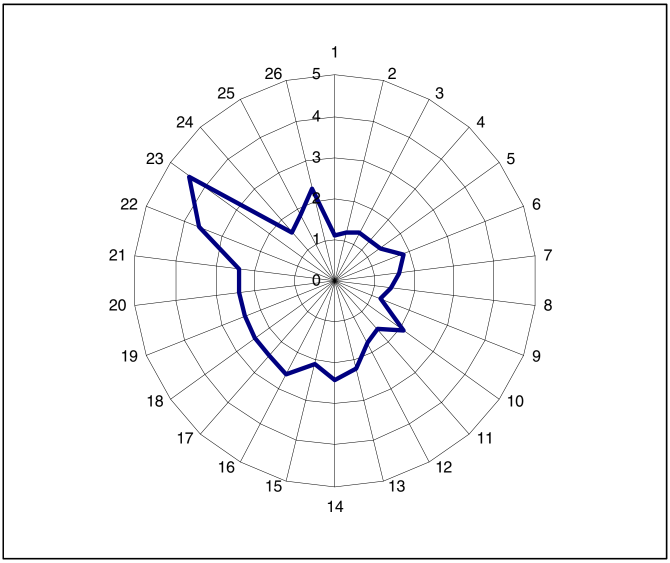

Fig. 1. Item radars for different end-user issues (1-6: ease of use and useful issues; 7-10: neighbourhood and traffic issues; 11-19: motivational issues; 20-21: lifestyle issues; and 22-26: attitude issues)

The following issues were taken up in the open comments: Step-Shape project really supported and motivated my PA. I wished to lose some weight, but I did not succeed. However, I feel more compact and my physical fitness is better than before the project. I feel myself younger. Step-shape project really motivated me walking. Step-shape project motivated me to competing with myself. I recognized how inactive I really am. And it is very little. I was glad to notice that my daily steps are easily 5000, I am normally physically very active person. Already my normal day includes pretty many steps. Without pedometer this positive activity would be a little bit unclear. Only keeping a pedometer make me more physically active.

Eight person reported to continue monitoring their daily steps with pedometer after the Step-Shape –project.

5 TAMPA-Model

After analyzing the user experience we aimed to modeling classification for ICT adoption and PA habits. The level of PA, awareness and use of ICT were selected as major determinants for the model.

Four main categories were formed (Fig. 2.):

1) Subjects who are highly engaged with ICT are ICT -actives (ICT-Act). Their interest in PA is low.
2) Subjects who are physically very active are PA-actives (PA-Act). They have some awareness of ICT supported PA but they do not use it actively. Their experience may also be negative towards ICT supported PA.
3) Individuals who are active both in technology and exercise are Double Actives (D-Act). They know and use technology in many ways, also to support their PA. They meet and often exceed the PA recommendations.
4) Double Inactives (D-Inact) are physically inactive. Their awareness of ICT supported PA is minimal or does not exist.

This categorization is called the TAMPA model (Technology Adaption Matrix for Physical Activity).

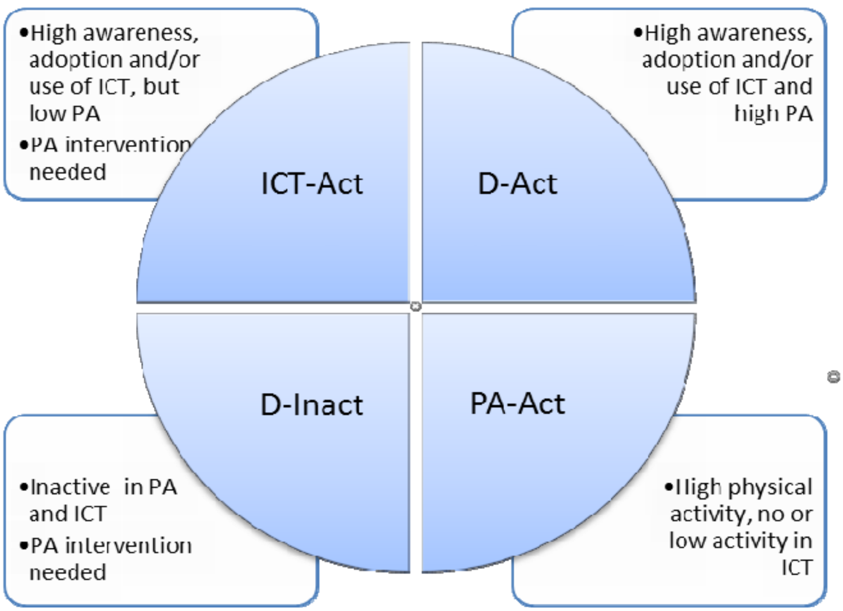

Fig. 2. TAMPA -model (Technology Adaption Matrix for Physical Activity. (ICT-Act = ICT –actives, D-Act = double actives, PA-Act = PA –actives, D-Inact = double inactives).

We suggest that the four different TAMPA segments need different kind of ICT and PA approaches to motivate and inspire subjects increasing their daily physical activity to health enhancing levels. PA promoters can apply this model to identify the level and use of technology for their customers. It is anticipated that more and more individuals are connected to different kind of ICT gadgets and applications. In some cases this kind of connectivity may decrease the physical activity level, which in turn may have deleterious health effects. The graphical demonstration shows what attention is "cost-effective", whether technology or PA as the primary driver. More subjects are needed to test and validate the TAMPA-model.

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