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Inhibitors, enablers and social side winds Explaining the use of exercise tracking systems

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Abstract

There has been a vast research interest in exercise tracking systems as they are hoped to boost motivation for exercise and thus improve users' health. However, research activity on actual use and experiences on using such systems has been mild: one has been more interested in the consequences of use than the use itself. To address this gap, we report a study, in which we examined the use of exercise tracking systems (i.e. physical devices with connected services and information systems) in their contexts of use. The study was based on diary data collected in Finland. Analysis of the data was based on a framework describing various techno-determinant inhibitors and enablers of technology use. Our study showed that the use could not be described by techno-deterministic factors only. Therefore, as a theoretical contribution, to capture the whole diversity of exercise tracking systems use, we supplemented the framework with two new categories, social and self. The results are discussed in the light of motivational factors of technology use, social participation and the evolving role of information technology as it comes pervasive and ubiquitous. Exercise tracking system providers may utilise our context-specific findings to improve their products and services.

Keywords: Inhibitors, enablers, social, sport technology, technology use

1 Introduction

Changes in work and everyday life have had a substantial effect on the physical activity and exercise habits of people in western societies: the level of physical activity of individuals has dropped drastically over the past twenty years. As work as such has changed, more and more people work sedentary and even the leisure time is dominated by sitting: one is often spending time sitting in front of a television or a computer. Thus, researchers have started to talk about sedentary lifestyle. (Matthews et. al. 2008, Juutinen-Finni 2010.) These changes in the way of life can be seen in the physical fitness of individuals as well: according to extensive population studies, it has decreased substantially e.g. in Finland. The level of physical activity and general physical fitness of Finns are forecasted to deteriorate also in the future. (Heiskanen et. al. 2011.) This development is considered extremely alarming, as poor physical fitness and low levels of physical activity are connected with many health risks, e.g. cardiovascular diseases and musculoskeletal disorders, which in turn lead to extremely high spending in health care (Borodulin 2006).

Because of its importance from the points of view of both public health and finance, promoting physical activity has become one of the key activities in western societies. By encouraging people to be more physically active, one hopes to prevent or at least diminish the threatening health problems and associated health care costs.

(Post)modern western societies are characterised by the ubiquitous use of technology physical activity being no exception. As well the intentional sport and exercise as everyday physical activities are nowadays quite often accompanied by technology: various monitoring devices (heart rate monitors, activity bracelets, mobile fitness apps…) and digital services connected to them are widely used as a part of the sport experience. By now, prior studies on these exercise tracking technologies have focused either on their use in measuring the level of actual physical activity (mainly for research purposes) or on their motivational role adding individuals' adherence to general guidelines on desired amount of physical activity (cf. e.g. Butte, Ekelund & Westerterp 2012 or Bravata et. al. 2007). This kind of focus is easy to understand considering the afore-mentioned goals of promoting physical activity for health reasons.

Earlier, we have researched the usage intentions and demographic variables explaining the use of exercise tracking devices (Makkonen, Kari, Frank & Moilanen 2012a; Makkonen, Kari, Frank & Moilanen 2012b; Makkonen, Kari, Frank & Moilanen 2012c). However, it is at least equally important to understand the previously uncovered reasons why individuals choose to use – or not to use – exercise tracking systems. To address this gap in research, the aim of this study is to find out, how these technologies are used in the actual contexts of use and what kind of experiences and feelings are connected to their use. It is also important to consider the fact that devices do not alone comprise a technology in use, but it is rather a system. Therefore, we opted for using the concept of *exercise tracking system*, with which we want to emphasise the fact that the physical device being used is only a part of a larger system delivering the benefit the user is seeking. In our view, the physical devices can be seen as distribution mechanisms for the benefits and services as suggested by Vargo and Lusch (2004) in their seminal work on service-dominant logic. Simultaneously they are, however, complicated technological creations with substantial abilities to serve – but also e.g. to irritate – the user.

In this article, we present the results of a study, for which we recruited a group of people to use an exercise tracking system (consisting of a Suunto Ambit 2 wristop computer and a sports community called Movescount (for more information on Movescount, see Malinen & Nurkka (2013)) for a limited period of time. Our aim was to understand the technology use at the level of an individual: what are the factors promoting or preventing the use of such systems? As a theoretical contribution, we extend previous frameworks regarding inhibitors and enablers of technology use and provide new context-specific knowledge on exercise tracking systems use. For practical implications, our results assist exercise tracking system providers in finding ways to promote their use and to refine them to true persuasive technology tools (cf. Fogg 2003, 32) and in that way to increase the physical activity level of individuals and help them in their quest for better health.

2 Theoretical Background

In our research, we see exercise tracking systems as IT-artefacts – as man-made pieces of technology with some information processing and mediating capabilities (Sjöström & Goldkuhl 2009). The system consisting of the actual physical device, the service available on the web and the computer systems behind all this can also be seen as an information system built in order to satisfy the desires of the system user (the individual engaged in exercise to be tracked), and therefore we decided to refer to the information systems science when considering theoretical background for our study.

There is a long and solid tradition on theorising the adoption and use of technology and information systems, and a vast amount of theories explaining this phenomenon exists. These theories can be divided into two categories according to whether they are based on technological determinism or social constructionism.

In hard technological determinism, technology is seen as an independent actor, which is created autonomously as a consequence of actions of its developers, and it enters a social system from outside. After this entrance, one is no longer interested in its further development within a system. Best-known examples of hard technological determinism are the diffusion of innovations theory by Rogers (1962) and technology acceptance model by Davis (1989). Soft technological determinism recognises the social consequences of introducing technology into a social system, but one believes that they can be controlled by the developer both at technical and at social level (Markus & Robey 1988). In other words, technology is determined by its developers, and technology has an effect on its users (Orlikowski 1992).

Theories based on social constructionism (originally Berger 1967) abandon the basic assumption of technology being the catalytic factor itself. Instead, they see technology and its development, adoption and use being intertwined with the social system. Examples of theories on this field are a model known as SCOT (social construction of technology, Pinch & Bijker 1984) and the model of social shaping of technology (Williams & Edge 1996).

2.1 Inhibitors and enablers

In theories describing information system success, emphasis has been on techno-determinant factors. One of the best-known models of information system success was

developed and updated by Delone & McLean (1992, 2003). The latest version of the model (DeLone & McLean 2003) identifies six success factors (system quality, information quality, service quality, use, user satisfaction and net benefits) based on 90 empirical studies examined and the results summarised.

Cenfetelli and Schwarz (2011) point out that just as Delone & McLean's model (1992, 2003), all dominant theories on technology adoption and use are focusing exclusively on the factors affecting positively on the adoption and use decisions. They refer to these factors as *enablers* and emphasise that to fully understand the phenomenon of the technology use, one has to pay attention to the factors inhibiting technology acceptance as well. These factors are referred to as *inhibitors*.

To test the role of inhibitors, Cenfetelli and Schwarz (2011) interpreted the DeLone & McLean (1992, 2003) model to present six enablers, of which three are connected to system and three to information, and defined the corresponding inhibitors. The enablers connected to system ("user's evaluation of the technical capabilities of the system and its usability") are reliability, flexibility and responsiveness, whereas enablers connected to information ("user's evaluation of the system's conveyance of semantic meaning and/or communication of knowledge) are accuracy, currency and completeness. The inhibitors defined by Cenfetelli & Schwarz (2011) based on a series of empirical studies are system-dependent inhibitors intrusiveness, effort redundancy and process uncertainty. Information-dependent inhibitors are respectively information overload, irrelevant requests for information and deceptiveness. For the definitions of these inhibitors, see Table 1 in section four (Results).

The framework suggested by Cenfetelli and Schwarz (2011) can be considered technodeterminant as it in no way refers to the social aspects of technology or information systems use. We wanted to assess its appropriateness and potentially extend it in the case of exercise tracking systems, which are used in the personal sphere of life normally tightly connected to the context of use and the social world of the user.

3 Methodology

3.1 Approach and methods

Our study can be defined as a diary study based on phenomenographic approach – as Limberg (2000) has put it: we had human experience as our research object. Diary study as a method was selected, because it is able to provide more authentic information on human-technology relationships and technology use *in situ* (e.g. experiences and feelings), as the so-called presentation effects (i.e., participants may act differently because of the presence of the researcher) are diminished (Carter & Mankoff 2005). Since users were free to report the experiences of their choice, it is likely that they have reported experiences and incidents with especially strong meaning from their point of view. This brings our study to the direction of critical incident technique (CIT) originally presented by Flanagan (1954). Our study also presents some of the methodological strengths generally associated with CIT: 1) we believe to have captured issues that might have been missed with other methods as responses were not forced to a predetermined perspective or framework, 2) the users have reported their experiences in their own words without being restricted to any specific model or set of terminology and 3) we have accessed us-

ers' actual (though reported) behaviour versus prospective and ideal behaviour (Gremler 2004; Holloway & Beatty 2008; Serenko & Stach 2009).

3.2 Participants and data collection

The voluntary participants (five men and five women with various exercise backgrounds) of our study were given a Suunto Ambit 2 –wristop computer with the instructions and other material they would have got if they had acquired the product at a shop by themselves. In addition to this, they were instructed 1) to use the device and connected services regularly in real-life situations for at least six weeks and 2) to keep a diary (to take notes) of their feelings, opinions, thoughts and concrete occurrences they experience during the test use. No specific requirements for the reporting (form, length, tone etc.) were set. These written experience diaries form the research data of our study. All participants were also asked for their informed consent for the use of the information provided by them in scientific research.

3.3 Descriptive level analysis

The process of qualitative data analysis was based on the NCT-model (noticing, collecting, thinking) adapted from Seidel (1998, according to Friese 2012, 228-239). In our case, the process was recursive, as we moved back and forth between noticing and collecting. We started our analysis by assessing the user-diaries by close reading them in order to preliminary determine the fit of the selected theoretical framework to be used in the analysis. During this phase, we also defined a code list based on the theoretical framework (categories of codes being enablers and inhibitors) and context-dependent attributes emerging from the data. We discovered that while the selected framework was suitable to be used as the basis for the analysis, the diaries also contained aspects, which seemed hard to be explained with the selected framework. Therefore, we opted for the possibility to use open coding as well. The systematic coding of the diaries was done with ATLAS.ti –software for qualitative data analysis. We used both the predetermined code list and open and in vivo –codes, which were used to capture the aspects not explained by the theoretical framework. Our coding system can be considered as focused coding: we only coded segments connected to adoption and use of technology omitting e.g. users' reflections on sport as such.

3.4 Conceptual level analysis

After the data was coded, we started the second phase of the analysis, in which the data was seen from the perspective of the research task with the help of the selected theoretical framework. This phase can be described as deductive content analysis or theory-guided content analysis (cf. e.g. Krippendorff 2013 or Sandelowski 1995), and it consisted of iterative cycles of analysing the data by exploring the frequencies and co-occurrences of the codes, linking the codes together and analysing these linkages. As often with the deductive content analysis, the analysis framework covered only part of the aspects in the data. Therefore, we also inductively defined two new categories (in addition to enablers and inhibitors), namely *social* and *self*. Finally, we integrated our findings into a whole, which will be presented as the results.

4 Results

As expected, the users had reported especially experiences they regarded as important or critical for their interaction with the exercise tracking system. Not surprisingly, negative experiences prevailed in the diaries. Most of them were connected to the incompatibility of own desires and functions offered by the system. Some of the negative experiences were strongly connected to the perceived usability of system: e.g., the instructions offered by the developers and manufacturers were regarded as extremely bad: they were ill structured and overwhelming in details.

4.1 Experiences using the system

In the noticing –stage of the descriptive level analysis we identified the experiences on using the system and classified them to negative and positive experience in the spirit of critical incident technique. Many of these experiences were then identified to be either inhibitors or enablers found in the framework, but to give a general impression of the user data, a summary of these experiences is presented below.

The negative experiences can be summarised as follows:

- Features of the system did not correspond to the desires of the user or the user was unable to find the feature corresponding her/his desires. The desires communicated by the users were connected to 1) one's own exercise background, 2) one's self-reflection of oneself as a person engaged in physical activity and 3) one's own experience as a user of technology.
- The use of the system was associated with a substantial usability problem, which prevented the user from performing the task desired. These problems had even aroused strong emotional reactions.
- The system had malfunctioned in ways unexpected by the user. The situations were especially connected to the use in actual exercising contexts, as the system malfunctioned technically or its function did not correspond to the mental schema of the user.

The positive experiences can be summarised as follows:

- The fluent functioning of the systems and corresponding feelings of flow were quite often mentioned as sources of joy. Especially stable and reliable presentation of context specific information (such as heart rate and speed) were experienced extremely positively.
- Quite often, the system managed to take its user by positive surprise with the produced information content or features the user was not expecting.
- The aspects of fun were mentioned especially when describing the experiences with the sports community on the web: it was regarded as some sort of game or play.
- The system was also reported to be able to strengthen users' self-efficacy or motivation in exercise.

4.2 Framework fit – inhibitors and enablers

As we analysed the collected data with the framework adopted from Cenfetelli & Schwarz (2011), we found it to fit to our study only partially: not all of the experiences reported by the users could be explained by the framework. Only one of the inhibitors

(irrelevant requests for information) was not to be found in the data, whereas all the enablers could be found in the data.

Illustrative quotes from our data corresponding the components of the selected framework are presented in the Table 1 below.

Inhibitor	**Example**
Intrusiveness (system) *System performs tasks that were not requested or expected creating a task interruption.*	*I was orienteering. For some reason, the tracking stopped although I only wanted to mark a lap. I had to pay extra attention to it during the training.*
Effort redundancy (system) *System requires unnecessary repetition of already performed steps.*	*My boyfriend examines the device and notices that once again I've become a male weighing 75 kg. I had to create my profile again. (User is a woman.)*
Process uncertainty (system) *User is left unsure whether the system processed a request by the user.*	*I started my swim training and pushed the START-button. Everything I saw on the display was the symbol for swimming. I wasn't sure, if the device was tracking my swim or not.*
Information overload (information) *Too much information is provided beyond the user's needs resulting in perceptions of being overwhelmed.*	*Movescount had too many options for showing the data. Besides, I didn't understand many of the physiological variables and they weren't explained anywhere.*
Irrelevant requests for (information) *Requests for information that is irrelevant or of a nature not needed for system transaction.*	-
Deceptiveness (information) *System fails to meet promises or expectations and such failure is perceived as purposeful by the user.*	*I miss 12:32 from the beginning, since the thing is unable to find GPS. I'm really pissed off, although game itself is going fine.*

Enabler	**Example**
Reliability (system)	*The device measures everything you need accurately and reliably.*
Flexibility (system)	*I like the profiles for different sports. They make the device more versatile.*
Responsiveness (system)	*Device starts tracking training really quickly: it finds satellites and HR-belt almost instantly and is ready to go in no time.*
Accuracy (information)	*I never experienced any fluctuations or strange numbers (data) as I was using the device.*
Currency (information)	*The speed display is more stable and accurate than in my other device. It is a great thing in mountain biking.*
Completeness (information)	*It's great to be able to track the time and distance, to see in Movescount where you have been and where you have had the highest heart rates.*

Table 1: Examples of inhibitors (Cenfetelli & Schwarz, 2011, definitions directly from the source) and enablers (DeLone & McLean 1992, 2002) found in the experience diaries of the participants. Enablers are listed according to Cenfetelli & Schwarz (2011) – they are not directly presented in the referenced works. Illustrative quotations heavily shortened and edited for readability and typographic reasons.

4.3 Side winds

Although the explanatory power of the theoretical framework with our data was decent, we also found a remarkable amount of factors influencing the use and adoption of exercise tracking systems, which could not be explained by the factors of the theoretical framework.

Most of these factors were strongly connected either to the reference groups of the user or to the user's self-reflection or self-image. Users reported their context-dependent experience on their teammates, their personal impressions, successes and failures. In the conceptual level analysis it was determined that most of these factors could be categorised either as social factors or as factors strongly connected to the self of the user. Therefore, we decided to create two new categories in addition to inhibitors and enablers. These categories are the category *social*, which includes factors describing the social environment, connections and actions of the user and the category *self*, which represents the self-reflective components of the context-dependent behaviour or technology use. These categories with illustrative quotes from our data are presented in the Table 2.

Social	**Example**
Role of the significant others	*My partner is using a heart rate monitor and (s)he recommended the use also for me.*
Significant social ties to be supported	*My passion is triathlon and I want to be able to share my training data and discuss my training with the triathletes of my choice.*
Own role in the social world of context	*I do not consider myself an athlete – I am only doing exercise for my health and fun and I can't imagine myself going to a gym.*

Self	**Example**
Self-reflection in the context of use	*I don't want to be like those pro-runners in their tights, with their recovery drink belts and bleeping sport gadgets.*
Self-efficacy in the context of use	*I've never been good at sports, but I still try to do something to keep myself lively and fit.*
Motives for the activity to be supported	*I always wonder if my exercise is doing any good. I want to stay fit and get fitter, but going for a walk just feels far too easy.*

Table 2: Examples of factors of the categories of *social* and *self* found in the research data. Illustrative quotations heavily shortened and edited for readability and typographic reasons. Please, see note for the new categories in section 5.3.

The categories of *social* and *self* were not as dominantly present in the experiences of the user as inhibitors and enablers. It seems that the techno-deterministic components of adoption and use (in this case inhibitors and enablers) are the most important factors having influence on the decision of an individual. However, the factors of social and self seem to shape the adoption and use decision of the users. In addition to this, they might alter the interpretation of a given feature or context. Therefore, we refer to them as side winds. One can think of an aeroplane: its course and speed are mainly determined by the head- and tailwind (inhibitors and enablers), but the side winds (in our case social and self) have to be taken into account as well when calculating the neces-

sary steering manoeuvres. Fundamentally, both the actual social components and the components connected to self are anchored to the social world the user is acting in. Therefore, they can be both seen as social side winds.

An important factor found in the user diaries was the gender-dependency of technology. The female users quite often perceived the tested system as masculine and especially the physical device was not regarded suitable to be used by women.

Both the original categories of inhibitors and enablers and the new categories of social and self are shown in the Figure 1 (below), which summarises our extended framework to explain the use of exercise tracking systems.

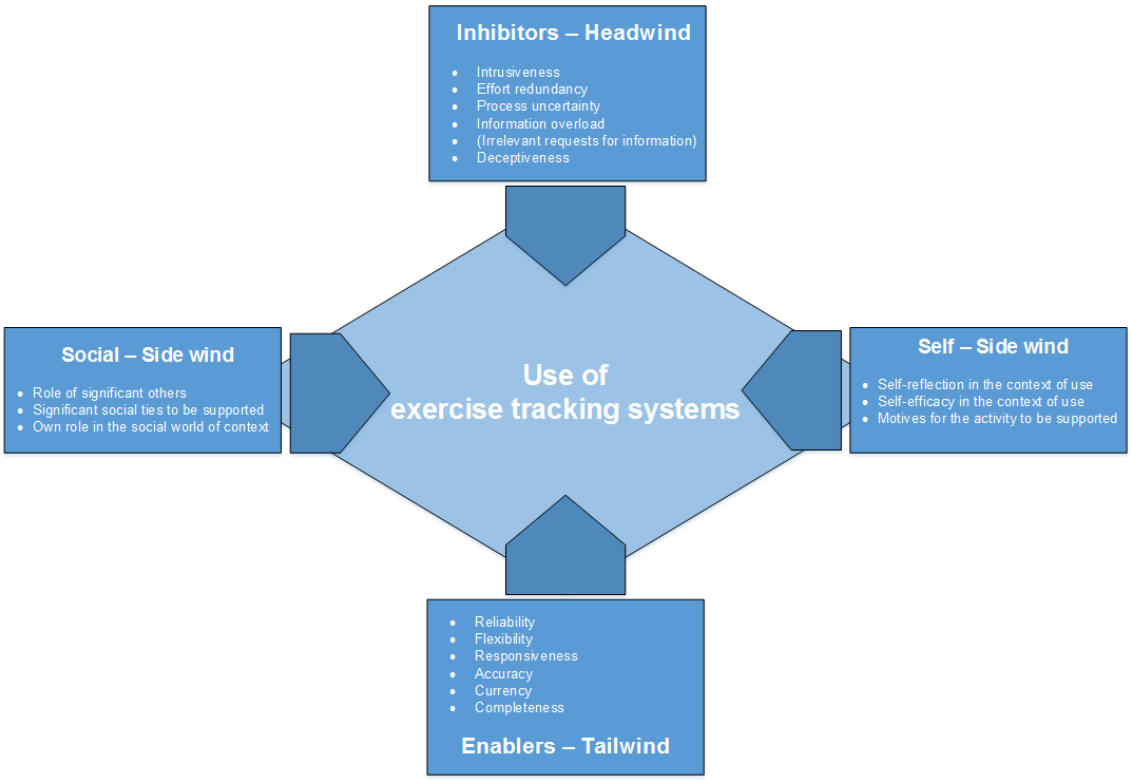

Figure 1: Extended framework to explain the use of exercise tracking systems. Framework is based on *inhibitors* and *enablers* as presented by Cenfetelli & Schwarz (2011) which are supplemented with the categories of *social* and *self* based on the data collected with user diaries.

5 Discussion

The selected techno-deterministic framework was quite adequate in describing the usage data. However, our study showed that in the case of individuals being the users, it is important to realise that enablers and inhibitors of technology use cannot be seen only techno-deterministically in relation to system and information.

First, one should consider the basic motives of using technology. Van der Heijden (2004) has distinguished utilitarian and hedonic information systems, the latter being strongly connected to leisure activities, focusing on the fun-aspect of use and encouraging prolonged rather than productive use. This is normally the case with exercise track-

ing systems, which are used in the private sphere of live. Techno-deterministic models of technology adoption and use are dominantly developed, used and researched in the context of utilitarian information systems, and the nature of information systems forms an important boundary condition for their applicability.

Second, the social context of the information system use becomes an important factor of technology adoption and use especially in the case of hedonic information systems used by individuals. Therefore, the social world the users are acting in has to be taken into account as well. Unruh (1980) suggests that we simultaneously live in different social worlds and that our involvement in these worlds has an effect on our concept of our self and on our behaviour in these worlds. Our role in these worlds can vary depending on the level of our commitment to the given social world and we can be strangers, tourists, regulars or insiders – insiders being those in the inner most circles of the social world.

Koski (2008) has refined Unruh's thoughts by bringing them to the world of exercise. He has coined the concept of physical activity relationship (PAR), with which he refers to the relationship describing individuals' social encounters with the world of sport and physical activity not only by exercising but also by following, producing and consuming the meanings of sport and exercise. Consuming meanings may also be interpreted as consuming and using artefacts vital for the involvement in a given social world (Schouten & McAlexander 1995). Hence, an exercise tracking system can be seen as such artefact to be consumed or as a medium acting as a platform enabling producing, transferring and sharing meanings of a social world of exercise.

5.1 Research implications

DeLone and McLean (2002) state that an important reason for their ten-year update of the information system success model was the fact that "the role of IS has changed and progressed during the last decade". This development has not ended – on the contrary, it is now more rapid than ever. Information systems use of today is characterised by factors almost incomprehensible only a decade ago: consumerisation, pervasiveness, convergence and ubiquitousness of information systems are challenging not only the IS-developers but also scholars trying to understand their adoption and use. Therefore, our study attempts to extend the previous theorising on technology enablers and inhibitors by binding them with dimension of social and self.

As technology and information systems are ever more entering into the most private spheres of our lives and into the high-involvement contexts of our selves (such as sport and exercise), it is extremely important to understand, how they are conceived, adopted and used in these settings. To achieve this, one has to do research not only to describe or explain, but also to understand. This intrinsically requires complementing techno-deterministic models and methods with models and methods anchored in the social. These two methodological foundations should not, however, be seen as opponents or extremities, since both of them have explanatory power regardless of the technology, context or social ties. An important future research direction is the interplay of these two - also the factors appearing to be strongly linked to technology *per se* might be influenced by the social in some contexts. This applies to interpretation of inhibitors and enablers in general as well: to certain extent, they are also socially constructed by the users.

5.2 Practical implications

Exercise tracking system providers may utilise our context-specific findings to improve their products and services. In the user diaries, negative experiences were distinctively dominant compared to positive experiences. This is not a surprise, as e.g. prospect theory (Kahneman & Tversky 1979) describes an asymmetry between negative and positive impressions despite them having a similar magnitude. As a result, negative impressions often overshadow positive impression when an object (in this case, exercise tracking system) is evaluated (Skowronski & Carlston 1987). However, many of the factors now conceived as inhibitors were actually neutral product characteristics or features, and they only became inhibitors just because of inconsiderate design or poorly structured instructions.

The exercise tracking system used in this study represents a state-of-the-art level in its class: the number of features is abundant or for some users, overwhelming – e.g. the user's guide of the physical device is 128 pages long. The system is designed by a company, which is known for its hobbyist product development strategy and for product development teams extremely passionate for sports themselves (Kotro 2005). In other words, the system was developed by people being insiders of a social world of sport and consequently it can be argued (or at least suspected) that it was developed also *for* people being insiders of a social world of sport.

Our study showed that the artefact designed appeared for many users as overly complicated, overwhelmingly capable and strongly linked to professional sports. Considering the market structure and high hopes on the use of exercise tracking systems as an aid to promote physical activity in general, we urge the developers for more active interaction with users in every circle of the physical activity relationship and social world of sport and exercise. In addition to this, the perceived gender-specificity should be taken into account as well: although technology products can never be totally neutral, they should be designed in a way that they are not perceived e.g. overly masculine, if they are intended to be used by both genders.

5.3 Limitations and future research

There are certain limitations for this study. This study was based on the input of ten users. Although saturation was detected on many areas of interest, the amount of data should be considered when assessing the results of the study. The amount of data also has an effect on the definition of the new categories of social and self : at the moment, they (including their names and factors) are quite abstract, but we hope to be able to define them more precisely as we collect more data on this research topic.

The study brought forward also many aspects strongly connected to the physical device or physical conditions of the system use. These aspects, which represented e.g. some aspects of physical usability, were not covered by the framework or by the new categories defined in this study.

In the future, the physical attributes of information systems use should be, however, researched further, as information technology is – as in the case of exercise tracking systems - becoming pervasive and ubiquitous (i.e. information systems are more often used e.g. through mobile devices).

The evolving nature of information technology into the direction of hedonic systems postulates the need for research especially in the areas connected to social and self. In addition to this, personal informatics – a class of tools used by people to collect context-specific personal information for purposes of self-reflection and self-monitoring to gain self-knowledge is an important technological direction and area of future research combining both the importance of physical attributes and relevance of the social understanding.

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