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Section 18.

Design for Behaviour Change

Designing for Lifelong Sports Experience

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In recent years, design for behaviour change by means of design and technology has been the focus of a large body of research. Advancements in personal informatics systems and applications of these in research have testified to the potential of design for behaviour change strategies in the context of sports and exercise. However, these efforts have been mainly focused at people who are new to sports and not so much at people who are already active. With the success of design for behaviour change studies, this group of more active users (i.e., *active exercisers)* with an interest in personal informatics has grown. The needs of this group of users are different from those who are unable or unwilling to change their activity behaviour. While the latter might lack knowledge and motivation to change behaviour, active exercisers are already motivated and are willing to stay physically active. Thus, this paper draws out the need and importance of a shift in the focus of designing for physical activity tracking, and discusses the significance of designing for lifelong sports experience.

active exercisers; behaviour change; design for sports experience

1 Introduction

There are many different reasons for people to be physically active. These relate, but are not limited to, emotional beneifts of exercising (e.g., feeling immersed or absorbed in the physical activity), social benefits (e.g., getting social support or praise from others), benefits of interacting with nature (e.g., seeking out suitable or motivating places to go for exercise), and health related benefits (Silvestri, 1997). In addition to these sources, people may also become motivated to start exercising as a resultant of new technologies entering the market such as smart watches, apps and dedicated health devices. Such personal informatics can serve as persuasive or supportive tools, aimed at helping people to "self-track, collect and reflect on personal information" (Li, Dey, & Forlizzi, 2010). Activity trackers are a type of personal informatics that either assist people to keep track of the number of steps they take (for example, by nudging them when they fail to take 10K steps a day), or help people to keep track of and reflect on their physical activity at more advanced levels. In the last decade, designing activity trackers to create awareness on the importance of physical activity (and increase physical exercise accordingly) has been a topic of considerable interest to (design) researchers (Li, 2009; Lin, Mamykina, Lindtner, Delojoux, & Strub, 2006; Rooksby, Rost, Morrison, & Chalmers, 2014).

Taking the Transtheoretical Model of Behaviour Change (TTM) (Prochaska, Redding, & Evers, 2008; Prochaska & Velicer, 1997) as starting point, physical activity behaviour change studies are directed mostly at changing behaviour of people who are at the early stages (mostly contemplation and preparation) of TTM. According to TTM, people pass through 5 stages of change. People start out from a pre-contemplation stage at which they do not even think of changing their behaviour. Next, they move through contemplation and preparation stages at which they gradually start thinking of changing their behaviour. If they pass through these stages and decide to change their behaviour, they take action (action stage), sustain the desired behaviour (maintenance stage), and finally come to a durable behaviour change.

Adoption and maintenance of physical activity has noteworthy life-long health benefits (Marcus et al., 2000). Thus, making people aware of their own behaviour, by giving personal information (i.e., about their physical activity level) and motivating them to adopt a healthier lifestyle (i.e, to become more active and move to action stage) is of great importance. However, although many potential exercisers seem to adopt new products and technologies in their lifes, there is limited evidence that adoption also leads to sustained behaviour change (Hermsen, Frost, Renes, & Kerkhof, 2016). Physical activity becomes a more planned and structured endeavour for those people with an aim to improve and maintain their physical fitness. They became more willing to join sports competitions, even though they do not have a chance to win (Araújo & Scharhag, 2016). However, regardless of their strong desire for durable change, this group of people is prone to relapse (Marcus & Simkin, 1994). The question thus becomes how to support this group of *active exercisers* through technology and design. This growing group of users is the one that we focus on in this paper.

2 Research Question and Aims

Although the one of the aims of activity trackers is to change people's behaviour, when people move to the action and maintenance stages of behaviour change process, these products become less useful to them. The main reason behind this shift is that when people start to be more active, the motivational needs of these people change as well (see Ludden & Hekkert, 2014). Data-based needs of these people differ from the people at the early stages of behaviour change, and they may need or want more information about their exercise behaviour than the number of steps taken. As a result, active exercisers seek for more advanced products to help them improve their performance and show their improvement (Kuru, 2016). Therefore, the technology should also shift the focus from merely informing the user about the collected data, to analysing it and turning these data into valuable knowledge for the users.

In sports science and psychology, there is a large body of knowledge on training and athlete behaviour. Generally, this knowledge has been applied to consumer products and applications. Designing for the last two stages of change is relatively new compared to physical activity motivation studies. This research area is open to contribution of designers who can specifically target challenges faced by active exercisers. These include external challenges such as weather conditions and work load, and internal challenges such as injuries and pregnancy. However, many of the activity trackers that are now available on the market do not respond adequately to changes that people might undergo after becoming more active. This paper draws attention to the changing needs of active exercisers by discussing the challenges of designing for active exercisers, and analysing how current knowledge in sports science and design for experience might contribute to designing for this particular group. Based on our analysis, we will propose research directions for designers to empower active exercisers to engage in lifelong training. Following up on these research directions, this paper takes the first step towards the development of design requirements to engage active exercisers with both the physical activity itself and product use to sustain flow experiences in both activity and product use.

3 Challenges of Designing for Active Exercisers

It is apparent that activity trackers are motivational tools for a majority of the users (Sullivan & Lachman, 2016). However, several researchers have shown that these devices are often abandoned after relatively short periods of use (Lazar, Koehler, Tanenbaum, & Nguyen, 2015; Shih, Han, Poole, Rosson, & Carroll, 2015; Sullivan & Lachman, 2016). Most of the less active people abandon these products after a couple of months, as they are discouraged by the feedback given by those trackers (Meyer et al., 2016). This is mostly because feedback does not address challenges faced by people who are starting to integrate sports in their lives (e.g., how to integrate activity with work or social life, or how to stay motivated even during times when progress is not apparent) (Kuru, 2016) .

There is a complex interplay between the changing user needs of active excercisers and evolution (or the lack thereof) in the the field of activity trackers (Clawson, Pater, Miller, Mynatt, & Mamykina, 2015). Most notably, whereas active exercisers constantly evolve to higher levels of performance (Suh & Hsieh, 2016), most devices are static in so far they only target a specific type of action (e.g. number of steps taken). In other words, such trackers are prone to abandonment not so much because active exercisers fail in keeping up with the desired change, but also as a result of a mismatch between (positively changing) user needs and technology. The reason behind their changing needs is that people are open to finding ways for further self-development and seek for more advanced products.

For instance, in a recent study on how running and the experience of supportive technology by amateur runners changes over time, it was revealed that data-based needs of runners evolve over time and once runners start to become more mastered at running, they require more running dynamics data (Kuru, 2016). With respect to the user requirements, the reason why people use running apps or sports watches varies. For instance, it has been shown that, when people become more experienced in running, they tend to use sports watches, while less involved runners keep using apps (Janssen, Scheerder, Thibaut, Brombacher, & Vos, 2017; Kuru, 2016).

Currently, there is a wide variety of wearable activity trackers on the market (see Figure 3). The product category as a whole ranges from pedometers that only count the number of steps taken to advanced sports trackers that measure several parameters of the exercise such as heart rate and vertical oscilation during running. Wearable sports trackers are the most advanced ones that give real-time feedback which active exercisers utilize during exercise (Daiber & Kosmalla, 2017). Recent research proves the abilities of the sensor technologies and wearables in measuring the wearer's key vital signals unobstrusively. One of the very recent examples is the closed loop smart athleisure fashion which measures the heart rate and breath of the wearer (eg: http://www.by-wire.net/clsaf/). Arguably, systems designed specifically for sport experience should support the development of knowledge and user skills (Mueller et al., 2011). That is, these systems should empower users with knowledge about their body, and facilitate improving skills through training and practice (Doherty, Lemieux, & Canally, 2014). To address this, the systems should facilitate listening to the "inside" of their body and should give reasonable feedback rather than simply forcing the users to push their limits (Mueller & Young, 2017).

As stated, current physical activity trackers only inform the user about the number of steps taken, while people have a lot to learn about physical activity dynamics. Advanced sports watches have a lot of multi-sport abilities. For instance, cyclists use smart watches for self-monitoring, and they are mostly used by "competitive cyclists" rather than commuters, in order to improve their cycling performance (Piwek, Joinson, & Morvan, 2015). Another example from the context of swimming relates to watches which can track and understand stroke type and give feedback about the efficiency of the strokes accordingly (i.e. Garmin multisport watches). However, it fails to identify errors in swimming technique, something which is extremely important in order to progress to more advanced levels of exercise (Morais, Marques, Marinho, Silva, & Barbosa, 2014). Even though these watches do more than just tracking number of steps, they still do not succeed in providing the valuable information that people need in order to improve themselves.

Figure 1. Examples of Current Activity Trackers

While performance becomes incrementally important for active exercisers, injuries can be frustrating for them as those can withhold people from long-term training. There are several causes of injuries in different sports. By focusing on technique, distribution of energy, and force during the course of a sports session, supportive technology could also prevent injuries. For instance, wrong running technique can result into injuries and knee problems (Novacheck, 1998) while knee, shoulder and overuse injuries are the most common types of injuries among swimmers (Kerr et al., 2015; Morais, Marques, Marinho, Silva, & Barbosa, 2014). Thus, while challenging the users for performance and supporting positive experience, the design of activity supporting technology should also prevent injuries and negative experiences. Therefore, the aim of design for sports experience should be sustaining activity while supporting life-long engagement with sports through products, systems and services.

4 Engaging Active Exercisers through Design

Engaging active exercisers through design can facilitate maintenance of the physical activity and ongoing product use over timeTherefore, engaging active exercisers through design has a twofold goal: engagement in physical activity and in product use.

4.1 Engagement in Physical Activity

In sports science, engagement with the physical activity has been connected to the experience of *flow* (Jackson, Ford, Kimiecik, & Marsh, 1998; Swann, 2016), as people are more motivated to engage in certain activities when they experience flow (Landhäußer & Keller, 2012). From a broad perspective, Flow Theory (Mihaly Csikszentmihalyi, 1988, 1990) addresses people's experience when they are highly involved in certain activities. When people are in a state of flow, "*the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it. (pg 4).* Importantly, people will be in a "flow state" if they have the time and opportunity to focus on the activity. The skills of the individual and the challenges of the activity define the level of flow: if these two are balanced (i.e., when user skills match the exercise challenge), flow will arise. Reversely, people may experience anxiety if the level of challenge is (too) high relative to their skills, and boredom if the challenge is too 'easy'. Furthermore, levels of flow increase when the user has control over the activity (Mihaly Csikszentmihalyi, 1988, 1990). In general, flow situations contribute to the personal development and thus life satisfaction of people in the long run (Mihaly Csikszentmihalyi, 1990; Landhäußer & Keller, 2012).
On a more specific level, flow makes people loose their sense of time in the activity and makes them forget about potential negative consequences of the sports activity (Engeser & Rheinberg, 2008). For instance, athletes highly desire flow experiences, as it may boost peak performances (Landhäußer & Keller, 2012). During flow, people do not worry about failure, which is why it is important to design for flow experiences. After all, when feeling 'good' (i.e., flow is associated with positive affect) and

worries recede into the background, active exercisers are likely to stay motivated and eager to keep improving their performance (Swann, 2016).

Importantly, however, flow experience and (related) loss of sense of time may also bring high risks as it may increase the likelihood of injuries resulting from over-exercising and fatigue (Schüler, 2012). In sports science, *periodization in training* has been used as a strategic method to prevent such consequences and optimize peak performance (Issurin, 2010). Basically, the idea of periodization is to split the training program into micro-cycles (such as days or weeks) within the (monthly or yearly) macro cycles, and plan each training session with a specific goal (such as improving performance, endurance or building strength) (Bompa & Buzzichelli, 2015; Mattocks et al., 2016). With these, both the effects of overtraining and the risks of injuries are minimized (Figure 2 shows this periodization of training). In short, the design challenge here is to both help active exercisers focus on their performance in the present moment, whereas at the same time it is important to help them take a long-term perspective with overarching goals as more experienced exercisers do.

We consider both perspectives on training and performance (focusing on the present moment and flow, *and* adopting a long-term perspective) as essential starting points which should inform the design of supportive technology for active exercisers. Hence, the design of such technology should be targeted at informing, challenging, and 'managing the exercise session' at both the the micro levels (specific race-based trainings) and macro levels (e.g., comprising weekly or monthly exercise plans). While doing so, available knowledge from sports science can also inform how the technology should react to prevent fatigues and long term effects of these fatigues. One promising avenue for doing so relates to the practice of mindfulness (Kabat-Zinn, 1994).

4.2 Engagement in Physical Activity through Flow and Mindfulness

Mindfulness practice aims at a non-judgmental present-moment awareness of internal events (i.e., thoughts and feelings) and/or external events (i.e., the environment). It is this complete focus on the task or environment in the present moment that underlies both mindfulness and flow. But whereas, flow has been recognized as important to sports experience, mindfulness practice has been relatively underexplored in sports, although it has been suggested that awareness and acceptance of the present moment may allow athletes to focus less on negative or distracting thoughts, but rather spend more energy and focus for on the task at hand (Pineau, Glass, & Kaufman, 2014). In line with such notions, some have pointed out mindfulness as a critical component of peak sport performance (Mihalyi Csikszentmihalyi & Jackson, 1999; Ravizza, 2002) and some research suggests that mindfulness exercises can indeed generate "flow", (Aherne, Moran, & Lonsdale, 2011; Kee & Wang, 2008). Furthermore, it has been shown that mindfulness training may decrease (stress-related) pre-competition salivary cortisol (John, Verma, & Khanna, 2011), decrease resting heart rate (Hewett, Ransdell, Gao, Petlichkoff, & Lukas, 20011), and decrease pain sensitivity (Kingston, Chadwick, Meron, & Skinner, 2007; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010). Hence, cultivating mindfulness via design may also decrease risk of injury and burnout.

Apart from being mindful of their own (intrinsic) thoughts and feelings, mindful athletes may also benefit from being mindful of the (extrinsic) environment. For instance, in addition to helping exercisers focus (i.e, becoming mindful) of their breathing, heartbeat or the sound of their feet on the ground, design may also direct attention to specific features of the (natural) environment such as multi-sensory properties (smell, the wind blowing) and spatial properties which have been shown to stimulate positive affect, creativity and inspiration (Fredrickson & Anderson, 1999; van Rompay & Jol, 2016).

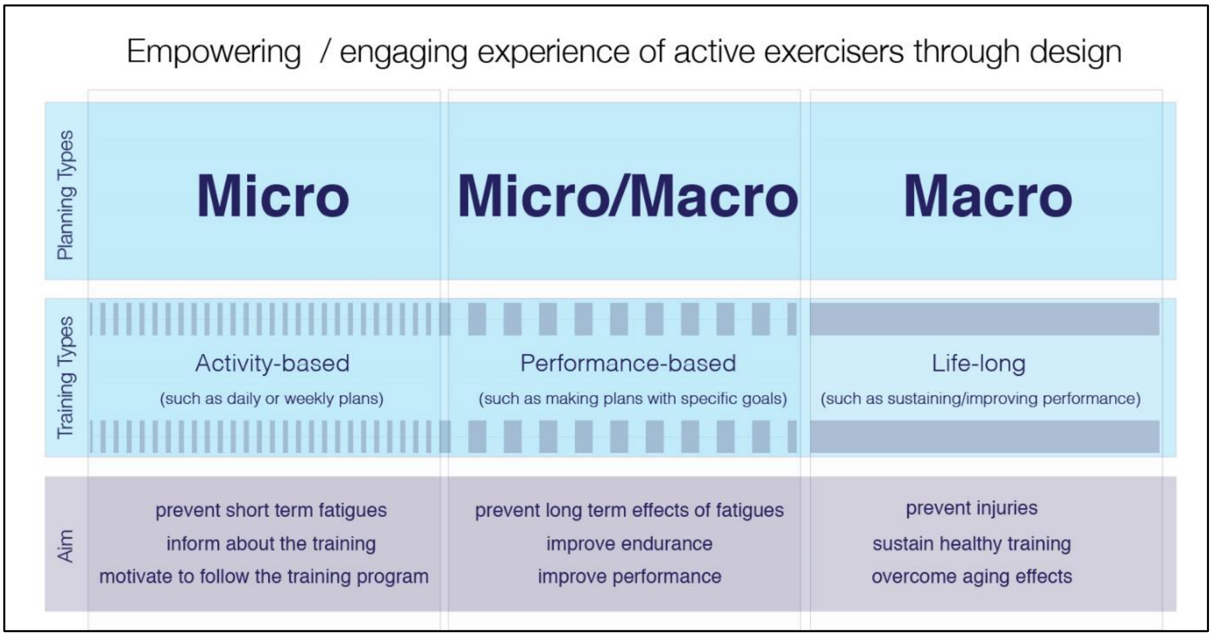

Figure 2. Aim of Periodization and Relations with Sports Engagement

In short, design and technology could generate flow both at the macro level (e.g., life-long flow experience in sports) and at the micro level, in relation to which mindfulness practice offers a particularily interesting starting point. Likewise, the design should inform the user about the benefits of micro plans such as improving endurance and performance in the longrun. But as outlined, design could also promote flow experiences at the micro level and accurate. Apart from generating flow through mindfulness, design research also points at the product and the way it interacts with the user as a source of flow.

4.3 Engagement in Product Use

Taking user experience as a starting point, flow experience can be reconciled with user engagement as it is strongly connected to how a product can attract and sustain user interaction. Early research by Overbeeke et al. (2004) state that products should engage users through their "physicality"; products should be fun to use, and thus, be engaging. Therefore, the goal of the designer should be ensuring pleasure or fun during product use. Overbeeke et al (2004) defined five aspects that are essential for understanding the nature of 'engaging experiences', which include "functional possibilities and performance of the product; user's desires, needs, interests and skills; the general context of use of the product; richness with respect to all the senses; possibility to create one's own story and ritual". A much-cited example in this context talks about Apple's ipod which stood out from (at the time current) music players by providing intuitive, smooth interaction (connecting and drawing on users' motor skills), connecting to user needs for easthetics and meaning (e., through its minimal design), and by allowing for personalization (e.g., by creating profiles, playlists and the like). As for sports, Apple's iWatch was designed based on these same principles, intending to provide flow and pleasure during product interaction. Engaging experience relates to users' skills of "knowing, doing and feeling" (Overbeeke et al., 2004). The experience of technological products also covers dimensions in each level, such as aesthetics, interactivity, pleasure, functionality and social issues. In this sense, the process of engaging experience is based on and related to "cognitions, motor skills and emotions" of users.

In product use, engagement is an evolving process, which covers engagement, non-engagement-disengagement and reengagement of the product (O'Brien & Toms, 2008). Overall *engagement* is defined as the actual experience of a product. When the novelty effect passes, users may *disengage* with the product. If, after a while, the user desires the experience and starts using the product again,

reengagement occurs. Understanding the overall engagement process will take time, thus engagement can be defined as a longitudinal process in which people's reactions towards the product can evolve over time.
We argue that the flow state can be considered both for the product usage and the physical activity and design can aim for sustaining "life-long flow". Design for sports experience of active exercisers can benefit from both sports science and psychology. Thus, we suggest that, design can (1) challenge performance and facilitate positive experience including flow at the micro level; (2) prevent injuries and impede negative experience and (3) sustain physical activity and thus life-long flow for active exercisers. We already have extensive knowledge on how to challenge people through technology, which can inform designers to design for micro training. However, facilitating macro plans through micro goals of training through design, and hence engagaging users with life-long training while overcoming challenges and pitfalls which are bound to arise as users progress through long-term training programs are not supported by the current knowledge about using technology to motivate people to be physically active. To fill this gap in knowledge, we need more insights in how activity-based needs of active exercisers change over time. At this point, there are several topics that need to be explored first. These include the current experience of exercisers with both activity and products and how dynamic their experience is. Therefore, in the following section, we offer several research directions to facilitate the design for sports experience process.

5 Research Directions and Conclusions

We have outlined how current products and applications aimed at motivating physical activity do not match the needs of lifelong training for active exercisers. This topic lies at the interplay of design, sports science and psychology. Thus, we can partly inform design by drawing on insights from the fields of sports science and sport psychology. However, studies from these fields usually do not consider the experience of (and engagement with) products when providing, for instance, user support and generating engagement and flow during the activity itself. We therefore suggest that designing for sports experience requires specific attention.

We propose that the focus of future research should be on designing for sustainable life-long training by preventing injuries and helping them physically active throughout their lives. Here, the role of the designer is very strategic. The aim of the designer should comprise a) clearly defining the needs of "the user" and "the active exerciser", and b) designing products, services or systems which incorporate sports experience knowledge into meaningful training plans and use experience." To achieve this, the micro plans (can be race-specific or activity specific) could be utilized to help active exercisers to improve their performance and give them insight in how current exercise influences performance in both the short and the long run (Bompa & Buzzichelli, 2015). The outcomes of the research should lead to guidelines to design supportive technology that empowers people to take care of and make the right decisions for themselves to be physically active throughout their lives.

We suggest three main areas of research that together inform the design of supporting technology for active exercisers throughout life.

1. **Activity-based training:** The focus of this area is helping active exercisers to formulate their own daily or weekly plans. In order to achieve this, we need more insights in how to design training plans which can prevent short term-fatigue and motivate people to follow through the training program. Through research, we should first explore both the activity and the technology experience of active exercisers; then the possibilities and strategies for engaging them with the activity (i.e., flow in the present moment and supporting mindfulness) and performance.
2. **Performance-specific training**: The focus of this area is helping active exercisers to formulate their own long-term performance and injury-preventive training plans. Thus, this second area of research focuses more on knowledge building (with respect to sports performance and dynamics over time) of active exercisers. To achieve this, it is important to do more longitudinal research on activity trackers and to study how more dynamic supporting technology could motivate and

engage users with both the activity and the product (used to track the activity). Furthermore, we should also develop strategies for preventing long-term effects of fatigues while improving people's endurance and performance.

3. **Life-Long training**: We know that when people get older, their muscle strenght decreases and people get more prone to injuries. However, in order to sustain the life-long engagement in the physical activity, we need more knowledge on providing directions to overcome the effects of aging on people's performance. In the long run, the aim is to prevent injuries and sustain life-long training. It is natural that, people disengage with sports when confronted with expected (such as pregnancy) or unexpected events or short-term disabilities (such as injuries or illnesses). Arguably, it is particularily important during these times to keep people motivated by, for instance, pointing out what they still *can* do. Therefore, this line of research should study the effects of short-term disabilities and strategies for keeping people's motivation and helping them to recover healthily. This also can lead to understanding what types of personalized data active exercisers would benefit from, and thus exploring the possibilities and strategies for engaging them with their data.

In conclusion, this paper has mostly focused on the potential of knowledge within sports science, psychology and design for experience to inform future development of activity supporting technology. We would like to emphasize that developments in related areas such as information and sensor technology can also largely (positively) influence future developments in this field. Developments in wearable technology, for example, have already identified sports clothing as an interesting field of application. Such developments could also include more advanced use of sensors and activity tracking systems that are better able to learn from and adapt to people's behavior. Such developments could be included in the three research areas that we have now defined. Together, these areas have the potential to inform the design of more personalized, engaging and motivating products and systems that could support people to be physically active throughout their lives.

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