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## Health Self-Management Applications in the Workplace

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# Summary



Health Self-management Applications (HSMAs) are sensor and intervention technologies that provide users with key metrics about their bodily functioning and health-related behaviours. These HSMAs are increasingly used in the work environment to facilitate workers to monitor their health behaviour and improve it where necessary (Jacobs et al., 2019; Kalantari, 2017). While the usefulness of HSMAs has been proven in the consumer and patient population (de Vries et al., 2016; Lorig et al., 2001), the use of HSMAs in the work environment suffers from high user dropout (Eysenbach, 2005) and does not seem to be effective in reducing sick leave (Linden et al., 2014). Also, the use of technologies such as HSMAs raises questions whether these technologies violate worker autonomy (Leclercq-Vandelannoitte, 2017).

Current HSMAs are able to provide different types of feedback, that can be adjusted to personal goals of the users instead of providing them with general norms (Bravata et al., 2007; Schermer, 2009). This personal attunement in the provision of feedback can improve their effectiveness, by giving feedback real-time and actionable (Kluger & DeNisi, 1996; Kulik & Kulik, 1988) instead of delayed, by giving developmental feedback in addition to performance feedback (Li et al., 2011) and by adjusting the feedback frequency to the receivers' preferences (Chiviawosky & Wulf, 2002; Lam et al., 2011). Based on the self-determination theory (Ryan & Deci, 2006), it is also assumed that the self-management function of HSMAs would increase the autonomy and intrinsic motivation of workers to self-regulate their health behaviour. In order to ensure that personal values such as autonomy are guarded, researchers can use knowledge from the field of Responsible Research and Innovation (RRI), supporting them in developing responsible technologies (Stilgoe et al., 2013; Von Schomberg, 2013)

Therefore, this thesis aims to examine how HSMAs can responsibly and effectively be developed and used to stimulate workers to show more healthy behaviours. This main goal is pursued by seeking answers to the following three sub questions:

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1. How do HSMAAs that provide both real-time and actionable feedback impact worker's health-related work behaviour? (Chapter 2)
2. Does the use of HSMAAs in the workplace promote employees' perceptions of autonomy in self-regulating their health-related behaviour? (Chapter 3)
3. How can HSMAAs for the work environment be responsibly developed, with attention for inherent values in and identification of stakeholder responsibilities for both design and implementation? (Chapter 4)

In chapter 2, we report on our first experimental study. This experimental study existed of a 6-week field experiment in an office environment where participants used a set of sensor tools for 6 weeks. In this study we examine the effect of real-time actionable feedback on the behavioural change of office workers using a set of HSMAAs in the workplace aimed at reducing prolonged sitting behaviour and preventing mental fatigue. Findings show that receiving real-time actionable feedback messages on sitting behaviour does not impact the immediate duration of the sitting event. However, during the experimental period, we observed a decrease in average sitting duration over time. In contrast, feedback messages on mental fatigue, which were based on typing behaviour, does influence participants in immediately taking a break from typing.

These findings suggest that in response to real-time actionable feedback, workers are unlikely to immediately alter harmful behaviour that they can identify themselves, such as prolonged sitting behaviour, but nevertheless tend to improve sitting behaviour over time. Real-time actionable feedback on fatigue during typing, however, was found to be effective in immediately adapting that behaviour. This pattern of results seems to suggest that real-time actionable feedback has direct effects on unhealthy behaviour that workers are unaware of, while it has delayed but lasting effects on

unhealthy behaviours that workers can identify themselves. This implies that in order to improve the long-term health behaviour of the worker, the sitting behaviour can be monitored for relatively short periods, whereas monitoring of fatigue during typing behaviour must be continued in order to ensure that workers can take timely breaks.

Chapter 3 describes the results from the second experimental study, in which healthcare workers used a Fitbit One for 4 weeks. In this chapter, we use questionnaire and interview data to explain how the use of an HSMA in the work environment affects the degree to which workers feel able to self-decide upon health-related behaviour in the workplace, their so-called 'perceived autonomy'. This perceived autonomy can be affected in both the work and home environment, referred to as work health autonomy (WHA) and home health autonomy (HHA), respectively. This chapter investigates what the effect is of differences in focus of feedback provided by an HSMA on employees' autonomy perceptions. Regarding feedback focus, we differentiate between performance feedback, which shows the discrepancies between one's actual behaviour and the standards set for such behaviour, and developmental feedback, which aims at facilitating learning and behavioural change. Moreover, we examine how differences in BMI (i.e., a proxy for health) moderate employees' autonomy responses to the feedback they received from the HSMA. Findings reveal that the use of an HSMA does not significantly increase perceived autonomy in self-regulation of health behaviour, and may even reduce it under certain conditions. Specifically, employees who receive mere performance feedback from their HSMA tend to perceive lower WHA than when they received additional developmental feedback. Furthermore, employees with higher BMI who received performance feedback perceive a greater loss of WHA than employees with lower BMI, and employees with higher BMI who received additional developmental feedback experienced a greater loss of HHA. Findings from our in-depth interviews show that higher-BMI employees felt external norms and standards for healthy behaviour as more salient and experienced more negative emotions when those norms are not met, thereby making these employees more

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aware of their limitations in the pursuit of health goals. These results show that there is no ‘one-size-fits-all’ approach when it comes to health promotion in the workplace. To avoid negative consequences of HSMA in the workplace, we suggest to make it part of a broader program on workplace health promotion. These programs should be implemented using input and ideas from a varied group of workers, and should preferably aim at a broad range of behaviours, including not only physical exercise, but also diet, mental health, and overall wellbeing.

The research upon which this thesis is built, was conducted in the project SPRINT@Work. In that project, we came across several ethical issues that affect the development and use of health-related technologies in the workplace. In Chapter 4, we explore these ethical issues. We identify three shortcomings in the research literature on ethics regarding new technologies. First, previous studies often focus only on either the development of new technologies or on the implementation of these technologies. Second, prior research overlooks the specific characteristics of the work environment that affect the development and use of technologies. Third, prior work has not addressed how developers as well as users may fail to recognize the ethical values of other stakeholders involved in design and use of new technologies. Using cases from SPRINT@Work, we show how a context-specific form of ethics can overcome these shortcomings. An example of this is the case of firefighters. Under current regulations regarding data protection (GDPR, 2016), an employer is not allowed to obtain personal health data from the worker, not even when the worker agrees on sharing data. On the other hand, however, this employer has the duty to keep the worker from getting harmed (Arbeidsomstandighedenwet, 1999). In case of a fire, these two regulations often clash. Our context-specific ethics takes into account the situational details regarding respective dangers of getting harmed and giving up privacy. Also, it uses the views from stakeholders, such as firefighters and their captains, as input for reiterations of this ethics, resulting in an approach that uses autonomy to protect both worker privacy and employer responsibility. We thereby show that the values

of responsibility, privacy and autonomy are not as rigid as reflected in the regulations, but there is an interplay between these three values that is impacted by the context-specific details. Applying this context-specific form of ethics to the work environment in SPRINT@Work can help overcome issues such as a loss of autonomy or privacy of workers.

In Chapter 5 we reflect on the main aim of this thesis, and conclude on the scientific and practical implications of this thesis. The main aim was to examine how HSMAs can responsibly and effectively be developed and used to stimulate workers to show more healthy behaviours. We conclude that HSMAs can contribute to healthy behaviour of workers by providing real-time actionable feedback on suboptimal behaviour. This real-time feedback however is not always a driver of beneficial behavioural change, but can reduce the perceived autonomy of less healthy employees. Our approach of using context-specific ethics enabled us to explore how to take into account the inherent ethical values of a technology during development and use, and how the implementation of HSMAs can benefit from a contextualized understanding of privacy and autonomy issues in the workplace.

We used a multidisciplinary approach to examine the development and use of HSMAs in the work environment. The use of objective measurements of mental fatigue in the workplace is innovative, and opens up promising research directions. We add to the field of workplace health promotion by using Feedback Intervention Theory (FIT) and Self-Determination Theory (SDT) to examine how HSMAs can facilitate workers in self-regulating their health behaviour, and we show how the current health of workers using a HSMAs impacts the perceived autonomy. Also, we show how a context-specific ethics approach building upon the framework for Responsible Research and Innovation (Stilgoe et al., 2013) can facilitate responsible implementation of HSMAs in the workplace.

Regarding the practical implications, this research shows that employers should be aware that there is no panacea for work-related

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illnesses. The use of technologies that improve worker health is promising, especially for behaviour that is not noticed by the worker themselves. To let all workers benefit from technologies aimed at health improvement, employers could use groups of employees and stakeholders to address and evaluate features of the technology. The effectiveness of health self-management could be improved further by using a broader workplace health promotion program, also focusing on mental health programs and lifestyle.

We combined insights from the fields of occupational health, job design, human behaviour, and responsible innovation, into a truly multidisciplinary view on a responsible and effective development and use of HSMAAs aimed at improving the health-related behaviour of employees. By doing so, using both quantitative and qualitative research and experimental and case study research, we pave the way for future research into this scientifically interesting and societally relevant topic.



