Sensors@Work

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DOI:
10.33612/diss.160700439

Chapter 8

Ethics in Design and Implementation of Technologies for Workplace Health Promotion

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Submitted

Abstract

Introduction: Responsible research- and innovation studies have established a firm framework for addressing ethical issues in designing and using new digital health technologies. However, despite this comprehensive ethics framework, there is still a lack of knowledge on (1) how to overcome the divide in ethical approaches to designing and implementing innovative technologies, (2) how context can play a role when addressing critical ethical issues such as privacy and autonomy, and (3) how ethical responsibilities of the different stakeholders can be made manifest and used. These three problems are a major challenge for the development and implementation of new digital health technologies. The aim of the present study is to address this challenge by analysing two ethical issues, privacy and autonomy of workers, in a real-life research setting.

Procedure: This study is an instrumental case study of a multidisciplinary research project, which aimed to develop sensor and intervention technologies for a sustainable workforce while considering both implementation and design. The analyses focus on two cases and reflect a real-life research setting of doing ethics. Design-use dynamics are identified and a context-specific approach of ethics is applied in a reiterating process of development and small-scale implementation of health-related technologies in the workplace.

Case studies: The results show how protecting the privacy and autonomy of workers cannot be seen as stand-alone issues, but rather, there is an interplay between these values, the work context, and the responsibilities of workers and their employer. Consequently, digital health technologies in this multidisciplinary research project are designed to improve worker conscientious autonomy, while concurrently creating balance between privacy and health, and assigning responsibilities to the appropriate stakeholders. At the same time, a close watch is kept on other critical values, such as privacy and autonomy.

Conclusions: Focusing on a contextual conceptualization of core ethical principles identified during the project helps to avoid compartmentalization, generalization, and neglect of responsibility. Developing context-specific ethics makes it possible to examine the particular implications of a certain value for a specific situation. There is a need for a practical, adaptive tool or guideline that helps engineers, researchers and other stakeholders in this process. This adaptive tool can only be developed if more researchers document and publish their ethics practices.

Keywords: Privacy, autonomy, generalization, responsibility, ethics, responsible research and innovation

8.1 | Introduction

A major challenge caused by the aging workforce is to keep workers fit for work (Kenny, Yardley, Martineau, & Jay, 2008) to achieve a sustainable workforce. Technological interventions can assist to maintain individual workability, for instance by addressing the needs of aging workers in an objective manner (Truxillo, Cadiz, & Hammer, 2015) and creating balance between individual capacity and workload through well-designed workplace health interventions (Kenny et al., 2008). Examples of digital health technologies that are applied in the workplace are accelerometers, measuring bending, standing and walking activity (Villumsen, Madeleine, Jørgensen, Holtermann, & Samani, 2017) and wearable sensors for measuring fatigue (Aryal, Ghahramani, & Becerik-Gerber, 2017). Technologies such as these are aimed at automatically measuring and intervening worker behaviour, by giving (automated) feedback through digital means such as smart phones or stand-alone digital applications. These digital health technologies are used in addition to existing workplace health practices.

Research into the design and implementation of digital health technologies is surrounded by ethical issues that require responsible research. It is important to think about what impact this technology might have on individuals who are targeted as potential users or even on society as a whole. Responsible research and innovation (RRI) is a field of science that aims to highlight these socio-ethical issues in research and innovation practices (Grunwald, 2014; Owen, Macnaghten, & Stilgoe, 2012). In the past decade, new knowledge and guidelines have been developed that empower researchers to incorporate the researcher's responsibility throughout the innovation process (Stahl, 2013; Stilgoe, Owen, & Macnaghten, 2013), focusing on anticipation of (un)foreseen ethical qualms, reflexivity on one's own role, inclusion of a diversity of perspectives, and responsiveness to societal needs. Studies that describe the employed techniques to overcome the socio-ethical issues in development are lacking (Fisher et al., 2015), and publications in the field of responsible research and innovation still struggle with three critical problems: compartmentalization, generalization, and vagueness about responsible use (Efstratiou et al., 2007; Kortuem et al., 2007; Leclercq-Vandelannoitte, 2017; Palm, 2009).

Compartmentalization of focus in the current setting refers to the focus on one part of the development or implementation phase, while not including the tension between the intended and actual use of a technology. That is, until now, studies have mostly focused on ethical issues in either the design of new sensor technologies (Aryal et al., 2017; Efstratiou et al., 2007; Motti & Caine, 2014; Saurabh, Rao, Amrutur, & Sundarrajan, 2014) or ethical issues in the implementation of existing technologies (Kortuem et al., 2007; Leclercq-

Vandelannoitte, 2017; Sole, Musu, Boi, Giusto, & Popescu, 2013). The issues surrounding implementation takes technologies as a given and does not question their inherent values in the design. This situation does not do justice to reality: if design and implementation do not acknowledge each other's ethical concerns and intended values, the final use of the technology will not reflect the intentions of both sides. A broader view on the transition between design and implementation is called for (Jakobsen, Fløysand, & Overton, 2019) to facilitate responsiveness between these phases of RRI.

In case of the second problem, generalization, a single issue is identified as a core problem and addressed in a general way without attention to the specific context. For example, privacy is one of the significant issues in the development and application of new technologies that collect large amounts of data of individuals (Al Ameen, Liu, & Kwak, 2012; Conger, Pratt, & Loch, 2013; Nissenbaum, 2010; Zhu, Gao, & Li, 2016). However, most analyses of privacy issues focus on technologies that are used in the public space. These analyses do not necessarily fit other important contexts, such as use of sensor technologies in the work environment designed for health promotion. With regard to new technologies designed for the working environment, specific issues that concern privacy in the worker-employer relationship remain unaddressed. Additionally, discussion lacks about how privacy is embedded in the broader context of the effect of for example digital health technologies on the autonomy of people, specifically workers. That is, research suggests that workers both experience (Leclercq-Vandelannoitte, 2017) and fear (Damman, van der Beek, & Timmermans, 2015) a loss of privacy and autonomy due to the use of (preventive) technology in the workplace. This lack of context-specific knowledge on both privacy and autonomy results in ethical issues that are not appropriately addressed in the development of new technologies. More research is necessary to address and contextualize these issues in the design and implementation of new digital health technologies.

Finally, the topic of responsible use of digital health technologies remains vague and unaddressed. Providing transparency about responsible use as well as identifying who is responsible are lacking. For example, Leclercq-Vandelannoitte (2017, p. 151) observed that in the use of ubiquitous technologies in the workplace, neither workers nor employers recognize who is responsible for technology, nor do they understand the importance of responsible use of these technologies. Furthermore, designers do not provide insight into the responsible use of their designs. Thus, identifying responsible use is notoriously difficult due to interdependent design-use dynamics (Kiran, 2012). These dynamics entail that design and use continuously impact one another because a particular function is often the reason for the design of a technology application. However, the adoption of the design can substantially change the function. An example is the innovation of the Short Message

Service (SMS), which was designed to enable mobile owners to receive messages about incoming voicemails as well as bills from the mobile company (Taylor & Vincent, 2006). However, SMS developed into a primary function for communication between individuals, thereby posing additional design demands as well as responsibilities that were not relevant to the original function. These interdependent design-use dynamics make it difficult to predict how a technology will be used, and whether it will be used as intended. However, this difficulty should not hinder designers from at least outlining the responsibilities inherent in their designs.

This study aims to overcome these issues of generalization and compartmentalization and additionally identify relevant responsibilities in the design and implementation of digital health technologies in the workplace. First, the present study outlines current knowledge on ethical (and legal) issues on the implementation of technologies in the workplace, specifically focusing on the two ethical issues that play an important role in the worker-employer relation: privacy (Spook, Koolhaas, Bültmann, & Brouwer, 2019) and autonomy (Damman et al., 2015; Leclercq-Vandelannoitte, 2017). Secondly, two cases were explored using a context-sensitive approach of ethics to investigate these ethical issues during the development and implementation of sensor and intervention technologies for health purposes in the workplace.

8.1.1 | Privacy of workers

Employers are obligated to guarantee a safe working environment for their workers and should be reluctant when it comes to meddling with the workers' private lives and personal data. Interfering with workers' health behaviour, especially as connected to lifestyle, is dubious at best. It targets individuals (at work and in private) instead of organizational and collective problems, even if the goal is sustainable employability (van Berkel et al., 2014). Therefore, sensor and intervention technologies should comply with several criteria to ensure worker privacy.

Firstly, according to the EU General Data Protection Regulation, article 15, section 1 (GDPR, 2016), the worker should be able to access all personal data and outcomes of sensor and intervention technologies, without the interference of others. Secondly, the employer should not have access to data and outcomes of individual workers or be able to derive these outcomes from group data (GDPR, 2016, sec. 6). Current regulations on data collection and individual privacy limit the possibilities of data sharing (GDPR, 2016). As stated in article 6, section 1, subsection d of the GDPR, data processing is only valid if it is necessary to protect the vital interests of the subject, hence, a life-or-death situation.

Legally, data sharing at a group level is only allowed if the data does not contain identifiable information, such as personal data traceable to individuals (GDPR, 2016, sec. 4). Specifically when it comes to sensor data that cross the border between work and private life, serious legal concerns arise regarding data and health privacy (Brassart Olsen, 2020). It could be argued, however, that sharing digital health data with relevant actors, such as health and safety workers, is beneficial for workers in specific contexts. In case of workplace improvements, the use of personal data could help improve working conditions. The GDPR, however, does not provide a legal basis for the exchange of personal data in these specific relationships (Arora, 2019), making it difficult to use digital health data in the working environment, even if it can improve a worker's health.

A needs assessment among workers with physically demanding work identified a demand for sensor and intervention technologies (Spook et al., 2019). However, respondents expressed concerns about what would happen with the personal data retrieved by the sensors, fearing their privacy would be violated, especially if employers had access to the data. These apprehensions confirm the findings of other studies (Choi, Hwang, & Lee, 2017; Jacobs et al., 2019). The GDPR, as described above, offers an extensive legal framework protecting the rights and freedoms of data subjects, ensuring data minimization, informed consent, good practice via the Data Protection Impact Assessment (DPIA), and privacy by design (GDPR, 2016; Lodge & Crabtree, 2019; Mulligan, Koopman, & Doty, 2016). Although this legal framework is intended to protect workers, in some cases workers are not necessarily protected by it, or do they want to be protected in this manner. That is, workers also declared that they would share their data with their employer to explore possibilities to improve working conditions if they could retain full ownership of the data (Spook et al., 2019).

Absolutizing a legal framework endangers narrowing the fundamental questions of why privacy is an essential moral value. Data protection is significant to ensure privacy, but it does not embrace a comprehensive understanding of the concept. Numerous scholars have warned against a reductionist conceptualization of privacy as merely about the protection of the personal sphere, raising questions about possible conditions under which this protection can be overruled (Barocas et al., 2013; DeCew, 2015; Dwork, 2006; Mulligan et al., 2016; Nissenbaum, 2010; Solove, 2008). They have argued for a broader understanding of privacy based on a reflection of practice and context. A legal framework for privacy by nature is fixed; however, privacy as a value should be shaped by each situation. Nissenbaum (2010, p. 2) succinctly summarized this concept: '*What people care about is not simply restricting the flow of information, but ensuring it flows appropriately*'.

Privacy as an essentially contested and malleable concept is dependent upon, amongst other things, the context in which it is examined, and the social and technological circumstances that apply to its context. As the theoretical debate about privacy continues, there is a need for a context-sensitive approach. Mulligan et al. (2016, p. 15) have suggested an approach based on four questions: *'While dilemmas between privacy and publicity, or privacy and surveillance, or privacy and security persist, the question we more often face today concerns the plurality available to us amidst contests over privacy: Which privacy? For what purpose? With what reason? As exemplified by what?*'. These questions enable researchers and practitioners to pragmatically define the relevant characteristics of the applicable notion of privacy.

8.1.2 | Worker autonomy

A significant challenge for a workforce that will continue working into older age is to keep workers fit for work (Kenny et al., 2008). van der Klink et al. (2016, p. 74) suggest to focus on sustainable employability based on a capabilities approach. Maintaining and supporting the ability of workers to continue working depends on the adaptation of work behaviour to changing circumstances. Worker autonomy in the self-regulation of work behaviour is crucial in this process (Ryan & Deci, 2006). Hence, organizations are introducing an increasing number of digital health devices on the work floor with which workers can regulate their tasks and work behaviour to ensure the autonomy needed for self-regulation.

Technological interventions can assist in maintaining workers' ability to work, for instance by developing technology that addresses the needs of ageing workers objectively, such as interventions that increase physical activity and ergonomically flexible workplaces (Truxillo et al., 2015). Thus, digital workplace health interventions can create a balance between workers' capacity and workload (Kenny et al., 2008), and sensor technologies, such as activity monitors and heart rate monitors, can accurately monitor workload. Additional intervention technologies, such as smart chairs (Goossens, Netten, & Van der Doelen, 2012; Roossien et al., 2017) can support workers in altering behaviour to prevent and solve health problems effectively.

Workers are willing to adopt sensor technologies that are perceived as useful (Choi et al., 2017; Jacobs et al., 2019), but workers' willingness to use these technologies depends on the addressing of concerns about data security and technology misuse (Jacobs et al., 2019). Philosophically, autonomy is complex, and caution is necessary to narrow the notion of autonomy to an idea of self-determination. Autonomy is a normative idea that directs actions governed by a responsible commitment to the norms with which one binds oneself. It can be about one's willed ideals as well as a commitment to the norms and standards

people encounter and adopt because of the setting, such as the workplace (Kukla, 2005). Thus, autonomy, also referred to as 'conscientious autonomy' (Kukla, 2005), covers the high moral values that direct peoples' lives as well as small practical commitments that shape ordinary happenings. For instance, if someone values being healthy, practical commitments could include walking to work instead of driving and taking the stairs instead of riding in an elevator.

8.1.3 | Responsibility in the work environment

The ultimate responsibility for safeguarding the working environment lies with employers. Employers are responsible for the capabilities of their workers, actively preventing harm and accidents (Arbeidsomstandighedenwet, 1999; Palm, 2009). For workers who labour physically, employers must protect workers' safety via periodic occupational health examinations and safety monitoring (Arbeidsomstandighedenwet, 1999). Despite employers' limited access to the outcomes of regular health checks, this examination protects workers because occupational physicians can access health data and warn workers of potential issues while bound to professional confidentiality.

To protect workers while using sensor and intervention technology, all stakeholders must be responsible for the proper use of these technologies (Johnson & Powers, 2005), although employers may have different views on this responsibility than workers (van Berkel et al., 2014). Both workers and employers acknowledge the responsibility to prevent harm in the workplace. However, many employers consider the responsibility to stay healthy and fit for the job to be the worker's responsibility, while workers embrace autonomy in their lifestyle choices (van Berkel et al., 2014). These contrary views see health as either a safety discourse or a lifestyle discourse (Allender, Colquhoun, & Kelly, 2006). Nevertheless, the responsibilities of workers and employers in both discourses must be examined through context-specific ethics to prevent ambivalence in the worker-employer relationship (van Berkel et al., 2014).

8.2 | Practical examples

8.2.1 | Project description

The project SPRINT@Work is an EU-funded interdisciplinary project aimed at developing and evaluating sensor and intervention technologies that contribute to keeping ageing workers healthy and effectively employable (Bonvanie, Broekhuis, Janssen, Maeckelberghe, & Wortmann, 2020; de Jong, Bonvanie, Jolij, & Lorist, 2020; de Jong, Jolij, Pimenta, & Lorist, 2018; Roossien, Heus, Reneman, & Verkerke, 2020; Roossien, Krops, Wempe, Verkerke, &

Reneman, 2021; Roossien et al., 2017). These health-related technologies were developed and implemented by researchers and engineers from a variety of disciplines (cognitive neuroscience, information management, biomedical engineering and rehabilitation medicine, community and occupational medicine), in collaboration with companies. The developed sensor and intervention technologies lead toward an automated, digital process of behavioural assessment of employees for health self-management purposes. Cognitive neuroscience and information management were represented by one professor and one PhD candidate, biomedical engineering and rehabilitation medicine were represented by two professors and one PhD candidate, and community and occupational medicine were represented by two professors, one post-doctoral researcher, and one PhD candidate. The four PhD candidates acted as executing researchers.

8.2.2 | Procedure: context-specific approach of ethics

In several intervision sessions between the executing researchers, and later, the entire project team, the following issues were addressed: (a) whether the legal framework of privacy identifies sufficiently what is at stake in the context of the development and implementation of sensor technologies for sustainable employability, and (b) whether self-management devices aimed to promote self-regulation can assist in enabling the autonomy of workers. The team developed a conceptual framework that contextualizes data protection and privacy issues. As well as the notion of worker autonomy into a framework of context-sensitive ethics that is helpful for both designing and implementing sensor technologies. This framework functioned as a benchmark for the researchers, so they could continuously check whether their proposed design was in line with context-specific ethics. During the project, this normative framework was continuously adapted using insights from the executed studies.

8.2.3 | Case studies

The present study highlights two case studies that were performed by the researchers of SPRINT@Work. The first case study was about monitoring the core temperature as a parameter of heat stress of firefighters. The objective of this study was to validate a wearable non-invasive core thermometer to monitor the core temperature of firefighters during firefighting simulation tasks (Roossien et al., 2020). The second case study was about a research on health self-management applications in the workplace of health care workers. This study aimed at investigating whether use of sensor and intervention technology enhances the autonomy of workers in self-regulating their health-related behaviour (Bonvanie et al., 2020).

8.2.4 | Participants

In both studies, the employer decided whether the study could be executed within the company. Thereafter, workers could voluntarily participate in the field studies. Employers were not allowed to oblige workers to use the sensor technology, nor can they ask for data if the worker voluntarily uses a sensor technology (Dutch Data Protection Agency, 2016). The intentions were articulated according to the declaration of Helsinki on research involving human subjects (World Medical Association, 2013), stating that participants should voluntarily give informed consent.

8.3 | Case study 1

8.3.1 | Privacy in the working environment: a case of firefighters

Firefighters would strongly benefit from sharing personal data about health measures such as bodily temperature acquired from wearable sensor and intervention technologies when entering a fire. During their job firefighters are exposed to a high thermal load due to heavy physical activity, external heat exposure from fires and the wear of highly insulated protective clothing (Roossien et al., 2020). This can lead to heat stress and subsequent related health problems, such as exhaustion, dehydration, mental confusion, and loss of consciousness (Roghanchi & Kocsis, 2018). In more extreme cases, heat strain can cause permanent damage and even be life-threatening (Krishnamurthy et al., 2017; Morgado, Talaia, & Teixeira, 2017), affect productivity and risk perception, and cause safety problems (Roghanchi & Kocsis, 2018). To monitor and prevent heat stress among firefighters, a wearable thermometer to measure the real-time body temperature is desirable. The firefighters themselves are not allowed to be distracted by immediate feedback about the obtained data, because they need to focus on the situation at hand. They neither have time nor opportunity to monitor the feedback and data from their own sensors. However, if the captains could monitor the current body temperature of their workers on-site using the real-time information from wearable sensor and intervention technologies, decline of the health and safety of the workers could be prevented.

Legally, an employer cannot ask permission to access the personal data of workers (GDPR, 2016, sec. 4), even if it is to the workers' advantage and safety. This issue points to ambiguity in the data protection law regarding the protection of workers' privacy opposed to the responsibility of the employer to safeguard workers' health and safety. Employers cannot, under any circumstance, use personal sensor data for the protection of health and safety of their workers. Although employers have the responsibility to protect workers from harm in

the work environment. An ensuing focus for the research team was to explore how privacy could be conceptualized in the specific context of sensor technologies at the workplace, despite such ambiguity.

8.3.2 | Context-specific approach to privacy

Following the pragmatic approach of Mulligan, the data sharing of these firefighters to determine what privacy might provide the protected firefighters in this case was analysed. Control over personal information, such as the core temperature and heart rate of the firefighter, is a critical target for protection. As previously stated, from the perspective of the GDPR, this type of data can only be accessed under stringent circumstances and must be handled by a health professional who is bound by professional confidentiality. Nevertheless, in the case of a fire, no such health professional is available. Thus, the harm that supposedly would be prevented by enforcing data protection might be superseded by the prevention of more prominent harm. This example illustrates how information becomes ethically and normatively significant. Not because it is about specific values such as privacy but because the context allows its use for action. In this case, the possible prevention of overheating. Hence, it is not about what information one has but about what one can do with that information.

Manson and O'Neill (2007) called the above explanation an agency-based model of informing and communicating, where it is necessary to analyse what the agent, in this case, the firefighter captain, can do with the private information obtained. If overheating can be prevented, firefighters might want the option to share sensor information with their captain, although the captain is not bound by confidentiality as a health professional. Hence, the firefighters' permission for the captain to access this information is based on the specific agency of the captain to protect the firefighters from overheating. A different way to protect the privacy of firefighters is making sure firefighter captains are bound by the confidentiality of their own profession.

The answers to Mulligan et al. (2016) questions—'Which privacy? For what purpose? With what reason? As exemplified by what?'—is that in the case of the firefighters, the privacy at stake is the ownership of personal data obtained by sensor technologies. The purpose of privacy is to give the firefighters control over their data, not only to prevent the employer's use of this personal information but also to allow the firefighters to share the data as they deem acceptable. The agency-based model exemplifies this purpose: in an ideal situation, the firefighter can opt to share data for protection from health hazards with the captain, who can act to prevent health hazards but cannot use the data for any other purposes. This example shows that a narrow interpretation of privacy might result in diminishing safety: if

privacy is unidimensional, and the only choice would be to decide to share the data with the employer, either the firefighter would accept more significant risks during the execution of the job because the data would be hidden (as in the GDPR), or the employer would have full access to all data, which could lead to misuse for other purposes.

8.3.3 | Responsibilities of stakeholders

In the case of the firefighters, the employer is serious about the responsibility for the health of the workers. The GDPR, however, prevents the employer from using personal data to protect firefighters from overheating in an emergency. In this case, the workers are at an impasse. Distraction from the task could cause immediate risks to themselves and colleagues; thus, it is impossible to self-monitor their current health parameters. This gap between the desired situation and current regulations is frustrating for the fire department because the captains wish to protect their firefighters, but the law prevents it.

8.4 | Case study 2

8.4.1 | Autonomy in the working environment: a case of health care workers

Healthcare workers are often subject to irregular working hours, performing shifts and night work, thereby impacting lifestyle choices such as their daily exercise and diet (De Jongh & Mcdougal, 2014). An unhealthy lifestyle for a healthcare worker not only impacts their employability in the long term (Hendriksen, Snoijer, de Kok, van Vilsteren, & Hofstetter, 2016), but also impacts the public's view on the healthcare institution, because the healthcare workers are assumed to ‘know best’ about the impact of lifestyle choices on long-term health. Both the issues of long-term health and the exemplary function of their work are well-known to healthcare workers, which is why many of them actively try to keep up good behaviour. An activity tracker is relevant for these workers, because it allows them to monitor their behaviour despite the changing hours and workload, and thereby supports these workers in becoming and staying healthy (Kalantari, 2017).

The use of sensor technologies to assist in sustainable employability hinges on offering workers objective feedback and interventions that allow them to self-regulate behaviour. Illustrative for the ideal of autonomy was a participant, self-identified as overweight and unfit, who was eager to experiment with an activity tracker. This activity tracker enabled her to receive automated digital feedback on her daily exercise behaviour. This worker was committed to improving her condition:

> *"I value a healthy lifestyle. I have difficulties keeping up with that for all sorts of reasons, and this is an opportunity for me to get some non-intrusive and time-saving support. I also would like to be an example for the patients who visit here. They need people like me as role models, people who struggle but make an effort to improve their health*."

She referred to her value of personal health. Receiving an activity tracker did not provide autonomy. However, due to the activity tracker, she could autonomously commit to her value of becoming healthy. This value had a different application in her work context, a healthcare organization, where she wanted to set an example for others. She wanted to show that increasing daily exercise by walking more and taking the stairs is an essential commitment to improving health. Thus, in the work context, the worker wanted to achieve a healthy lifestyle as well as provide the moral value of being an example. She translated the value of her health and her position at work into a daily practical commitment of taking more steps. Thus, the use of this sensor technology helped her to achieve her ideal.

Nevertheless, the commitment of the worker was not only shaped by a momentous decision to accept the activity tracker. Her commitment was confirmed by making some progress in walking more steps. However, it was disaffirmed when a colleague from higher management rebuked her for taking the elevator, saying that was not why she was given the activity tracker. This encounter made her question whether the entire experiment was about her improvement in health and realizing her values, or whether it was ultimately about organizational control and cost reduction.

8.4.2 | Context-specific approach to autonomy

This example, although an individual experience, illustrates how personal autonomy can easily be threatened in a work environment if personal values are not acknowledged. Giving workers a health device does not merely provide a means for self-regulation. Because the technology is embedded in a context that can promote or disavow the responsible commitment to the norms to which one is bound. This realization calls for reflection on how the introduction of technology can affect workers' autonomy, and how the context of the implemented technology influences the perceptions regarding workers' autonomy.

Worker autonomy as a prerequisite for health self-regulation was empirically investigated in the study of Bonvanie et al. (2020). It examined activity trackers that give feedback information on health-related behaviour to workers. The example of activity trackers is of interest because it is used as a technology that enables workers to self-regulate a healthy lifestyle (Bravata et al., 2007; Mattila et al., 2013). The underlying assumption was that the

use of digital health technologies provides workers with autonomy via feedback and the freedom to respond to self-regulate health-related behaviour. The findings revealed that the use of a sensor technology did not significantly increase perceived autonomy and may have even reduced autonomy under certain conditions, especially for less healthy workers (Bonvanie et al., 2020). Moreover, workers who had used an activity tracker to monitor their behaviour before they received an employer-provided device experienced the same decrease in autonomy as workers who used the activity tracker for the first time. This finding suggests that the activity tracker does not limit the autonomy of workers; instead, perceived autonomy may decrease due to the hierarchical relationship between workers and employers.

Kukla (2005) identified the idea of conscientious autonomy: autonomy that is committed to one's willed ideals as well as the norms and standards encountered in a particular setting that are adapted as normative (Kukla, 2005). Hence, one can determine why the autonomy of certain workers declines when using a sensor technology. The normative standards of the activity tracker that were applied were externally imposed. The goal was to walk 10 000 steps per day and take ten flights of stairs. Some participants agreed with this goal and internalized the normative standard. Others, however, did not and perceived the feedback as pressure to aim for 10 000 steps.

Moreover, the employer demonstrated a value for healthy workers. Before the experiment, several activities, such as a week of taking the stairs and a healthy cafeteria project, showed the values and norms of the employer. Participants who shared the same value of healthy living but had other ideas to implement it, felt as if the activity tracker forced them to commit to someone else's normative standards. Therefore, employers must be cautious when implementing sensor technologies in the workplace.

8.4.3 | Responsibilities of stakeholders

Similar to the case of the firefighters, the employer was responsible for the health of the health-care workers. In order to improve healthy behaviour, the employer initiated the workplace health promotion program. This blended program of physical and digital support focused on improving physical health of the workers by giving workers an activity tracker, offering a smoke-free property, promoting a week of taking the stairs, and providing a healthy cafeteria. Although the employer implemented methods to improve the workers' health, the study of Bonvanie and colleagues (2020) showed that this approach might have actually been counterproductive for workers of lesser health. Participation in the study and being able to discuss the impact of technologies with different stakeholders within the development process, thereby caused the employer to reconsider these workplace health

promotion policies. That is, the employer altered the strategy to include a more diverse group of workers in the decision-making process regarding new technologies, thereby aiming to facilitate a healthy workplace and lifestyle for all workers.

8.5 | Discussion

Previous literature on responsible research and innovation struggled with three major problems: (1) compartmentalization, (2) generalization, and (3) vagueness about responsibilities. Rather than developing a theoretical approach to these problems, we highlighted two cases in SPRINT@Work. We aimed at describing how we explored two critical ethical issues in the development and implementation of digital health technologies, privacy and autonomy in the setting of doing research and developing the technologies. A context-specific analysis of both values was employed, keeping in mind previous research and the legal context. For the firefighters case study, this analysis resulted in the description of an agency-based concept of privacy, where it is necessary to analyse and regulate what the agent can do with the private information obtained (Manson & O'Neill, 2007). For the case study of the health-care professionals, this resulted in a conscientious autonomy enhancing approach for the design and implementation of digital health technologies in the workplace. When this approach is employed, all stakeholders (with a specific emphasis on the user(s)) have to be actively involved in the design and implementation phase in order to achieve the intended goal of the technology, which is to enhance health-related behaviour (Kukla, 2005).

8.5.1 | Decompartmentalization of focus

These case studies show the necessity of including the tension between the intended and actual use in the development and implementation of a new technology. However, in the present, responsibilities regarding the assessment of risks of the new technology get indistinguishable when a transition between phases occurs (Jakobsen et al., 2019). More specifically, although the researchers might have reflected on the impact of the technology, after the development phase responsibilities shift towards the user or organizations that implement the technology. They do not necessarily reflect on possible ethical and societal risk, and primarily focus on productivity or increasing product acceptance (Chatfield, Borsella, Mantovani, Porcari, & Stahl, 2017; Leclercq-Vandelannoitte, 2017). In this study, the reflection on both design and field experiments involving health-related technologies in the workplace, caused the researchers to reflect on the interpretation and implications of the concepts of privacy and autonomy. This approach of integrating development and use was necessary to successfully implement techniques from the field of RRI, such as reflexivity

and responsiveness. The project allowed for a cyclic approach, using outcomes from early implementations of technologies as input for further development. As a result, we were able to take unforeseen ethical issues into consideration, because they appeared during use by end-users. This then allowed us to alter the technology or the choices that were made during development and implementation. In the case study of the firefighters, the balance between privacy and health was only reached because the researchers were able to use input from actual use, thereby improving the application of the core thermometer in the workplace, which consequently benefits the firefighters' health.

8.5.2 | Prevention of out-of-context generalization

A responsible decision to provide workers with sensor technologies to sustain their employability requires careful analysis of the values at stake (ten Have, van der Heide, Mackenbach, & de Beaufort, 2013) in the context of the specific workplace and the individual worker. The case studies showed that generalized ideas of privacy and autonomy were insufficient because these generalized ideas did not answer contextualized questions specific to the work environment. In contrast, concepts that guide reflection towards identifying what is at stake in a specific context are more helpful. Both the agency-based model of privacy (Manson & O'Neill, 2007) and the notion of conscientious autonomy (Kukla, 2005) provide a framework of what is at stake in a specific context. The cases of the firefighters and the healthcare professionals are illustrations of how these concepts help to identify bottlenecks, implicit norms, and courses of action. These examples are a source of moral knowledge, given that the experiences in the field informed the researchers about what users' value and the dynamics between the engineer, employer, and user were explored by testing the conceptualization of ethical principles in the work environment and further adjusted as deemed necessary.

In case of privacy, the GDPR offers a basic framework for the implementation of protection measures, while it also leaves room for interpretation and discussion. The GDPR (2016) obligates and ensures that the decisions regarding data protection taken by the controller, for instance an engineer or a researcher, are taken with great care, especially when *"processing of the data could result in high risk to the rights and freedoms of natural persons"* (GDPR, 2016, sec. 35 (3)). In order to help the controller, make responsible decisions regarding privacy of individuals, the data protection impact assessment (DPIA) (Bieker, Friedewald, Hansen, Obersteller, & Rost, 2016) is developed as a risk assessment method. This includes a multiple stakeholder approach during which privacy risks are identified. During meetings with stakeholders, a context-specific method of privacy by design is applied to design protection measures that are appropriate for a specific context.

Similar to the DPIA, the current study used a context-specific approach of ethics to assess privacy and autonomy concerns in the workplace. Both approaches are reiterative and need to be performed again when the context or risks change. Even though the DPIA builds upon the same principles as the context-specific approach of doing ethics, the DPIA's (and the GDPR's) main focus is to protect the privacy of the user without including other ethical issues in its analysis. Although it is a step in the right direction, in the development of new digital health technologies other values, such as health, autonomy and responsibility, and the interplay between these values need to be reflected upon as well.

8.5.3 | Making implied responsibilities explicit

The two core ethical concepts of privacy and autonomy contribute to identifying responsibilities. Both cases demonstrated that engineers and researchers of digital health technologies for the workplace must reflect explicitly on the critical ethical principles of what they design as well as the implications of these principles in implementation and use of the design. A commitment to ensuring privacy as described in the context of this multidisciplinary project gave the team the responsibility to design an agency-based handling of data.

Acting responsibly regarding health in the workplace is considered important (van Berkel et al., 2014) but employers experience difficulties taking their responsibility, and in the case of health promoting technologies in the workplace, other stakeholders find it difficult to share this responsibility. Leclercq-Vandelannoitte (2017), in a study about the use of ubiquitous technologies in the workplace, observed that "*despite their prevalence and the importance of their consequences for workers, neither salespeople nor managers seem to be aware of them, feel responsible for them, or appear able or willing to identify the responsibilities involved in this process*". In the case of workplace health promoting technologies, responsibility involves multiple stakeholders with a prominent role for the employers (Palm, 2009), engineers (Doorn, 2012) and researchers (Doorn & van de Poel, 2012; La Fors, Custers, & Keymolen, 2019). To protect the privacy of workers while gathering personal data, all stakeholders need to take their responsibility for the use of the involved technology (Johnson & Powers, 2005).

The engineers have the responsibility to design the technology in such a way that it guarantees the privacy of the user and supports the user in his/her ability to react autonomously (Robaey, Spruit, & van de Poel, 2018; van de Poel & Verbeek, 2006; Verbeek, 2011). However, engineers often do not offer sufficient insight into what constitutes a responsible use of their designs (Leclercq-Vandelannoitte, 2017). Technologies are never value neutral (Martin & Freeman, 2004), and it is important that researchers and engineers

explore how the development and implementation of their technologies influence and mould the ethical values such as privacy, but also the autonomy of employers and workers and help them reflect on this explorative process (Robaey et al., 2018; van de Poel & Verbeek, 2006; Verbeek, 2011). The responsibility of engineers and/or researchers should focus on perspectives such as value-sensitive design, critical technical practice, reflective design, and values in design (Cummings, 2006; Shilton, 2013).

The ethical responsibilities inherent to the designs should be identified and based on value-sensitive design, critical technical practice, reflective design, and values in design, and should always be included in designing and implementing technologies (Jing & Doorn, 2019). However, ethical concerns arise as soon as technological innovations are introduced into the workplace (Martin & Freeman, 2004), and although an ethical script of an innovation shows what the default choices regarding privacy, responsibility and autonomy are. At the same time, the reaction of the environment on this built-in ethical script plays a significant role. The ethical script is mainly developed by the engineers and researchers who develop the technological intervention, but the response of the employer on this ethical script largely determines the privacy of workers and their possibility to exercise autonomy in the workplace. The case studies thereby add an interesting view on the responsible research and innovation of health-related technologies to be used in the workplace and gives employers more hands-on advice on how to responsibly implement these technologies.

The reflection on the responsibility of workers and employers is not a one-time action. As stated before, differences in interpretations of responsibilities can cause significant problems between workers and employers (van Berkel et al., 2014), and the use of technology often alters the original function (Kiran, 2012). When using new technologies, workers and employers should discuss the responsibilities and intended actions of these technologies with the designers. This discussion should also entail the continuous reflection of the employer, to determine whether the conscientious autonomy of the worker has improved: In the case of the healthcare professionals, sensor technologies enabled workers to take responsibility to target work-related health parameters within the workplace. In general, however, these technologies are most effective when workers feel autonomous to self-regulate health-relevant actions (Bonvanie et al., 2020). Thus, employers should be alert for non-intended effects of sensor technologies and ensure an environment that facilitates workers to take their responsibility. When workers and employers share values, such as health, technologies that support the workers' personal goals could increase a sense of conscientious autonomy, thereby improving the self-regulation of healthy behaviour.

8.5.4 | Call for an adaptive tool

Laws and regulations aim to offer protection to users of new technologies, but tend to focus on data access and privacy, thereby leaving out other values, such as responsibility and autonomy, that are in close interplay with privacy (GDPR, 2016). It is therefore important that engineers and researchers themselves consider how the design and implementation of their technologies influence and mould the values of the users and adapt their technologies, to protect the user from harm, but also to increase the acceptance. Multiple tools are available, but there is a need for a practical tool that is formed by looking at the various practices in which one can involve all those stakeholders and learn from those lessons instead of having to keep reinventing the wheel. An adaptive tool which helps guide them in the assessment of the interplay between values inherent in the design and implementation of new technologies are lacking. This tool must automatically lead to the information you need in your own deliberation process. In order to be able to develop this adaptive tool or guideline, more multidisciplinary teams involved in innovation practices should publish their way of doing ethics (Fisher et al., 2015).

8.6 | Conclusions

This study aimed to create more awareness of the importance of context-specific ethics in design and implementation of digital health technologies. Focusing on a contextual conceptualization of the core ethical principles in the design and implementation of digital health technologies helps to avoid compartmentalization, out-of-context generalization, and neglect of identifying responsibilities. Although it is a long reiterative process in which all stakeholders need to be included in order to assess all critical ethical issues sufficiently, this process is crucial for achieving the intended goal of a technology. There is a need for a practical and adaptive tool or guideline that helps engineers, researchers and other stakeholders to address these ethical issues. This study contributes to the development of such a tool by giving an elaborate description of our approach and techniques, but is not directly applicable to similar projects. Such an adaptive tool, however, can only be developed if multiple research teams describe and publish their approaches and techniques used to solve their ethical issues.

Acknowledgments

We would like to thank prof. dr. Sandra Brouwer, prof. dr. Ute Bültmann, prof. dr. Monicque Lorist, prof. dr. Michiel Reneman, prof. dr. ir. Bart Verkerke, prof. dr. ir. Hans Wortmann and Leonie Oosterhuis M.Sc. for their support and input during this study.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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