



Values that Matter: Mediation theory and Design for Values

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Philosophy of technology could bring new insights when applied to design practice. This paper brings together mediation theory and design for values. We present a new design for values methodology: Values that Matter. Via the four phases; explore, conceptualise, anticipate and test, VtM allows for anticipating value dynamics. It starts with the assumption that value expression and definition arise in the interplay between users and technology. An extensive mediation analysis then helps to provide insight in and allows for anticipation on potential effects of technology on users and value dynamics, something that current value sensitive design approaches cannot deliver. Those insights are tested with involved actors to bring about best values by design. VtM has been applied to the case study of ViSi Mobile, a medical device developed for continuous monitoring of vital signs in hospitalised patients. A redesign was proposed that better empowers these patients.

Keywords: Values that Matter, Design for Values, Design for Value Change, Mediation Theory, Responsible Design

Introduction

How to integrate ethics in design practices? Among the various approaches that have been developed at the interface of the ethics of technology and design research, the approach of Value Sensitive Design (VSD) (Friedman, 1996) emerged as a key. The main focus of this approach is the identification of the values that are at stake in relation to concrete technological innovations, in order to take these into account in design practices and to concretise these in a material design. Values refer to what a person or people consider important in life (Friedman, Kahn & Borning, 2006). Or, as described in more detail by Van de Poel and Royakkers: “lasting convictions or matters that people feel should be strived for in general and not just for themselves to be able to lead a good life or realize a good society” (Van de Poel & Royakker, 2011, p.72).

VSD’s methodology is threefold. First, the ‘conceptualise’ phase aims at identifying and ordering all values at stake. Consequently, ‘empirical investigations’ is for studying the ideas of stakeholders on values. Finally, existing technologies and their embodied values are studied as part of the ‘technical investigations’ followed by the design of the new product. One of the standard examples in the field – in which this methodology actually pioneered – is the development of interfaces to fine-tune the cookie settings of web browsers, integrating the value of privacy in the actual design of information technology (Friedman, Kahn & Borning, 2006).

VSD lacks a clear methodological framework despite the fact that it has been frequently used (Winkler & Spiekermann, 2018). VSD falls short especially with respect to its understanding and use of values. Namely,



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VSD “seems to assume that values remain stable during adoption and use” (Van de Poel, 2018). We believe, however, that values only arise in the interplay between users and technologies and are far from stable. It is therefore impossible to design for values without considering the interaction between technology, users and resulting values.

Technologies are not neutral tools. They help to shape the behaviour, experiences and even frameworks of interpretations of their users: a smartphone is not just a tool to make phone calls and exchange information, but also has important implications for people’s attention and concentration, the character of friendships, the ways in which people listen to music and watch movies, et cetera (Verbeek, 2010). Users’ perception, behaviour and resulting values are not stable properties, but artefacts of the technologies used. Designing for values should, therefore, anticipate the user-technology-value dynamics.

We take the ‘safe cigarette’ as an example. The safe cigarette was an initiative of the American National Cancer Institute in the 1970s. By embodying ‘health’, as a value with stable properties, in the design of a cigarette, the institute developed a cigarette with a better filter containing lower levels of nicotine with the aim to decrease nicotine intake and a better health of the smoker (Warner & Slade, 1992). Yet, after introduction to the market, the nicotine intake of cigarette users only increased (Nakazawa, Shigeta & Ozasa, 2004). As smokers were so used to their normal levels of nicotine, the safe cigarette created unconscious behaviour changes; smokers smoked more often, inhaled deeper and broke off filters to be satisfied in their daily doses of nicotine. So, instead of positively influencing the health of people, the safe cigarette negatively affected it.

This example shows that designing for values as stable properties instead of anticipating the influence of technology on user behaviour and values could end in designs ‘biting back’; resulting in other and even opposite effects from the ones inscribed (Tenner, 1997). We can identify two types of value dynamics. First, there is a dynamic in value expression. The way in which technology affects a value depends on users’ perception and behaviour as a result of the technology. In the example, the value of health is not improved but threatened due to users’ behaviour changes. Second, there is a dynamic in value definition. The definition of a value is subject to the technologies that embody and express the value. With respect to the example, embodying ‘health’ in a ‘safe’ cigarette creates a shift from ‘healthy equals non-smoking’ towards ‘healthy equals safe cigarettes’. This change in value definition results in undesired behaviour. A major question then concerns how one can design for values when the content of what constitutes the values is subject to the design itself?

In summarising, we believe that VSD fails to adequately design for values as it considers values as stable properties instead of products of user-technology interactions. The user-technology interactions create two types of value dynamics: dynamics in value expression and value definition. This paper aims to go beyond the Value Sensitive Design approach, on the basis of the perspective of the philosophy of human-technology relations, and more specifically, from the approach of ‘technological mediation’. This approach analyses technologies as ‘mediators’ between users and their environment (Verbeek, 2010). From this perspective, the ambition to design values ‘into’ technologies needs to take into account that these technologies will always have mediating effects, by reorganising the behaviour and experiences of users, and sometimes even by affecting the value frameworks from which they can be evaluated.

We will report here an approach to ‘design for values’. It takes the phenomenon of technological mediation as the starting point to anticipate the effects of design on value expression and definition. First, we introduce the approach of technological mediation. Thereafter we propose the design methodology ‘Values that Matter’ (VtM). This four-phased methodology; explore, conceptualise, anticipate, test, provides a responsible way to design for values and value change. To illustrate the methodology, VtM is brought into practice with a case study of a medical wearable wrist device used to continuously measure vital signs of patients in the hospital; ViSi Mobile (VM) (Sotera Wireless, CA, USA). We will study the mediating effects of ViSi Mobile and propose an alternative design that better takes into account value dynamics.

Mediation theory

The approach of technological mediation is built on the idea that technologies are not neutral. Humans shape technologies and become simultaneously shaped by them. The mediation approach originates from the postphenomenological work of the North-American philosopher Don Ihde (Ihde, 1993). Postphenomenology studies the relations between humans and technologies and the implications technologies have for human

practices and perceptions (Rosenberger & Verbeek, 2015). Rather than being ‘objects’ opposed to human ‘subjects’, technologies should be seen as ‘mediators’ between human subjects and the world: when technologies are used, they help to establish relations between the person using the technology and her or his environment. For example, cars do not just move people from one place to another but give them a different experience of the world than when they would walk or ride a bike. A car, for example, may provide individuals with the value of autonomy as it opens up a new world unable to be reached before. Likewise, diagnostic devices in healthcare do not only help doctors to obtain a diagnosis but also greatly affect the value of responsibility, as it takes along new ones (Verbeek, 2008).

Technological mediation typically has two dimensions (Verbeek, 2010). There is first the ‘hermeneutic’ dimension, related to the impact of technology on perception and interpretation. Technologies can here amplify or reduce the perception of certain elements of the world. The other dimension of technological mediation is the ‘existential’ one. It focuses on how technologies help to shape actions and social practices. Technologies thereby can invite for or inhibit certain behaviour. MRI imaging is a good example of both types of mediation. Hermeneutically, MRI scanners help neuroscientists to understand the brain and to develop ideas about the human mind and human behaviour in relation to the brain, which also results in new societal frameworks of interpretation, like the idea that ‘we are our brains’. At the same time, existentially, these scanners reorganise the actions of doctors and the interactions between doctors and patients, while also changing social practices, like marketing (‘neuromarketing’) and psychiatric care (‘neuropsychiatry’) (De Boer, Te Molder, & Verbeek, 2018).

A special category of mediations is the mediation of moral frameworks. Interestingly, technologies cannot only be evaluated ethically but also have an impact on the ethical frameworks for evaluating the technologies. An example is the birth control pill. While being a product of the sexual revolution, it also helped to shape that same revolution. By loosening the connection between sex and reproduction, the birth control pill has shifted normative frameworks regarding sexuality: what counts as ‘normal’ takes on a different meaning. An interesting example of this moral mediation is the impact of the birth control pill on the acceptance of homosexuality. As Mol has shown, the disconnection between sex and reproduction also resolved an often-used argument against homosexuality: the argument that it was unnatural to have sex with somebody of the same sex, since this sexual relation cannot result in reproduction (Mol, 1997). Since the introduction of the birth control pill, the norm that sex is connected to reproduction has lost its self-evident validity.

A more recent example of this moral mediation, which has been studied empirically, is the impact of Google Glass on definitions of the value of privacy. By analysing how people discussed Google Glass online, in comments on YouTube videos of Glass users, it appeared to be possible to investigate how the value of privacy gets redefined when people apply it to a new technology (Kudina & Verbeek, 2019). Technology and morality are intricately connected. This gives an extra dimension to the ethics of technology since it implies that the ethical frameworks with which we evaluate technologies are themselves co-shaped by these technologies.

Mediation theory provides a clear framework for understanding value dynamics; the impact of user-technology interaction on value expression and value definition. Therefore, it could help a design for values methodology to anticipate in a structured way the effects that design will bring about. Only a few other authors have introduced mediation to design (Swierstra & Waelbers, 2012; Verbeek, 2013), but none have proposed a way to do this systematically. We present a design methodology based on the approach of technological mediation and aiming to anticipate technological mediations of interpretations and actions at the individual and social level, as well as the technological mediation of normative frameworks. This methodology is called Values that Matter.

Values that Matter

The design for values methodology Values that Matter aims at developing designs that embody and anticipate important values. Its name is twofold. First, it refers to the important contribution of values to life. Second, it stresses the context-dependence of values as the type of values result and depend on user-technology interactions. The methodology consists of four phases, shown in figure 1. It starts with the exploration phase in which the important actors and values become identified. Based on that, the conceptualisation phase aims to develop a concept that does justice to the identified values for the identified actors. These two phases are quite similar to the VSD methodology. It is in the anticipation phase when value dynamics comes to play a role and where the difference starts with VSD. This phase aims, via mediation theory, to provide an anticipatory understanding of the interplay between users, technologies and values before actually implementing a

technology. The testing phase allows for testing actual mediations and value conflicts as an input for conceptualisation and helps understanding how the anticipated values become appreciated subjectively in real life. Together with the previous two phases, conceptualise and anticipate, this phase allows for multiple iterations to optimally improve values by design. All four phases and their intermediate steps are illustrated in detail.

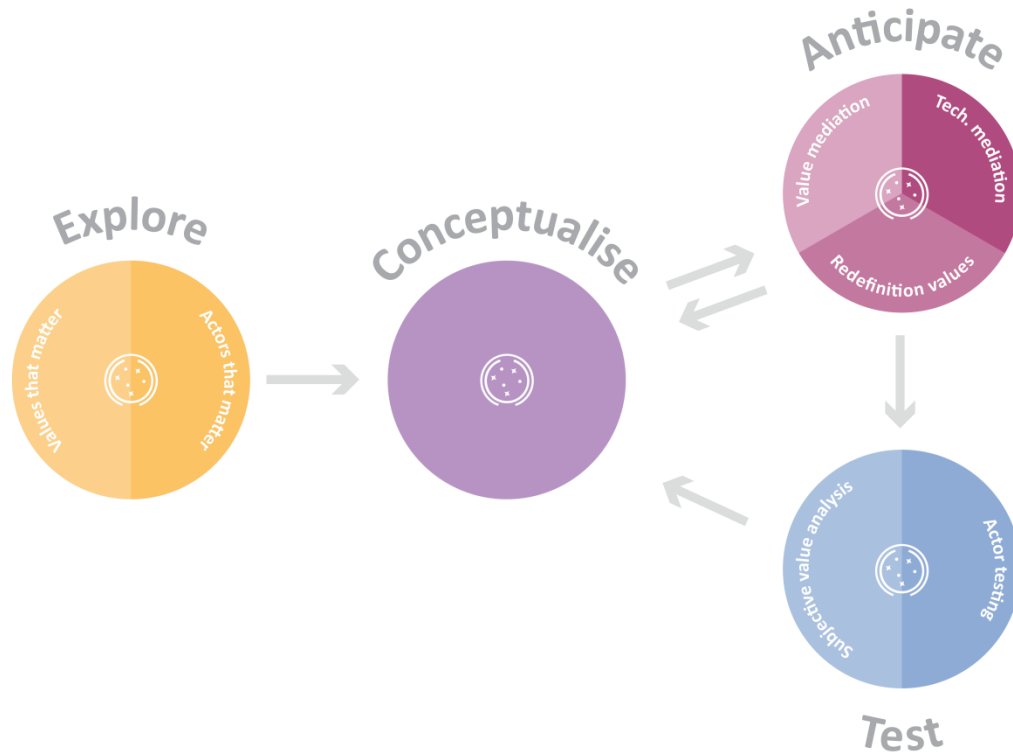


Figure 1. Framework Values that Matter

Explore

The exploration phase is for mapping out the context of the design problem. In this context, we focus on two important elements: actors and values.

Actors that matter

At first, the design team needs to identify all actors, (groups of) individuals, of importance in the design problem. Those actors need to be involved in one way or another with the design problem and will be in (in)direct interaction with the future design solution. Identification of actors could be facilitated by means of literature studies on the context of the design problem and interviews with certain actors to identify potential others.

Values that matter

Each actor has a different relationship to the design problem, resulting in different preferences, needs and values. The design team should identify per actor which values are important and to what extent. Some values might be important for all actors, whilst others could matter for just one. To understand which values matter and to define a hierarchy in values, the design team should first turn to the actors themselves by means of qualitative analyses (e.g. interviews, diaries, questionnaires...). Yet, actors reason from their current context. As values arise from the interplay between users and technologies, a new technology might change the context and introduce new values. Only the designer is able to anticipate these additional values. Brainstorming about values, literature reviews on the design problem and reviews of similar existing design solutions could help the designer to identify the additional values.

Conceptualise

The identified actors and belonging values together form the preliminary value framework. The design team starts ideation just after finishing this framework. This process of ideation should result in a concept. A concept can be anything from an abstract idea to a fully developed prototype. By means of iterations with the following phases, the concept will be developed every time with more detail up until its script solves the design problem whilst simultaneously embodying the important values for the different actors. As value conflicts could arise within a concept, the defined value hierarchy could help in decision making.

Anticipate

The anticipate phase aims via an anticipatory technology assessment at understanding the effects of the concept on value dynamics within the earlier defined value framework. Mediation theory provides the knowledge to do so. The anticipate phase consists of three steps, each described below. This phase can be executed in a multidisciplinary team including a range of actors involved in the design problem, to gain the greatest understanding of all possible ways of mediation.

Technological mediation

It is in this step that the actual mediation analysis will be executed. To systematically assess the mediating effects of the concept on all involved actors, we propose to create an actor-matrix, shown in figure 2. An actor-matrix is a matrix that lists all involved actors in both the first column and first row. This will result in a matrix with two types of crossings: a crossing between the same actor and a crossing between two different actors. All crossings of the first require an 'individual mediation' analysis. All crossings of the latter require a 'mediation of relations' analysis.

Mediation of individual: in the individual mediation analysis, the design team studies how the human-technology relationship between the actor and the concept forms the perception and actions of the actor. Mediation of perception entails the effect of the concept on the way the actor perceives himself and the way he perceives the world around him. Mediation of action entails the effect of the concept on the actions of this actor.

Mediation of relations: apart from individual perception and action, a technological concept affects the relationships between different actors. The design team should identify what kind of relationship the concept constitutes between the two actors. This should always be seen from the perspective of the actor on the left towards the actor on the right, as the relationship might be differently seen from the opposite perspective. A concept might influence how one actor perceives another actor and acts towards this other actor.

This systematic mediation analysis helps to gain a deep understanding of all the potential mediating effects of the developed concept on the different involved actors and relationships between those actors.

	Actor 1	Actor 2	Actor n...
Actor 1	Human-technology relationship <i>Mediation of perception and action towards the self and the world</i>	Human-technology-human relationship <i>Mediation of perception and action towards the other</i>	Human-technology-human relationship <i>Mediation of perception and action towards the other</i>
Actor 2	Human-technology-human relationship <i>Mediation of perception and action towards the other</i>	Human-technology relationship <i>Mediation of perception and action towards the self and the world</i>	Human-technology-human relationship <i>Mediation of perception and action towards the other</i>
Actor n...	Human-technology-human relationship <i>Mediation of perception and action towards the other</i>	Human-technology-human relationship <i>Mediation of perception and action towards the other</i>	Human-technology relationship <i>Mediation of perception and action towards the self and the world</i>

Figure 2. Actor-matrix for the Values that Matter methodology

Redefinition values that matter

A preliminary list of values that mattered per actor is developed during the exploration phase. Those values matter in the context of the design problem. When a concept becomes introduced to solve the design problem, it does not leave the list of values unaffected. The design team should, therefore, redefine their value framework. The mediation analysis is of help here. Some of the earlier defined values that were considered important might disappear, as the concept does not affect those values. New values might be added that become affected by the solution. For each value that disappears during redefinition, the design team should ask the key question: Does this matter? The answer to the question depends on the relevance of the value and the corresponding actor. When an important value has been lost, the design team should return to the conceptualise phase and reconceptualise their concept so that it will after all again embody the lost value.

Mediation of values

On the basis of the mediation analysis and the redefined list of values, the design team can now start the mediation of values analysis. They identify the effects of their concept on the different values that matter. Each identified value could get one of three labels: 'threaten', 'enhance' and 'transform' (Manders-Huits & Zimmer, 2009). A value gains the label threaten when it becomes affected negatively by the concept. A value with the label enhance will, on the contrary, become improved by the concept. Finally, the label transform is left. When a value gets this label, we deal with the mediation of moral frameworks. The concept then changes the content of what constitutes the value. Value transformations are not by default burdensome. Designers could even decide to consciously design for positive value transformations; design for value change.

After the value mediation analysis, the design team analyses their concept. How many values does it affect negatively (values labelled as 'threaten' or 'undesired transformation') and to whom do those values belong? Are there conflicting values? Are there values that cannot be given a label, as it is still unknown which type of technological mediation will be dominant? Based on the questions, the design team can either decide to return to the conceptualise phase or proceed to the test phase. Considering the first, they should redesign the source of the concept that creates the shortcomings of the design. Considering the latter, the design team can test with the actors questions brought up by the mediation analysis.

Test

In the previous phases, a concept has been developed that embodies an anticipated set of values. This phase is for testing the anticipated technological mediation. The design team should have clear questions at the start. Those could include which type of technological mediation will become dominant or how to deal with value conflicts. Moreover, it allows for studying how the anticipated set of values is actually experienced subjectively by the different actors.

Actor testing

The design team should bring their concept to the different actors and study its mediation. Via qualitative studies as, for example, interviews, observations or diaries, they can gain an idea about the real technological mediation of the concept, actors' appreciations of certain values over others or the effect of the concept on the values that matter.

Subjective value analysis

The study results of the previous step should now be analysed to answer all questions defined upfront. Answers to questions on most common type of mediation or value conflicts provide input for reconceptualisation. Answers to actors' experienced value mediation should be studied. Is the concept ready to be implemented in society or do actors experience a threat to the identified values? For each threatened value, there is an imbalance between the anticipated effect on values and the subjectively experienced effect on values. Designers should aim to find the best balance between 'what we think is good for the actor' and 'what the actor thinks is good for him'. When they conclude a value is threatened, the team should again identify the source of the concept causing the threat as input for reconceptualisation. The result of a few of those iterations between conceptualise, anticipate and test is a product that optimally improves both anticipated and subjective experienced values.

Case study: ViSi Mobile

As VtM makes the greatest difference in its anticipation phase, we will illustrate this phase by means of a case study. The case study comprises the medical device ViSi Mobile, shown in figure 3. ViSi Mobile is a wearable device that continuously measures five vital signs of hospitalised patients: arterial blood pressure, heart rate, respiration rate, oxygen saturation, and skin temperature. All data are displayed on a module on the wrist of the patient and sent to an external computer. A computer algorithm converts the vital signs into a Vital Risk Score (VRS). This score reflects the physiological state of a patient and is used as a warning for clinical deterioration. When the score is above certain predefined settings the medical staff is alarmed for extra checking on the patient (Sotera Wireless, 2018).

ViSi Mobile could create a paradigm shift in the wards of hospitals. Traditionally, nurses have to collect the vital signs of patients manually, three times a day. It takes approximately six minutes to measure, via several devices, the necessary data of a patient, write it down and insert the data in the electronic health record system. Nurses taking vitals may be less reliable and is subject to inter-observer variability. Furthermore, the large gap of eight hours between two subsequent manual measurements could result in missing data relevant for patient's care. ViSi Mobile is able to overcome these drawbacks and moreover can provide a detailed insight into the data of a patient with potential for prediction and prevention of disease course. Apart from a few minor and solvable technological problems such as a fast decay of its batteries, false-positive alarms and lost contacts between skin and sensors, ViSi Mobile has been reported a promising new device in hospital care (Weenk et al., 2017).

ViSi Mobile has been developed by the American company Sotera Wireless. In 2017, the Radboud University Medical Center in Nijmegen started a pilot study with the device to assess its potential in improving healthcare. The pilot study involved 60 patients at the internal medicine and surgery wards and showed the superiority of the device in measuring patients' vital signs in comparison to daily measurements of nurses (Weenk, Koeneman, et al., 2019).

In this setting, we studied the potential mediating effects of ViSi Mobile on their carriers: the patients. Via our Values that Matter methodology we aimed at finding mediating effects of ViSi Mobile, the potential for improvement and recommendations on actual implementation. First, we studied the mediating effects of ViSi Mobile without involving any actors. Consequently, mediating effects were discussed with patients wearing ViSi Mobile and with hospital staff. Moreover, mediating effects were derived from a first set of semi-structured interviews with 60 patients, 20 nurses, 3 physician assistances and 6 medical doctors on the positive and negative effects and perceived facilitators and barriers of the device (Weenk, Bredie, et al., 2019). We illustrate only the mediating effects of ViSi Mobile on the perception, action and values of patients that we anticipated and were simultaneously confirmed by the different actors themselves. We end with a few recommendations for the hospital on improving ViSi Mobile's design and way of implementation.



Figure 3. ViSi Mobile

Anticipate – technological mediation

Mediation of individual

Each patient is unique. Consequently, there is not one type of technological mediation. Below, we present potential mediating effects of ViSi Mobile that different types of patients can and have experienced. First, with respect to mediation towards the self, ViSi Mobile might affect patients' ideas of health. For patients, health is something intangible; invisible for the human eye, including mostly subjective feelings about one's own body. ViSi Mobile renders visible health. It quantifies health into a set of always the same objective qualities such as blood pressure, respiration rate and heart rate. ViSi Mobile is a material translation and construction of reality. Using ViSi Mobile changes patients' intentionality into a combination of original subjective feelings over own body with quantifiable data perceived on a screen.

This could have both positive and negative effects on the perceptions and actions of a patient. When patients feel similar as the device tells them they feel, patients could experience the same positive feelings as the reasons people have for using self-tracking devices at home (Gimpel & Nißen, 2013). ViSi Mobile could first provide self-entertainment: the enjoyment of data collection of own body. Second, it could contribute to self-association, in which ViSi Mobile provides the tools to understand the self in relation to others. Third, self-design might become affected. In that, patients can optimise their own bodies. It furthermore creates a ground for self-discipline: having a sense of purpose and motivation. Finally, it allows for self-healing: becoming more independent from regular healthcare, being able to leave their bed and walk around.

Yet, when the feelings of patients do not match with the data ViSi Mobile displays, which is when one feels bad or good and the data tells otherwise or when patients detect fluctuations in ViSi Mobile's data but do not understand those, ViSi Mobile mediates patients negatively. This mismatch between feelings and data could reintroduce Descartes' notorious mind-body dualism in which feelings are mind and data of ViSi Mobile body. Patients could then start to either lose trust in the data or in own feelings. In the first situation, patients could distrust ViSi Mobile and maybe even the surrounding healthcare of the hospital. In the second situation, patients could lose self-consciousness and self-confidence. They might feel anxious and suffer from feelings of alienation from themselves.

Apart from mediation towards the self, ViSi Mobile affects patients' perceptions and actions towards the world. The idea of continuous monitoring could, on the one hand, might make patients feel safe, being observed and looked after for. On the other hand, it might make patients feel exposed and objectified as a study object: unable to hide or simply opt-out.

Mediation of relations

ViSi Mobile does not only affect the patient as an individual but mediates the relationships between patients and other actors. Although many relationships between actors become affected by ViSi Mobile, we will here only consider the mediating effect of ViSi Mobile on the relationship between the patient and the nurse, seen from the perspective of the patient, summarised in the actor-matrix shown in figure 4. Due to ViSi Mobile, the patient might either see the nurse more or less often, depending on the behaviour of the nurse. ViSi Mobile provides nurses with time by replacing the time-consuming manual measurements. Nurses can now either decide to spend this gained time on socially interacting with the patient or on spending this time on other tasks. The first may lead to increased and possibly better patient-nurse contacts. This could result in an improved relationship with the nurse, feelings of trust, safety and being cared for. The latter would lead to decreased patient-nurse contacts. This might negatively affect patients' experiences. The relationship with the nurse might deteriorate, patients might feel alienated by hospital personnel, stressed for not knowing whether they are actually monitored or could experience feelings of exposure to an unknown monitoring 'eye'.

	Patient	Nurse
Patient	<p>Patient - ViSi Mobile relationship</p> <p><i>Patients might enjoy self-entertainment, self-association, self-design, self-discipline and self-healing.</i></p> <p><i>Patients might distrust VM's data or own feelings. They can lose self-consciousness and self-confidence.</i></p> <p><i>Patients might feel safe.</i></p> <p><i>Patients might feel exposed and objectified.</i></p>	<p>Patient - ViSi Mobile - Nurse relationship</p> <p><i>Patients might see nurses more often. This might result in feelings of trust and safety.</i></p> <p><i>Patients might see nurses less often. This might result in stress and feelings of alienation.</i></p>
Nurse		

Figure 4. A segment of the actor-matrix of ViSi Mobile

Anticipate – redefinition values that matter & mediation of values

Several values seem to become affected by ViSi Mobile based on the previous short mediation analysis. A selection of those values includes autonomy, bodily health, relations, bodily integrity, purpose, identity, safety and privacy. We report here the first three as these provide the opportunity for improving the design and implementation of the device.

At first glance, autonomy could be labelled 'enhanced', as ViSi Mobile seems to provide patients with the autonomy to look after their own health, understand own health and act based on that knowledge independently from the hospital staff. Yet, this label is debatable for two reasons. First, it requires that patients can interpret the displayed data and the meaning for healthier behaviour. However, from conversations with patients, we often found the opposite. Patients did not understand ViSi Mobile's data and when they did, they did not know how to act. Instead of enhancement, autonomy then may become threatened. Second, where patients gain autonomy in relation to the hospital personnel, they lose autonomy with regards to the medical device itself. Namely, ViSi Mobile takes away the autonomy to define health.

Bodily health is labelled 'transformed', as ViSi Mobile changes patient's definition of health from current and past subjective feelings into objective, current data only. ViSi Mobile excludes from the definition of health feelings and past healthcare records. This value transformation is burdensome as it might make patients feel confused, anxious and stressed, unable to relate their feelings to their bodily data.

Finally, with respect to the value relations, the relationship between patient and nurse becomes affected by the way ViSi Mobile is implemented in the care path. When the implementation of ViSi Mobile results in fewer visits of nurses, the value becomes threatened. Meanwhile, when nurses come by more often, the value will be enhanced.

Reconceptualise

Although ViSi Mobile provides benefits for the hospital, there are opportunities for improvement of the design and recommendations for implementation when the device is adopted on a larger scale. Some are discussed.

The device could benefit from a redesign with respect to the values of autonomy and bodily health. Those become negatively affected by the design of the display of ViSi Mobile on the wrist of patients. This display shows the data that can cause confusion by the patient. A redesign could target this display to improve both values. First, ViSi Mobile can help patients with the ability to be independent, converting the negative label of autonomy into a positive. Such may be done by providing patients with healthcare advice. On the basis of the physiological data of a patient, ViSi Mobile could provide this patient with tangible advice via pop-up notes on its display. For example, ViSi Mobile senses that the heart rate of a patient increases. The patient could be stressed. ViSi Mobile could advise him to find relaxation. Likewise, a patient with a low oxygen saturation could receive the advice to sit in bed and do breathing exercises. As well, when ViSi Mobile senses that a patient has not moved during the day, a pop-up note could recommend making a walk. These tangible goals allow patients to actually use ViSi Mobile's data to become autonomous by understanding how to independently improve their health.

To prevent the negative transformation of the concept of bodily health, ViSi Mobile should take into consideration the feelings of a patient and her or his healthcare records. It should include first the feelings of a patient, for example by allowing patients to report on their subjective well-being via pop-up notes. Furthermore, ViSi Mobile should provide patients with the opportunity to see their past healthcare records by, for example, entering a new screen on its display.

Finally, the double-sided mediating effect of ViSi Mobile on patient-nurse interactions shows the importance of involving nurses during the implementation of the technical device. Fostering close nurse-patient contacts would warrant for positive effects on their relations. With a few of those changes to the design and way of implementation of ViSi Mobile, the device will improve the values that matter and be able to positively reshape healthcare for both hospital staff and patients.

Discussion and conclusion

In this paper, we have developed Values that Matter, a design for values methodology inspired by the philosophy of technology. Value sensitive design approaches do, in their methodology, not greatly differ from more traditional design approaches. When we take, for example, the often used Double Diamond Model, it includes the phases discover, define, develop and deliver (Design Council, 2007) and follows thereby, just like any design methodology, a process with iterations between analysis, idea generation, prototyping, testing and implementation. The main difference between traditional design approaches and value sensitive design approaches lies in the focus on creating value for the company over creating –literally- value for the user. Yet, VtM is not like any other design approach. The main difference with other design (for values) methodologies, is the anticipatory approach and, in particular with respect to VSD, its understanding of values as a result of the interplay between users and technologies. The methodology of VtM is built around the ‘anticipate’ phase that makes the methodology unique. Other design methodologies could benefit from adopting such a phase to understand and anticipate design’s effects in the real world.

As such an anticipatory phase requires guidance, VtM aims to provide this methodological guidance by proposing the phases ‘explore’, ‘conceptualise’ and ‘test’. To optimally contribute to the ‘anticipate’ phase, all phases require follow-up research.

First and foremost, with respect to the exploration phase, questions still need to be answered concerning the actors and values. For example, what range of actors should become involved? Apart from actors present during the use of a design, should actors involved in the production and recycling of it be taken into consideration as well? And in case of conflicts, can certain actors become prioritised over others, and, when possible, is that ethical? Furthermore, with respect to values, is it possible to create a list of all potential values that could become embodied by design? What qualifies as a value? Are there values that matter in each situation compared to values that only matter in particular situations? And is it then possible to make a universal ranking of values, and if not, how to facilitate value ranking per context to solve conflicts in values?

Second, the conceptualisation phase needs a clear methodology. How to actually translate values into design requirements and embody values in design? Third, with respect to the anticipation phase itself, follow-up research should define this phase’s ability to guide each designer through the anticipating process. Is more guidance, for example, necessary with respect to what type of mediation is studied? The case study showed it might be necessary to demarcate between the mediation of different personas within the same actor (each patient is unique) and different periods of time over the adoption of a technology. Finally, with respect to the testing phase, a more detailed understanding is essential in the balance between the ‘objective’ anticipated and the subjective experienced values. Actors are not always aware of what (value) is best for them and might need little anticipated help of designers. Yet, that could result in conflicts between ‘what we think is good for you’ and ‘what you think is good for you’. When that leads to actors unwilling to use products, even though they are good for them, the products are useless. A detailed understanding is therefore necessary in how to deal with those situations.

VtM has been applied to the case study of ViSi Mobile. We have only studied the ‘anticipate’ phase and involved only a few actors in the process. The case study has nevertheless shown the potential of VtM to identify recommendations for design and implementation. When we would have used the traditional Value Sensitive Design approach, we would not have been able to identify the great range of value dynamics resulting from the mediation of ViSi Mobile. We would first not have been able to identify the different anticipated ways of value expression of ‘autonomy’ and ‘relations’. Moreover, we would not have been able to

understand the change in the definition of 'health'. The used case confirms the applicability of the methodology and shows the necessity to proceed in the future with testing the entire design methodology, in greater collaboration with real design processes, companies and actors.

We have done a first attempt to provide a systematic philosophical framework for designing and anticipating value dynamics and piloted this in a relevant new technology for in hospital patient care. The preliminary results encourage the use of VtM to design more responsibly for values and even the potential to consciously design for positive value change.

References

- Achterhuis, H. (1995). De moralisering van apparaten. *S&D*, 1, 3-11.
- De Boer, B., Te Molder, H., & Verbeek, P.-P. (2018). The Perspective of the Instruments: Mediating Collectivity. *Foundations of Science*, 23(4), 739-755.
- Design Council. (2007). *A study of the design process. Eleven lessons: managing design in eleven global brands*. London: Design Council.
- Friedman, B. (1996). Value Sensitive Design. *Interactions*, 3(6), 16-23.
- Friedman, B., Kahn, P. H., & Borning, A. (2006). Value Sensitive Design and Information Systems. In P. Zhang & D. Galletta (Eds.), *Human-Computer Interaction in Management Information Systems: Foundations*. New York: M.E. Sharpe.
- Gimpel, H., & Nißen, M. (2013). *Quantifying the Quantified Self: A Study on the Motivation of Patients to Track Their Own Health*. Paper presented at the Thirty Fourth International Conference on Information Systems, Milan.
- Ihde, D. (1993). *Postphenomenology: Essays in the Postmodern Context*. Evanston: Northwestern University Press.
- Kudina, O., & Verbeek, P.-P. (2018). Ethics from Within: Google Glass, the Collingridge Dilemma, and the Mediated Value of Privacy. *Science, Technology, & Human Values* (Online First).
- Manders-Huits, N., & Zimmer, M. (2009). Values and pragmatic action: The challenges of introducing ethical intelligence in technical design communities. *International Review of Information Ethics*, 10(2), 37-45.
- Mol, Annemarie. 1997. *Wat is Kiezen? Een Empirisch-Filosofische Verkenning (Inaugural Lecture)*. Enschede: University of Twente.
- Nakazawa, A., Shigeta, M., & Ozasa, K. (2004). Smoking cigarettes of low nicotine yield does not reduce nicotine intake as expected: a study of nicotine dependency in Japanese males. *BMC Public Health*, 4(28), 1-9.
- Rosenberger, R., & Verbeek, P. -P. (2015). *Postphenomenological Investigations: Essays on Human–Technology Relation*. Lanham, MD: Lexington Books.
- SoteraWireless. (2018). ViSi Mobile. Retrieved from <http://www.soterawireless.com>.
- Swierstra, T., & Waelbers, K. (2012). Designing a Good Life: A Matrix for the Technological Mediation of Morality. *Sci Eng Ethics*, 2012(18), 157-172.
- Tenner, E. (1997). *Why Things Bite Back- Technology and the Revenge of Unintended Consequences*. New York: Random House.
- Van de Poel, I. (2018). Design for value change. *Ethics and Information Technology*, 1-5.
- Van de Poel, I., & Royakker, L. (2011). *Ethics, Technology and Engineering*. Oxford: Wiley-Blackwell.
- Verbeek, P. -P. (2008). Obstetric ultrasound and the technological mediation of morality: A postphenomenological analysis. *Human Studies*, 31(1), 11-26.
- Verbeek, P. -P. (2010). *What Things Do: Philosophical Reflections on Technology, Agency, and Design*. Pennsylvania: Pennsylvania State University Press.

- Verbeek, P. -P. (2013). Technology Design as Experimental Ethics. In S. Van den Burg & T. Swierstra (Eds.), *Ethics on the Laboratory Floor* (pp. 83-100). Basingstoke: Palgrave Maxmillan.
- Warner, K. E., & Slade, J. (1992). Low Tar, High Toll. *American Journal of Public Health*, 82(1), 17-18.
- Weenk, M., Bredie, S. J. H., Koeneman, M., Engelen, L. J. L. P. G., Van Goor, H., & Van de Belt, T. H. (2019). *Continuous monitoring of vital signs on the general ward using wearable devices: patients' and healthcare professionals' views*. Radboudumc: Nijmegen.
- Weenk, M., Koeneman, M., Van de Belt, T. H., Engelen, L. J. L. P. G., Van Goor, H., & Bredie, S. J. H. (2019). Wireless and continuous monitoring of vital signs in patients at the general ward. *Elsevier*, 136, 47-53.
- Weenk, M., Van Goor, H., Frietman, B., Engelen, L.J.L.P.G., Van Laarhoven, C. J. H. M., Smit, J., Bredie, S.J.H., Van de Belt, T. H. (2017). Continuous Monitoring of Vital Signs Using Wearable Devices on the General Ward: Pilot Study. *JMIR MHealth Uhealth*, 5(7), 1-14.
- Winkler, T., & Spiekermann, S. (2018). Twenty years of value sensitive design: a review of methodological practices in VSD projects. *Ethics and Information Technology*, 1-5.