

ARTICLE

Valuation in health and ageing innovation practices

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Abstract

In the development and deployment of health and ageing innovations, underlying values such as privacy or quality of life are often seen as a relatively stable starting point, if considered at all. However, values are neither stable nor singular. This paper introduces a valuation framework to explore the co-constitution of values and technological innovations. A careful and ongoing reflection on values and valuation, in particular in innovation practices targeted at older people, is crucial when aiming to increase sustainable innovations. Therefore, we include a Social Sciences and Humanities (SSH) perspective to technological development and innovation, to understand better the construction and co-constitution of ageing-in-place technologies. This framework is developed following a review of literature on values and valuation in the broad field of SSH. The proposed valuation framework consists of three core elements: (a) value multiplicity, (b) value dynamism, and (c) valuation implications. To demonstrate potential applicability of the framework, we conducted a thought experiment on values and valuation practices related to the development and potential further deployment of a COVID-19 health app in the Netherlands. This experiment pays special attention to multiple values at stake and implications for older adults who age in place. We argue this valuation framework provokes reflection on dynamic and multiple values underlying technology use and non-use, and contributes to responsible health and ageing innovations.

Keywords: valuation; health innovations; Science and Technology Studies; ageing in place; co-constitution

Introduction

Over the last decade or so, innovation policy has focused on and substantially funded new technologies designed specifically for older people. In Europe, large-scale funding programmes like the European Commission's Horizon 2020 or the Active and Assisted Living Programme (AAL) have developed technologies such as robots, active and passive monitoring devices, digital health apps, and others that are meant to support active and healthy ageing by enabling older people to remain living independently at home (*i.e.* ageing in place¹). These investments

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into ageing-in-place technologies have led to a wide range of prototypes, new businesses and large-scale piloting activities. They also increasingly receive criticism because of the often negative images of ageing and later life that they presuppose and promote, and because of their strongly instrumental view on the role of technology in the lives of older people (Mantovani and Turnheim, 2016; Neven and Peine, 2017). To address these issues, the Social Sciences and Humanities (SSH) – among them scholars from Age Studies and Gerontology – have received increasing attention as potentially relevant partners in the development of new ageing-in-place technologies.

Previous studies have already pointed out the risk that SSH researchers are instrumentalised in ageing-in-place technology projects, where they are often engaged in realising technology goals already set in funding programmes and innovation policy documents (Gallistl and Wanka, 2019), and to align stakeholders behind the idea that technologies are necessary and inevitable solutions to the problems of ageing (Neven and Peine, 2017). Various scholars therefore warn that social scientists should avoid their contribution being only a symbolic one (Viseu, 2015; Balmer *et al.*, 2016). In this paper, we engage with this ongoing discussion around the pitfalls and opportunities of SSH involvement in European old-age technology policy. We argue that recent empirical and theoretical work on the co-constitution of ageing and technology (Peine and Neven, *in press*) is particularly fruitful for SSH scholars working on ageing and later life to realise a critical mandate in technology projects – a mandate that moves from a mere ancillary function to a central role in reflecting upon and balancing relevant stakeholder positions, including those of older people. In our view, such a move is a necessary precondition for the development of technologies that suit the lives of older people, and thereby ultimately also for the success and scale of policies on ageing-in-place technologies.

To enable a better inclusion of an SSH perspective in the development of such technologies, that are often embedded in policy-driven innovation projects, we present a conceptual framework on value co-creation that we have developed in the context of the large-scale innovation pilot project GATEKEEPER. This pilot project deploys, tests and integrates different apps and technologies for ageing in place at a number of pilot sites across Europe.² To explore values, in particular how values come into being and interact in practice (*i.e.* valuation), we draw on the rich body of literature in the emerging field of valuation studies. Values can be found by looking at what gets valued and how, *i.e.* exploring what matters for actors involved (Doganova *et al.*, 2014). This goes beyond economic price or power, and contributes to the social ordering and reordering of ‘a variety of situations’ (Kjellberg and Mallard, 2013: 23).

While the focus on values is common and typical for SSH participation in ageing-in-place technology projects (Mantovani and Turnheim, 2016; Camp and Lorenzen-Huber, 2017), there is also a widespread belief that values, ultimately, can be reduced to an understanding of users and their needs as an *input* for the design of ageing-in-place technologies (Sixsmith, 2009; Peek *et al.*, 2016; Gwyther *et al.*, 2018; Gallistl and Wanka, 2019; Peine and Neven, 2019). This view overlooks the diversity and complex relationality of values in such diverse settings as private homes, neighbourhoods, Research and Development laboratories,

policy discourses, and so forth. In other words, in our approach, we explicitly distinguish values from needs, which are the common focus of user involvement in many innovation activities targeted at older people. Here, the rationale of capturing needs in innovation projects is that this enables the development of technically fitting innovations for the targeted ‘users’. A focus on needs often results in a checklist of functional – and measurable – parameters and technologies that are expected to fulfil a direct and well-defined need, like tracking and managing one’s own health.

To move beyond such reduction of values to a design input requires the exploration of embedded valuation practices rather than the mapping or understanding of values at one point in time and isolated from their context. Hence our framework questions the idea of values as (more or less) stable targets for technological interventions (Peine and Neven, 2011; Boenink and Kudina, 2020). Instead, we focus on how values themselves are mutually shaped and continuously reshaped by ageing-in-place technologies. In doing so, we connect with recent studies that have demonstrated how innovation discourses and design projects are important arenas that shape societal imaginaries of ageing, including supposedly ideals of a good later life (e.g. Twigg, 2012; Buse *et al.*, 2017; Katz and Marshall, 2018), and thereby also the very values that they are meant to address.

Below we first sketch the conceptual background of our framework. We conceptualise values and valuation practices, drawing on the emerging field of valuation studies (Doganova *et al.*, 2018), and inspired by Science and Technology Studies (STS). STS studies relations between people and technology and has demonstrated how both technology and people construct each other and, therefore, can only be understood in relation to each other (Sismondo, 2010). We specifically base our conceptualisation on the co-constitutional understanding of ageing and technology, as proposed by Peine and Neven (2019, *in press*): we started our literature search by exploring meanings of values and valuation in the journal *Valuation Studies*, and reflected on how valuation is studied in established approaches to health, innovation and values. In particular, we looked at valuation approaches in Health Technology Assessment and value-sensitive design. Hence, we followed a snowball method to enrich our search and acquire an in-depth understanding of the underlying key literature. After this conceptualisation, we introduce the core elements of our framework, for which we draw on our literature review. Three core elements provide an approach to explore values and valuation in innovation practices: (a) value multiplicity, (b) value dynamism (*i.e.* over time and place), and (c) valuation implications (consequences of valuation practices). Subsequently, we apply our framework in a COVID-19-related thought experiment, where we reflect on how valuation matters in the introduction and use of a COVID-19 health app in the Netherlands. Finally, we reflect on the contribution of our proposed valuation approach to theory, that is, related to the in-depth and continuous reflection on valuation in the practices it evokes, and to more responsible and sustainable innovations for an ageing society.

The co-constitution of values in ageing and technology innovations

Peine and Neven (2019, *in press*) recently demonstrated how an interventionist logic is widespread and dominant when thinking about ageing and technology,

both among practitioners and in academic studies of ageing and technology. Under this logic, ageing and technology are conceptualised as two separate spheres, and technology exists as an intervention to, rather than an element of, ageing and later life. In the worlds of designers and engineers, the perception is widespread that users (older adults and their formal and informal care-givers), their needs, requirements and even their values can be understood as an input for design. In analysing the deployment and implementation of new technologies into the life-worlds of older people, the focus is predominantly on understanding their actual impact. In this perspective, technology intervenes in later life, and evaluations of new technologies are done against a pre-defined set of criteria, values or categories that describe – or rather, prescribe – what is ‘good’ or ‘acceptable’ and what should be embedded in the design.

Values and valuation

In contrast to this, a recent body of theoretically driven empirical research, referred to as Socio-gerontechnology (Peine *et al.*, 2021), has shown that such assumptions neglect the multiple and dynamic relations that co-constitute forms of ageing and technology and thus also of values. Notions of ageing, technologies, as well as of values, continuously change. They are situated but not static. For instance, Lassen and Moreira (2020) explore two Danish ‘inclusive cycling’ initiatives. They show how in these initiatives, which both aimed to support active ageing, different bike designs also created markedly different forms of active ageing, one emphasising social participation and the other stressing physical activity. Thus, while ‘active ageing’ as a generic idea has become widely influential across policy initiatives at national and international levels, its forms are multiple, enacted through specific and situated practices and relations; or, what active ageing is, depends on the practices and relations through which it is enacted. Technologies such as bikes do not simply support (or fail to support) the idea of active ageing, but their design and use co-constitute specific enactments of it.

We therefore argue that the shift from an interventionist to a co-constitutionalist understanding of ageing and technology also requires a shift towards a more practice-based conceptualisation of values, to reflect their dynamic and situated entanglement with new and existing technologies and with the broader context in which valuation practices take place. Indeed, interventionist accounts also widely underlie ethical discussions about ageing and technology that do focus on values – such as access, prevention, privacy, the human touch, patient safety or human dignity (Bombard *et al.*, 2011; Van Wynsberghe, 2013) – but these accounts assume that such values can, at least in principle, be defined in a singular and stable way. This is what Boenink and Kudina (2020) call the ‘entity trap’ – the idea that values can be identified at one point in time and then remain more or less stable. They suggest reconceptualising values to inquire how practices change when new technologies are introduced. To avoid the ‘entity trap’ they propose understanding values as lived realities, interactive and dynamic. Therefore, they argue, not only current values should be studied, but also the becoming of valuation routines. So far, we argue, this has not been appropriately accounted for in existing practices of technology assessment, and certainly not in relation to ageing-in-place

technologies. For instance, valuation processes in health have been dominated by traditional Health Technology Assessment practices for decades, measuring efficacy, safety, quality and costs of a new innovation (Banta and Jonsson, 2009). Instead of studying health and ageing innovations as stable ‘interventions’, we therefore move towards understanding the dynamics and the ways how innovation, and underlying valuation practices, co-constitute health and ageing (*i.e.* citizens having different and changing roles and perspectives as user, consumer, patient, (self-)manager, informal care-giver, representative, member of ‘the public’, potential future user), and add an agency, practice-oriented perspective.

Moving from an approach where values are captured at one point in time as stable entities towards considering values as dynamic requires an *ongoing* attention to values, including continuous exploring and reflection in time and space. While the approach in which values are considered to be ‘stable’ enables a way to already ‘build’ human values in the design and subsequently evaluate and account for such values – an approach often associated with the term ‘value-sensitive design’ (Van der Hoven and Manders-Huits, 2020) – the inherent dynamism and multiplicity of values get missed and many projects fail to reach scale due to a lacking awareness and attention to how innovations fit within their prospective context (time and place), and in which values and valuations play a significant role. Even more attention is needed to the dynamics of these contexts and to how innovations can maintain the initial fit.

To understand better valuation and how valuation affects health and ageing innovations, we look at the emerging field of valuation studies, which finds its origin in STS. Valuation studies specifically explore the becoming of values in valuation practices. A distinction is made between two main perspectives. On the one hand, (e)valuation is positioned as the basis for creating, maintaining, rearranging and changing social order, assuming a possibility to capture values at one point (*see* Stark, 2011; Lamont, 2012), as in value-based health-care approaches (Porter and Teisberg, 2006) or value-sensitive design of care technologies (Van Wynsberghe, 2013). Value is understood as a certain type of worth that is given to something. Valuation and evaluation processes in this view come with social and cultural processes in which a reference is used to enable the comparison or negotiation of the value of an entity. On the other hand, values are understood as being made or given to ‘things’ in practice, while these valuation practices simultaneously shape (and reshape) values (Zuiderent-Jerak and Van Egmond, 2015). Valuation studies not only focus on exploring how values are made in valuation practices, for instance in the development of new technologies and introduction of innovations, but also on how valuation practices are dynamically constructed in interactions between different stakeholders and with their environment. Dussauge *et al.* (2015: 10) argue it is important to also look at how concerns or stakes are made: ‘the production – in practice – of what comes to count as valuable, desirable, or otherwise worth caring for’.

Valuation is considered a social practice as it includes assessing and producing values; the valuation practice in itself is described as an ‘engaging practice’.³ To study valuation as social practice, Muniesa (2011) suggests going back to the pragmatist movement of Dewey (1923), in which Dewey argued to shift from value to valuation, considering valuation explicitly an action (and thus dynamic). In this understanding, value is a practical performance (Dewey, 1923). Studies on the

performative accounts of valuation focus on how values create performances and are subsequently being reshaped (e.g. Stark, 2020). Muniesa (2011: 26) distinguishes value(s) and valuation by explaining that something has a subjective value based on its own condition, as well as on individual experiences – how it is liked by individuals – and on how it is related to other things, such as work or money. People often try to objectify such values by looking for standards (Dewing, 1941; Muniesa, 2011) that give guidance or enable comparisons, for instance.

Valuation, on the other hand, is constructed by ‘something that happens to something, and this happening can be a matter of consideration or of relation, or both at the same time’ (Muniesa, 2011: 26). This means that value depends on valuation practices, on how it is done, by whom and why, and subsequently on its associated problems or even broader, its implications, which will reconstruct the meaning of these values as well. Valuations are performed almost everywhere and multiple ways are used ‘to assess such things as creditworthiness, performance, aesthetics, or return on investment’ (Helgesson and Muniesa, 2013: 2). To understand these values, they need to be explored in the practices in which they are embedded. Instead of implementing values in practice, values are dynamically shaped in these very practices. Unpacking relations between values and active processes is considered crucial to understanding valuation (Doganova *et al.*, 2018).

A conceptual valuation framework

From our review of values and valuation in different fields, we distinguish three core elements which are important when aiming to explore valuation practices in active and healthy ageing innovations: (a) value multiplicity, (b) value dynamism, and (c) valuation implications. By studying value multiplicity and value dynamism as part of valuation implications, more insight can be gained into how ageing and technology co-constitute each other and subsequently how to facilitate a more reflexive and responsible co-constitution. Rather than looking at how values relate to performances, we suggest a valuation approach to anticipate future performances of these values and valuation practices.

(a) Value multiplicity

Values do not exist as context-independent concepts. Rather, what values are, how they come to matter in the lives of (older) people and what experiences we connect to them can only be meaningfully answered in relation to the socio-material practices in which they are enacted. Creating an Active Ageing Index to measure and compare the ‘untapped potential of older people for active and healthy ageing across countries’⁴ implies a very different enactment of the value ‘active ageing’ than an older adult’s routine outdoor walks recommended by their general practitioner as a way to take care of their troubling heart (Aceros *et al.*, 2015: 108). Thus, value multiplicity is more than a plurality of values or a plurality of meanings attached to them. This concept emphasises that something like active ageing, that usually is taken as one, can be enacted in many ways (Lassen and Moreira, 2020). Values, as they are part of a co-constituting interplay of humans, technologies, ideas and other socio-material factors, *are* different ‘things’ in different situations (Mol, 2002, 2010) (including places and times).

(b) Value dynamism

Rather than being stable entities, it has been demonstrated that values and valuation (practices) are situated, contextually defined and thus dynamic. Values are affected by time and how they are constructed is related to an inherent temporariness, which is also affected by spatial and societal contexts. Hence, values are constantly being defined and redefined (Birch, 2012, 2017). Past expectations and future promises play a role, as well as other people's perspectives towards these same values.

To understand values, values need to be explored in the practices and places in which they are embedded. Instead of implementing values in practice, which is deemed impossible, values are – in this understanding – shaped in these very practices. For instance, policy is an important place where health and ageing values come into being and where their meaning is negotiated. Zuiderent-Jerak *et al.* (2015) studied values in public health policy and suggest looking for compositions of values rather than the definition of one value only. By studying how values hang together it becomes possible to find out what is done to ensure and shape these values in practice. Initiators of innovation policies, such as governments, try to ensure that the values they consider as important and that they inscribe in their policies, are also considered important by the citizens involved. They thereby need to be aware of value dynamism. The dynamic nature of values is related to attempts of organisations, like these governments, to steer on valuation in practice and thereby encourage or discourage the individual meanings attached to certain values.

(c) Valuation implications

Valuation, the process of how values come into being, is not without implications and is even considered a crucial problem for the SSH, according to scholars in valuation studies. Understanding valuation is considered to be a requirement for understanding 'how our world is constructed, transformed, or fractured' (Mission Statement of the journal *Valuation Studies*⁵). By introducing this third element of our framework, we suggest not focusing merely on valuation problems but studying the broad implications of values and valuation practices. To understand better the potential challenges and opportunities of ageing innovations within their societal context, and thereby contribute to opportunities to achieve meaningful implementation and scale eventually, we suggest attuning to implications. Values affect each other and their contexts in interaction – sometimes creating tensions, other times shaping opportunities – thereby also creating and reshaping the meanings given to values in practice.

We suggest that such valuation implications derive from a value multiplicity and dynamism described under (a) and (b); exploring these is necessary to unpack potential valuation implications. Reflecting on prospects and related valuation should also urge an awareness to remain attentive to value multiplicity and dynamism, not only at the start but as part of an ongoing process.

Valuation of a COVID-19 monitoring app: a thought experiment

To illustrate the use of our proposed valuation framework we provide a thought experiment based on the discourse around the COVID-19 mobile applications, or simply COVID-19 apps in the Netherlands, in particular in the period between

March and June 2020. COVID-19 measures provide an unfortunate opportunity to reflect on (potential) valuation practices and their implications in radically changing scenarios for all, but in particular for the older adults group, categorised as being at risk. We first introduce the explicit scenario used for this thought experiment,⁶ to then explore the co-constitution of ageing, value(s) and technologies in applying our valuation framework. In particular, we discuss the three elements of our proposed framework to demonstrate how – although our thought experiment is clearly situated in time and context – our valuation framework can be applied to facilitate a better understanding of how values are being constructed in practice and thereby enable a more conscious, reflexive development and deployment process.

COVID-19 risk mitigation management in the Netherlands

The fact that health monitoring and contact tracing apps play an important role in governmental responses to the COVID-19 pandemic illustrates the extent to which digitisation permeates health and ageing not only in the context of technology innovation projects, but also on a broad-scale societal level. The COVID-19 crisis situation can be seen as a pressure cooker in which societal stakeholders (including technology designers, policy makers and ‘the public’, *i.e.* in this case all citizens living in the Netherlands) need to reconcile various values, like privacy, safety, freedom, and social and economic equality, in a crisis situation that requires swift choices. Hence, while we cannot know at this point how the discussion around such apps will play out in the future, the current discussion allows us to speculate about future scenarios. Although these cannot be comprehensive, they serve as good examples to show how values often create tensions and are articulated in different ways.

In March 2020, the Dutch government, advised by an outbreak management team existing of health-related experts such as general practitioners, medical specialists and epidemiologists, introduced a risk mitigation plan to protect all citizens, people at risk in particular. When focusing on specific implications for older adults ageing in place, all people over 70 were categorised as ‘high-risk’ in these first plans. The outbreak management team emphasised it was crucial that older people avoid contact with people showing symptoms, but also advised people over 70 with reduced immune defence to avoid physical social interactions as much as possible (Rijksoverheid, 2020a). This message was repeated on several occasions in the preceding period. Further implications of this crisis policy included, among others, that older adults were advised not to leave their house when it was not absolutely necessary, to postpone visits to their family, friends and others, and arrange their formal and informal care to be provided remotely whenever possible, visits to the general practitioner included (Rijksoverheid, 2020b). Nursing homes were asked to ban all visitors, including independently living spouses, partners and relatives. When leaving the home, social distancing rules applied, supermarket chains decided to open their stores an hour earlier for people 70 years or older and thereby provided them with an opportunity to do their groceries ‘more safely’ and at distance. Safety gear and screens were introduced to enable contact when distancing was impossible or difficult, and non-urgent surgeries were postponed until further notice (Rijksoverheid, 2020b).

‘De Corona Check’: a COVID-19 health app

In the development of the COVID-19 risk mitigation plan, in which a medical orientation is prioritised, the role of apps has been assumed to be potentially valuable. Soon the idea was introduced to develop and deploy three kinds of apps to support further risk mitigation: (a) a health app, that enables self-assessment in a check for symptoms and subsequent (self-)monitoring; (b) a tracing app, that helps with tracking down people who have been in contact with infected people; and (c) a post-lockdown app that provides a health access code or statement that should help to identify whether it is safe to meet and interact. In our thought experiment we engage with the introduction and use of the first kind of app, *i.e.* a health app.⁷ We draw on information about a ‘check’ app called De Corona Check,⁸ which is the most used COVID-19 health app in the Netherlands. It aims to enable symptom checking, self-assessment and self-monitoring over a longer period of time, with medical expertise available remotely for advice and telemonitoring purposes (Grutters *et al.*, 2020).

Although this app was not designed to replace (regular) care, the underlying idea, according to the developers, was that smart technology would help identify potential infections and simultaneously reduce the burden of care; general practitioners and other medical professionals could refer their patients to the app to check their own health (Grutters *et al.*, 2020). De Corona Check is supposed to facilitate managing the number of hospitalised patients, reducing a further burden of care. A short-term survival chance is chosen over quality of life and a long-term health situation. Users of this app have to answer a short questionnaire. After filling in information on age, postal code, gender (male/female), immune-suppressing medication, comorbidity and possible test results of a previous COVID-19 test, symptoms are checked using a scale from 1 to 10, measuring lost sense of smell and taste, coughing, sore throat, nasal cold, shortness of breath and temperature. In addition, a request for contact could be added. Based on their answers, app users receive advice within 24 hours (Elbers and Sollie, 2020). When the system marks a person at risk, a co-ordination board receives a signal to act upon the given answers (*i.e.* the advice). This board consists of medical professionals who check the symptoms entered by users and, based on this information, provide medical advice (Elbers and Sollie, 2020). All data added voluntarily by users can be used for data analysis and are supposed to contribute to the regulation of patient streams in hospitals. When infected, and during recovery, additional apps are used to monitor care needs, but technological solutions are also suggested to support remote care, informal care-givers and social contact.

Next, we explore the core elements of the valuation framework we have introduced in relation to COVID-19 discussions and the De Corona Check app: value multiplicity, value dynamism and valuation implications.

Value multiplicity

In reflecting on the development of the app, the underlying rationale for creating such an app is to regain control as a government and as health managers involved. By helping citizens to self-monitor their health condition, developers assumed De

Corona Check app would help manage the pandemic impact, decreasing further societal disruption and the care burden. Occurring disruption and the urgency to develop instrument(s) to manage the crisis showed the limited governmental and societal preparedness to deal with such a crisis. 'Preparedness' is an essential concept in relation to (public) health policy and crisis management (Mahmood *et al.*, 2020; Sheehan and Fox, 2020). Mahmood *et al.* (2020) showed how health systems focused on safety in minimising further infection spreading, where digital health could have played a more important role if systems and infrastructures had been in place. They argue (digital) infrastructures could contribute to a better 'preparedness', including: stronger infection control, access to telemedicine, remote monitoring (and tracing), and empowerment of professionals and citizens (via digital training, information and advice). Sheehan and Fox (2020) focused on lessons learned, highlighting five key areas essential for preparedness: governance, information, services, determinants and capacity. Hence, preparedness provides an excellent example of a value to demonstrate our understanding of value multiplicity. In the context of COVID-19 policy measures, we see how 'pandemic preparedness' comes into play as a value that receives increasing attention in policy making and media reflections. Valuation of 'pandemic preparedness' here not only implies a new prioritisation and meaning of preparedness as a value for society, but by way of its enactment – partly through the use of a health app – also reshapes the material infrastructure for current and future (more permanent) ways of realising 'preparedness'. It is discussed that COVID-19 apps would have worked much more effectively if they had already been in place at the start of the pandemic.

The different ways of valuing preparedness during this pandemic bring also new enactments of, among others, prevention. While traditionally, health-monitoring apps are seen as supporting individual health (to bring down health-care costs for the entire society), the valuation of preparedness in COVID-19 policy responses configures prevention as a public value, eventually supporting 'public health'. A (potentially privacy-compromising) data infrastructure serves the purpose of preventing future public health crises.

For a long time already, Dutch prevention policies aim to influence individuals' ideas and behaviour in line with what is considered, by public health experts and policy makers, the 'best way of living', thereby aiming to contribute to the quality of 'public health'. In this crisis, health policy is under pressure. Policy makers' and experts' ideas and insights are emphasised in designing measures that aim for a 'common good', while individual voices are downplayed. What this common good is, is communicated by prescriptions (*i.e.* governmental measures). Under conditions of information overload and uncertainty-related anxiety during the COVID-19 crisis, there appears an increased tendency to favour recently acquired information because of its ease of recall – a heuristic (and risk) known as availability bias (Zagury-Orly and Schwartzstein, 2020). What is the 'best way of living' for 'the public' has multiple interpretations.

Besides a divide between 'the government' and health institutions *versus* 'the common citizen' or 'the public', also within the groups we presented here, valuation differs, thereby complicating decision-making. For example, some citizens, health professionals and policy makers are convinced of one's own responsibility in

anticipating potential health development by self-tracking their health. Other citizens use apps out of curiosity while some prefer not to use an app, for instance because they have doubts about the usefulness, privacy or the time it will cost. Some citizens deny restrictions are needed as they do believe the pandemic is part of a bigger conspiracy and information about the infection rate and age distribution makes some younger people feel more or less untouchable while older citizens were expected to 'stay safe' at home. Where citizens demonstrate different responses, the government balances public health with citizens' willingness to live by the created restrictions, conscious of the impact of their decisions for upcoming elections. The developed app affects different stakeholder groups differently. Where a reduced burden of care plays an important role for involved care divisions (hospitals, primary care), public health officers value long-term use and citizens' potential adherence to monitor their health as part of a wider responsabilisation policy, while other experts primarily focus on 'big data' for research purposes. The specific COVID-19 situation opens up opportunities for learning and development only possible under pressure.

These aspects show some of the complexities and the issues at stake in valuation practices around a COVID-19 health app and other situations more broadly. Our point here is that in the design of a COVID-19 health app, existing values and the relations between them become articulated differently, reshaping how we do and experience these values as material structures and social norms.

Value dynamism

Values are fluid, relational, situated in time, enacted in and by their contexts, and often co-constituted by technology. Due to time restraints – an urgency to crisis management – a careful reflection on and consideration of values of Dutch citizens that may come into play once such an app is introduced and implemented is nearly impossible. Instead of negotiating how giving away some privacy and getting more engaged in self-monitoring can be balanced, the app is introduced top-down and as it is. Using De Corona Check affects different valuation practices and (re)shapes underlying values as well, including how and what meaning is given to these values and subsequently to the app. Here we reflect on the notion of privacy. The health app is not only meant nor used to self-assess, but also involves outsiders. Medical experts contact and advise the users on what to do if an inscribed algorithm marks the user as being at risk or at the user's request. An indication of not being at risk might reassure some users they are healthy and safe. For many older adults, similar monitoring apps are already (being) developed, in relation to several chronic diseases (*e.g.* diabetes, Alzheimer's disease, cardiovascular diseases) or as part of lifestyle interventions (risk prevention). Within the GATEKEEPER project, we see how similar apps are introduced to monitor one's blood pressure, glucose level or mental health. In this COVID-19 scenario, using a (self-)monitoring app has become a more highly charged choice than before, as taking care of oneself is directly related to taking care of others, changing, among others, the role and meaning of autonomy, privacy, agency and shared decision-making.

In the COVID-19 crisis situation, not only does the current situation define how a variety of COVID-19 apps are introduced and used, but also an assumed future

use of such apps. How meanings of values change over time is hence important. This can be illustrated by reflecting on meanings of solidarity and prioritisation in relation to the use of a COVID-19 health app. At moments when care availability is under pressure, the willingness to follow the rules – which can be demonstrated in using such a health app – can become part of what is considered to be good and responsible citizenship (with users being the assumed responsible citizens in this example). Media messages, stories and the own users' experiences affect ideas on who should get help (first) and why and how this should be arranged in specific situations. According to the developers, using the app will contribute to reducing the burden of care, and thereby the app might also become instrumental for policy makers, as well as for users and care-givers who aim to contribute to the risk mitigation policy. Over time, users (and non-users) will constantly negotiate whether they are willing to share private information. Different reasons will play a role, including the considered own responsibility, being convinced about the app's contribution to health monitoring, to public health in general, expected individual gains, *etc.* Data scientists have a long-term interest based on their research agenda, while health managers focus on immediate effects and strategies to deal with the pandemic.

Hence, the valuation of privacy, prevention, preparedness, and other known and unknown values changes while apps develop and new apps are introduced. Values are fluid and co-constituted together with the further design and use of apps. Valuation will be affected by this fluidity, as well as by its interrelation with other values including a presumed cost-efficiency, personalised care and data security. After all, valuation is not a one-off shot that reflects a set of (more or less adequately mapped) stable values. Our thought experiment shows that new valuation routines may hinder dynamism to some extent as they position some valuation practices as better or more important than others.

Valuation implications

Reflecting on the implications of valuation practices in this thought experiment helps to illuminate underlying tensions. Timing and temporality play an important role in decisions made by governing agencies. A COVID-19 health app also needs to reconcile – at times conflicting – values such as privacy, prevention and pandemic preparedness. As a consequence of designing and introducing a health app in the middle of a crisis, trade-offs between values take place under pressure and can be distinguished more easily. The values reflected on in the above paragraphs are framed differently in a crisis compared to a 'normal' situation, due to the societal context and political pressure. At certain moments in the period reflected on, compromises to privacy were deemed more justifiable than before the crisis started. Individual health had become a public problem. Although the COVID-19 health app serves to support individuals to self-assess and seek help when needed, there is an overarching and underlying ultimate aim to prevent a further spread of the virus in society-at-large by facilitating early detection and risk prevention.

In the design of the COVID-19 app, known value conflicts do not only appear, they are also articulated differently. Privacy, for instance, is reframed as a matter of

public health, whereby specific boundaries between what should be private and what should be public are redrawn. Being in a crisis period can be understood as being in a situation of ‘radical openness towards the future and the instability concerning the present’ (*cf.* Kornberger *et al.*, 2019: 242), which makes decision-making very temporal (related to the crisis) and timeless (no perspective of changing situation) at the same time. Saving individual lives is weighed against quality of life, freedom of society and socio-economic concerns, while prevention has turned into a value of public interest, rather than an individual responsibility. Due to the COVID-19 crisis, individual agency in deciding which values are important is affected at a larger and more invasive scale than before, and public prevention values are being more foregrounded than individual interests.

Co-constitution of ageing, technologies and values

Taking the valuation practices of the COVID-19 health app thought experiment into account helps us to reflect on how not only health and ageing are co-constitutive, but also the underlying values at stake in health and ageing innovations. What kind of an app is deemed legitimate by most stakeholders involved depends on underlying valuation practices. Legitimacy is multiple and dynamic as well; its meanings change as time passes, events occur, and in interaction with other values and acts of prioritisation. Older adults who are advised not to visit their grandchildren continuously weigh the benefits of mitigating a health risk against what they consider to be important in their daily life (*e.g.* practices that affect their quality of life and wellbeing). Observing how other older adults act in such a situation, in an ongoing valuation process, also affects their own valuation perspective. A health app becomes meaningful only when being used and in co-constitution with the users and related values. Older adults have to weigh trust in this smart technology’s benefits against other values, such as a belief and willingness to ‘public health’.

Due to the ‘experimental’ nature of developing and using a COVID-19 health-monitoring app, there are continuing shifts in the group of stakeholders, as well as in their goals and their competencies, leading to distributed roles with multiple and dynamic positions towards values (Hinings *et al.*, 2018). Experts involved in the outbreak management team change continuously, as well as the status of the team and the value attached to the team’s advice in governmental regulations. Societal dynamics, developments in other countries and regions, new information and research outcomes, and dialogues between citizens, including (in)formal meetings of citizens with experts, affect how the app is valued by citizens. Health-care professionals’ and managers use (or non-use), for instance, by promoting and actively engaging with the app, affect a more general perception of the app as well. Involvement of diverse stakeholders (from different disciplines) in the development of the COVID-19 health app means that *intertwined institutional practices* (*e.g.* different regulatory requirements; variety in approval and monitoring regimes) do also play an important role in valuation implications of COVID-19 apps. Over time, a willingness to negotiate values like privacy or an obligation to self-monitor against more (experienced) freedom in the everyday life exemplify citizens’ dynamic perspectives towards values.

Health apps are expected to play a key role in the move towards personalised health care, in which each individual is more involved and *responsible* for the management of their own health-generating health information that contributes to clinical decision-making (e.g. Lupton, 2016; Sharon, 2017). But digital health also gives rise to more complex forms of monitoring, blurring the boundaries between public and private surveillance (Sharon, 2017), which could potentially lead to problems regarding autonomy (authenticity) and solidarity (e.g. poor surveillance of efficacy, safety and quality of the health app). This happens, for example, by motivating users to turn to self-surveillance and to invite peers to participate in monitoring practices by sharing personal data on social media or other digital platforms, hence decentralising knowledge, power and decision-making (e.g. Lupton, 2014). In the introduction of health apps within the GATEKEEPER project and other projects in the domain of active and healthy ageing, we observe the technological potential is often emphasised and recognised by stakeholders involved, while their impact on other values remains underexposed. Values like privacy are considered negotiable and being related to a lack of education and training about a technology (i.e. more information about technology and training to enable its use is expected to decrease privacy concerns in this example). In this perspective, values' importance is anticipated in the development and design, but the actual changes and values considered important by different stakeholders – older citizens, in particular – in relation to everyday life remain undiscussed. Applying the proposed valuation framework provides an opportunity for timely and continuing attention to not only values but also their underlying valuation practices and implications.

Although not discussed earlier, it is also important to acknowledge that digital health innovations, such as a COVID-19 health app, can also fail due to a variety of causes, including *functionality, compliance, opportunistic behaviour, mistrust* and *power asymmetries*. Digital health developers originating from the information technology sector, for example, have difficulties complying with the high *safety and quality standards* and *strict and complex regulation* in the health-care field (Steinberg *et al.*, 2015). The (valuation) problem here is that digital health technologies need to be legitimised and institutionalised in new categories, routines, norms and regulations (e.g. Bowker and Star, 1999). Next to the multiplicity and dynamics of these more institutional values in the development of digital health innovations, such as the COVID-19 health app, the implementation of important *societal values*, such as privacy, ownership and equality, in the technological design of digital health products is challenging (e.g. Lupton, 2014, 2016; Jasanoff and Kim, 2015; Sharon, 2017).

Conclusion and discussion

In this paper, we brought together insights from different theoretical discussions on values and valuation practices to create a conceptual framework that enables a more responsible reflection on values and valuation in large-scale health and ageing innovation projects. Starting from a problematisation of an often dominant interventionist understanding of ageing and technology with a limited focus on 'user needs and requirements', we turned to a co-constitutive valuation approach. Drawing on a conceptualisation of literature on values and valuation in innovation,

we identified three theoretical valuation concepts that better acknowledge the co-constitutive and dynamic character of ageing, technology and their values: (a) value multiplicity, (b) value dynamism, and (c) valuation implications. Our proposition is that health and ageing innovations can become more meaningful and potentially sustainable for older people and their care-givers, but also for other stakeholders such as entrepreneurs, local policy makers and health-care professionals, when these valuation concepts are taken into account.

We suggest taking our framework as a starting point for studying how value multiplicity and value dynamism relate to each other and lead to valuation implications, which subsequently also reshape the value multiplicity and dynamism. Exploring these elements and their interrelatedness helps to gain further insight in how ageing and technology co-constitute each other. This could contribute to co-creating health and ageing innovations in a more sustainable way, as it enables:

- unpacking different meanings in relation to notions of (good) care, quality of life, ageing in place, smarter living homes (home as hybrid sites through competing narratives and contested meanings);
- understanding how value conflicts are solved (or not solved) and how specific values become dominant over others, i.e. valuation or prioritisation in valuation practices;
- exploring how health innovations (e.g. digital technologies) reshape and are reshaped by the home environment, daily practices and daily life experiences of different stakeholders, including older citizens;
- eliciting future policy implications in order to deal responsibly with ageing in place and construct responsible implementation pathways.

We developed our framework not only to study valuation practices, but also to shape valuation processes in more responsible ways. In co-creation workshops organised as part of the GATEKEEPER project, the practical applicability of this framework has been and will be further explored. We therefore developed a script and template for an open approach towards valuation, guiding stakeholders in innovation projects in a bottom-up dialogue on values and valuation, as well as a reflection on the multiplicity and dynamism of different values. In addition, an ongoing reflection on valuation implications is encouraged, aiming to co-create implementation pathways that are attentive to the everyday life values of older citizens. Besides creating an awareness among professional stakeholders about the importance of paying attention to these different everyday life values, it should become a natural part of innovation projects to give voice to the values older citizens consider important at specific moments in time and how these change in interactions, over time and due to changing contexts.

We assume stakeholders – including ‘the public’ – have an elusive nature (*cf.* Beumer, 2019). One stakeholder only represents a temporary and partial perspective. Our intention is not to provide a framework that should capture every detail, but to explore a great(er) variety of perspectives to enable anticipating future scenarios and what will be at stake in these scenarios. By unpacking valuation practices it not only becomes apparent how values come into being in co-constitutional

processes, but also underlying differences, tensions and dynamisms are revealed. Our point is not that valuation practices can or should be fully anticipated and avoided. Rather, our framework stimulates a sensitivity towards potential valuation practices, their multiplicity, dynamics and implications for those involved. Guiding and facilitating an increased awareness of and ability to reflect on value multiplicity, dynamism and the valuation implications arising from these, open up opportunities for better continuous reflexivity and awareness within policy and society. An improved attentiveness to the situatedness in time and space of values and valuation practices makes new debates on the role of technologies in and for health and ageing possible and emphasises the importance to keep all stakeholders, citizens included, engaged in discussions on future developments and prospects.

Summing up, our proposition is that deploying, experimenting with and further developing a valuation approach into a practice-oriented framework for valuation in health innovation can contribute to more responsible health and ageing innovations, in particular concerning smarter living homes and environments, as it enables stakeholders to explicate and – most importantly – to develop a sensitivity towards the multiple values at stake.

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Notes

1 We understand ageing in place as a broad concept, drawing on the work of, among others, Andrews *et al.* (2007), Van Hees *et al.* (2018) and Wiles *et al.* (2012), exploring the home and its environment as a place that enables ageing independently, both with and without smart technologies as well as other forms of help and care.

2 For more information about the GATEKEEPER project, see <https://www.gatekeeper-project.eu/>.

3 Helgesson and Muniesa (2013: 3) demonstrate how valuation translates into social practices: 'Valuations of creditworthiness regularly translate into interest rates (Poon, 2009), the valuation of the worth of damaged nature might translate into economic damages (Fourcade, 2011), and the valuation of academics might translate into who gets research grants or attractive positions (Lamont, 2009). The performance of valuations are thus not only ubiquitous; their outcomes participate in the ordering of society'.

4 For more information on the Active Ageing Index, see <https://statswiki.unecce.org/display/AAI/Active+Ageing+Index+Home>.

5 For the full Mission Statement, see <https://valuationstudies.liu.se/about>.

6 For more in-depth information on the use and relevance of a thought experiment, we refer to the work of, among others, Irvine (1991) and Yeates (2004).

7 We do not look into COVID-19 tracking and tracing apps such as 'De CoronaMelder' in the Netherlands. We are looking at the health app because of its important similarities with other health

assessment and monitoring apps in the field of health and ageing, like the technologies introduced within the GATEKEEPER project in which we are involved.

8 Also see <https://decoronacheck.nl/>.

References

- Aceros J, Pols J and Domènech M** (2015) Where is grandma? Home telecare, good aging and the domestication of later life. *Technological Forecasting & Social Change* **93**, 102–111.
- Andrews GJ, Cutchin M, McCracken K, Phillips DR and Wiles JL** (2007) Geographical gerontology: the constitution of a discipline. *Social Science & Medicine* **65**, 151–168.
- Balmer AS, Calvert J, Marris C, Molyneux-Hodgson S, Frow E, Kearnes M, Bulpin K, Schyfter P, Mackenzie A and Martin P** (2016) Five rules of thumb for post-ELSI interdisciplinary collaborations. *Journal of Responsible Innovation* **3**, 73–80.
- Banta D and Jonsson E** (2009) History of HTA: introduction. *International Journal of Technology Assessment in Health Care* **25**, 1–6.
- Beumer K** (2019) On the elusive nature of the public. *Nature Nanotechnology* **14**, 510–512.
- Birch K** (2012) Knowledge, place, and power: geographies of value in the bioeconomy. *New Genetics and Society* **31**, 183–201.
- Birch K** (2017) Rethinking value in the bio-economy: finance, assetization, and the management of value. *Science, Technology & Human Values* **42**, 460–490.
- Boenink M and Kudina O** (2020) Values in responsible research and innovation: from entities to practices. *Journal of Responsible Innovation* **7**, 450–470.
- Bombard Y, Abelson J, Simeonov D and Gauvin F-P** (2011) Eliciting ethical and social values in Health Technology Assessment: a participatory approach. *Social Science & Medicine* **73**, 135–144.
- Bowker GC and Star SL** (1999) *Sorting Things Out. Classification and Its Consequences*. Cambridge, MA: MIT Press.
- Buse C, Nettleton S, Martin D and Twigg J** (2017) Imagined bodies: architects and their constructions of later life. *Ageing & Society* **37**, 1435–1457.
- Camp LJ and Lorenzen-Huber L** (2017) Privacy implications of aware, active, and adaptive technologies. In Kwon S (ed.), *Gerontechnology: Research, Practice, and Principles in the Field of Technology and Aging*. New York, NY: Springer, pp. 91–114.
- Dewey J** (1923) Values, liking, and thought. *Journal of Philosophy* **20**, 617–622.
- Dewing AS** (1941) *The Financial Policy of Corporations*, 4th Edn. New York, NY: Ronald Press.
- Doganova L, Giraudeau M, Helgesson CF, Kjellberg H, Lee F, Mallard A, Mennicken A, Muniesa F, Sjögren E and Zuiderent-Jerak T** (2014) Valuation studies and the critique of valuation. *Valuation Studies* **2**, 87–96.
- Doganova L, Giraudeau M, Kjellberg H, Helgesson CF, Lee F, Mallard A, Mennicken A, Muniesa F, Sjögren E and Zuiderent-Jerak T** (2018) Five years! Have we not had enough of valuation studies by now? *Valuation Studies* **5**, 83–91.
- Dussauge I, Helgesson CF and Lee F** (eds) (2015) *Value Practices in the Life Sciences and Medicine*. New York, NY: Oxford University Press.
- Elbers G and Sollie A** (2020) De Corona Check-app: monitoring en advies [The Corona Check app: monitoring and advice]. *Huisarts en Wetenschap [General Practitioner and Science]* **63**, 67.
- Fourcade M** (2011) Cents and sensibility: economic valuation and the nature of ‘nature’. *American Journal of Sociology* **116**, 1721–1777.
- Gallistl V and Wanka A** (2019) Representing the ‘older end user’? Challenging the role of social scientists in the field of active and assisted living. *International Journal of Care and Caring* **3**, 123–128.
- Grutters LA, Majoor KI, Mattern ESK, Hardeman JA, Van Swol CFP and Vorselaars ADM** (2020) Home telemonitoring makes early hospital discharge of COVID-19 patients possible. *Journal of the American Medical Informatics Association* **27**, 1825–1827.
- Gwyther H, Cooke R, Shaw R, Marcucci M, Cano A and Holland C** (2018) Perceptions and experiences of frailty interventions: quantitative and qualitative results from a survey of partners within the European Innovation Partnership on Active and Healthy Ageing (EIP-AHA). *Ageing & Society* **38**, 1843–1867.
- Helgesson CF and Muniesa F** (2013) For what it’s worth: an introduction to valuation studies. *Valuation Studies* **1**, 1–10.

- Hinings B, Gegenhuber T and Greenwood R** (2018) Digital innovation and transformation: an institutional perspective. *Information and Organization* **28**, 52–61.
- Irvine AD** (1991) Thought experiments in scientific reasoning. In Horowitz T and Massey G (eds), *Thought Experiments in Science and Philosophy*. Lanham, MD: Rowman Littlefield, pp. 149–166.
- Jasanoff S and Kim SH** (2015) *Dreamscapes of Modernity. Sociotechnical Imagineries and the Fabrication of Power*. Chicago, IL: University of Chicago Press.
- Katz S and Marshall BL** (2018) Tracked and fit: Fitbits, brain games, and the quantified aging body. *Journal of Aging Studies* **45**, 63–68.
- Kjellberg H and Mallard A** (2013) Valuation studies? Our collective two cents. *Valuation Studies* **1**, 11–30.
- Kornberger M, Leixnering S and Meyer RE** (2019) The logic of tact: how decisions happen in situations of crisis. *Organization Studies* **40**, 239–266.
- Lamont M** (2012) Toward a comparative sociology of valuation and evaluation. *Annual Review of Sociology* **38**, 201–221.
- Lassen AJ and Moreira T** (2020) New bikes for the old. *Science & Technology Studies* **33**, 39–56.
- Lupton D** (2014) Critical perspectives on digital health technologies. *Sociology Compass* **8**, 1344–1359.
- Lupton D** (2016) Digitised health, medicine and risk. *Health, Risk & Society* **17**, 473–476.
- Mahmood S, Hasan K, Carras MC and Labrique A** (2020) A global preparedness against COVID-19: we must leverage the power of digital health. *JMIR Public Health and Surveillance* **6**, e18980.
- Mantovani E and Turnheim B** (2016) Navigating the European landscape of ageing and ICT: policy, governance, and the role of ethics. In Dominguez-Rué E and Nierling L (eds), *Ageing and Technology – Perspectives from the Social Sciences*. Bielefeld, Germany: Transcript, pp. 227–239.
- Mol A** (2002) *The Body Multiple: Ontology in Medical Practice*. Durham, NC: Duke University Press.
- Mol A** (2010) Care and its values: good food in the nursing home. In Mol A, Moser I and Pols J (eds), *Care in Practice: On Tinkering in Clinics, Homes and Farms*. Bielefeld, Germany: Transcript, pp. 215–234.
- Muniesa F** (2011) A flank movement in the understanding of valuation. *The Sociological Review* **59**, 24–38.
- Neven L and Peine A** (2017) From triple win to triple sin: how a problematic future discourse is shaping the way people age with technology. *Societies* **7**, 26–37.
- Peek ST, Luijckx KG, Rijnaard MD, Nieboer ME, Van der Voort CS and Aarts S** (2016) Older adults' reasons for using technology while aging in place. *Gerontology* **62**, 226–237.
- Peine A and Neven L** (2011) Social-structural lag revisited. *Gerontechnology* **10**, 129–139.
- Peine A and Neven L** (2019) From intervention to co-constitution: new directions in theorizing about aging and technology. *The Gerontologist* **59**, 15–21.
- Peine A and Neven L** (in press) The co-constitution of ageing and technology – a model and agenda. *Ageing & Society*. Available online doi:10.1017/S0144686X20000641.
- Peine A, Marshall B, Martin W and Neven L** (eds) (2021) *Socio-gerontechnology – Interdisciplinary Critical Studies of Ageing and Technology*. London: Routledge.
- Poon M** (2009) From New Deal institutions to capital markets: commercial consumer risk scores and the making of subprime mortgage finance. *Accounting, Organizations and Society* **34**, 654–674.
- Porter ME and Teisberg EO** (2006) *Redefining Health Care: Creating Value-based Competition on Results*. Boston, MA: Harvard Business Press.
- Rijksoverheid [Government of the Netherlands]** (2020a) *Letterlijke tekst persconferentie minister-president Rutte en minister Bruins naar aanleiding van de maatregelen tegen verspreiding coronavirus in Nederland*. [Literal Text Press Conference: Prime Minister Rutte and Minister Bruins According the Measures Against Spreading of the Coronavirus in the Netherlands]. Available at <https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/documenten/mediateksten/2020/03/12/persconferentie-minister-president-rutte-en-minister-bruins-naar-aanleiding-van-de-maatregelen-tegen-verspreiding-coronavirus-in-nederland>.
- Rijksoverheid [Government of the Netherlands]** (2020b) *Measures Communicated Between March and June 2020*. Available at <https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/nieuws>.
- Sharon T** (2017) Self-tracking for health and the quantified self: re-articulating autonomy, solidarity, and authenticity in an age of personalized healthcare. *Philosophy and Technology* **30**, 93–121.
- Sheehan MC and Fox MA** (2020) Early warnings: the lessons of COVID-19 for public health climate preparedness. *International Journal of Health Services* **50**, 264–270.
- Sismondo S** (2010) *An Introduction to Science and Technology Studies*, Vol. 1. Chichester, UK: Wiley-Blackwell.

- Sixsmith A** (2009) Understanding the older user of ambient technologies. In Jacko JA (ed.), *Human-Computer Interaction*. Berlin: Springer, pp. 511–519.
- Stark D** (2011) What's valuable? In Beckert J and Aspers P (eds), *The Worth of Goods. Valuation and Pricing in the Economy*. Oxford: Oxford University Press, 319–338.
- Stark D** (2020) *The Performance Complex: Competitions and Valuations in Social Life*. Oxford: Oxford University Press.
- Steinberg D, Horwitz G and Zohar D** (2015) Building a business model in digital medicine. *Nature Biotechnology* **33**, 910–920.
- Twigg J** (2012) Adjusting the cut: fashion, the body and age on the UK high street. *Ageing & Society* **32**, 1030–1054.
- Van den Hoven J and Manders-Huits N** (2020) Value-sensitive design. In Miller K and Taddeo M (eds), *The Ethics of Information Technologies*. London: Routledge, pp. 329–332.
- Van Hees S, Horstman K, Jansen M and Ruwaard D** (2018) Meanings of 'lifecycle robust neighbourhoods': constructing versus attaching to places. *Ageing & Society* **38**, 1148–1173.
- Van Wynsberghe A** (2013) Designing robots for care: care centered value-sensitive design. *Science and Engineering Ethics* **19**, 407–433.
- Viseu A** (2015) Integration of social science into research is crucial. *Nature* **525**, 291.
- Wiles JL, Leibing A, Guberman N, Reeve J and Allen RE** (2012) The meaning of 'aging in place' to older people. *The Gerontologist* **52**, 357–366.
- Yeates LB** (2004) *Thought Experimentation: A Cognitive Approach* (Dissertation for the degree of Master of Arts). University of New South Wales, Sydney.
- Zagury-Orly I and Schwartzstein RM** (2020) Covid-19 – a reminder to reason. *New England Journal of Medicine* **338**, e12.
- Zuiderent-Jerak T and Van Egmond S** (2015) Ineffable cultures or material devices: what valuation studies can learn from the disappearance of ensured solidarity in a health care market. *Valuation Studies* **3**, 45–73.
- Zuiderent-Jerak T, Grit K and Van der Grinten T** (2015) Critical composition of public values: on the enactment and disarticulation of what counts in health-care markets. In Dussauge I, Helgesson CF and Lee F (eds), *Value Practices in the Life Sciences and Medicine*. New York, NY: Oxford University Press, pp. 119–135.