



Science, technology and the ‘grand challenge’ of ageing— Understanding the socio-material constitution of later life



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ABSTRACT

In this paper, we introduce the themes addressed and the approaches used in this special issue. We start by briefly discussing the state of the art in research and policy making related to science, technology and ageing. We argue that an important gap characterizes this state of the art: current approaches do not consider material practice and materiality to be an inherent part of later life as constituted in contemporary societies. Science and Technology Studies (STS) provide both the theories and methods to address this gap, and thus deploy a theoretical and empirical understanding of science, technology and ageing that captures how later life co-evolves with the practices of technology use and design. We briefly discuss how the articles in the collection each contribute to such an understanding across various locations. We conclude that, together, the contributions specify a perspective on the *socio-material constitution of later life* that implicates an important agenda for the future study of ageing and gerontechnology innovation.

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1. Introduction

Demographic ageing is widely seen as a major challenge that drives the future of science and technology policy and management in industrialized societies (Grübler et al., 2007; Phillips, 2011; Schuitmaker, 2012). In Western Europe, the population aged 65 or higher will increase from 18.5% in 2010 to 27.3% in 2035, and the population aged 80 or higher will increase from 5.1% to 8.6% in the same period.¹ A common reasoning among policy makers, companies, researchers and lobby groups suggests that this demographic disruption will lead to a crisis for healthcare systems, for pension schemes, for the innovative capacity of economies, and for the social relations between different age groups (Nye, 2009). Science, technology and innovation are widely perceived to provide the means for solving this “grand challenge” of demographic

ageing (Östlund, 2004; Mort et al., 2012; Neven, 2011; Peine and Herrmann, 2012; De Smedt et al., 2013; Cagnin et al., 2012). In the EU, for instance, the Ambient Assisted Living Joint Programme has funded research and development into ICT-based solutions to support active and healthy ageing with about 700 million EUR since 2008; an additional 143 million EUR were funded through the FP7 programme on “ICT for Health and Ageing Well” in 2013 alone.²

At the same time, the nature of later life and its relation with science and technology is changing. Current generations of older persons have experienced different waves of new household technology innovations during their life course; and with the baby boomers,³ the first cohort that has been

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¹ Source: UN World Population Prospects (2012 Revisions): <http://esa.un.org/wpp/>.

² See <http://ec.europa.eu/digital-agenda/en/active-and-assisted-living-joint-programme-aal-jp> and http://cordis.europa.eu/fp7/ict/programme/challenge5_en.html.

³ The term baby boom usually refers to the exceptionally high birth rates after World War II that occurred in Western European (and North American) countries. While the timing of the baby boom has been slightly different in these countries, we use the term baby boomer to describe those born between 1946 and 1964.

exposed to modern digital technology, at least in the later phases of their lives, is going into retirement (Sackmann and Weymann, 1994; Mollenkopf, 2003). The baby boomers are also the first cohort that has been enculturated into consumer lifestyles, which implies that many of them continue to express their life styles and develop identity through the use and consumption of technology well into old age (Joyce and Mamo, 2006; Jones et al., 2008; Higgs et al., 2009; Gilleard and Higgs, 2011). In other words, older persons are increasingly used to use technology as part of everyday culture. As Loe has recently pointed out: Even the oldest old of today “can be and are technogenarians in their active use of everyday technologies to create meaningful lives and maintain health” (Loe, 2010, p. 320).

Innovations for older persons are usually referred to as *gerontechnologies* (Graafmans et al., 1998; Charness and Schaie, 2003; Joyce and Loe, 2010; Sixsmith and Gutman, 2013). They are not only seen as a potential solution to the problems and challenges associated with ageing; they are also perceived to have a considerable potential to open new market opportunities for innovative companies (Kohlbacher and Herstatt, 2011; Gassmann and Keupp, 2009) and scientific enterprise, and to provide learning opportunities, new experiences, enablement or simply fun for older persons (Astell, 2013; Larsen et al., 2013). Gerontechnological innovations are embedded in a “triple-win narrative”, where policy makers, innovators and older persons are said to equally benefit from scientific and technological innovation (see Neven, 2011, 2014). So far, however, the realization of this triple-win has remained disappointing (Gassmann and Keupp, 2009; Kohlbacher and Hang, 2011; Sixsmith, 2013; Östlund, 2011; Botero and Hyysalo, 2013).

This special issue focuses on a pertinent reason for this disappointment: The current generation of older persons creates “new patterns for life in the space between [...] the ‘main acts’ of adulthood (career- and family-building) and the frailties of old age” (Moen and Spencer, 2006: 133). It has remained challenging to address these new patterns in innovation processes (Sixsmith, 2013; Lawton, 1998; Fozard et al., 2009; Wahl et al., 2012). Ageing baby boomers are different from younger users in terms of the needs that arise from ageing bodies (Twigg, 2004; Brooks, 2010; Czaja et al., 2013); they have undergone different technological experiences during their lives (Docampo Rama et al., 2001; Fozard and Wahl, 2012; Sackmann and Winkler, 2013); they are apt to reject technologies that too overtly position them as frail and old (Neven, 2010; Bailey et al., 2011; Jæger, 2005a); and they rearticulate meaning and identity as they move into later life with new and existing technology (Gilleard and Higgs, 2011; Mollenkopf et al., 2011; Chapman, 2006). Yet they often also defy existing stereotypes of inept and vulnerable technology users that are set apart primarily by the problems they have in engaging with science and technology as passive recipients (Joyce and Loe, 2010; Brittain et al., 2010; Östlund and Linden, 2011; Loe, 2011). As technology users, current generations of older persons are characterized by a simultaneous need to create new patterns of meaning and sense of self for retirement and later life on the one hand, and to cope with emerging illness and frailty on the other (Peine and Neven, 2011; Peine et al., 2014). Failing to address this simultaneous identity as agents and recipients of scientific and technological change constitutes a risk to produce a triple loss—older persons do not get the technologies they need, companies fail to tap into

the opportunities of the emerging silver market, and the government subsidies for gerontechnological innovations result in prototypes and experiments that do not spread or scale.

2. An STS contribution to science, technology and ageing

Against this background, it becomes clear that ongoing policy discourses tend to express an overly instrumental view on technological innovation: Science and technology are positioned as solutions to otherwise independent problems that exist in the domain of individual and demographic ageing (Mort et al., 2012; Xie, 2003; Jæger, 2005b; Roberts and Mort, 2009; Oudshoorn, 2011). For one, this perspective is vulnerable to producing an understanding of the ageing process that emphasizes problems and shortcomings. This may contribute to a further scientization and biomedicalization of ageing or reinforce structural ageism in policymaking and institutions, as others have highlighted before (Östlund, 2004; Joyce and Mamo, 2006; Joyce and Loe, 2010; Calasanti, 2003; Moreira and Bond, 2008). Probably more important, however, this perspective neglects that the increasing deployment of scientific understandings and technological objects in the life of older persons alters the ideas about what it means to be or grow old — and that older persons are important agents in this re-articulation through their use of science and technology.

In this special issue, we interrogate this latter aspect. We demonstrate how the practices of ageing, science and technology are entangled in the design and use of technoscientific objects. This ongoing entanglement, we argue, transforms (and has transformed) the very idea of later life itself (see Vincent, 2006). The contributions in this special issue present empirical insights and develop conceptual tools to understand this transformation better by illuminating, in one way or the other, how technoscientific objects constrain or enable new practices and roles in the lives of older persons. Together, the contributions urge us to consider who acts, and is granted agency, in the design and use of science and technology; they highlight how technoscientific objects articulate definitions and role models for age and ageing; they explore how older persons are constrained by, but also re-articulate or defy such definitions and role models; and they illuminate what it means to grow old *with* science and technology as part of everyday culture.

Hence, this special issue addresses a pressing lacuna in the interdisciplinary study of ageing and gerontology. Indeed, gerontology has long demonstrated the social constitution of ageing (Baars, 1991; Dannefer and Daub, 2009), but it has sidelined the role of science and the design and use of technology as important arenas of this constitution (Neven, 2011; Joyce and Loe, 2010; McCreddie, 2010; Schwanen and Ziegler, 2011; Peine et al., 2014). Social and cultural gerontology have criticized the notion of ageing as a biomedical process, and have focused on the contextual factors that shape the practices and patterns of ageing, i.e., how the latter emerge and evolve at the intersection of institutions, role models, normative expectations and individual agency over the life course (Cain, 1964; Lawton and Nahemow, 1973; Riley, 1986; Kohli, 1986, 2007; Riley and Riley, 1994; Featherstone and Wernick, 1995; Katz, 2001; Cruikshank, 2003; Vincent, 2003; Dannefer and Settersten, 2010). Technology consumption has been shown to

be an important playing field in this process (Jones et al., 2008; Higgs et al., 2009; Gilleard and Higgs, 2011). Besides such broad claims, however, cultural and social gerontology have largely ignored science and technology as empirically and theoretically relevant topics (McCreadie, 2010). Regarding social science theories of later life, the classic Latourian divide still seems to be in place (Latour, 1993): social sciences have delivered profound insights into the social constitution of ageing. But they have thoroughly banished technoscientific objects from analyses of this constitution (Joyce and Loe, 2010; Schwanen and Ziegler, 2011), and relegated them to the realm of engineers and technologists. Vice versa, in the emerging interdisciplinary scientific community of Gerontechnology, social science insights about age, ageing and later life are typically regarded as a design input. As an interesting object for social science analyses in itself, however, the transformative effects of science and technology have barely received empirical and theoretical attention (Östlund, 2004; Peine and Neven, 2011; Jæger, 2005b; Mortensen et al., forthcoming).

This special issue uses concepts and approaches from Science and Technology Studies (STS) to close this gap. STS is the branch of social sciences—involving scholars with often interdisciplinary backgrounds in sociology, history, philosophy, science and/or technology—that acknowledges social existence as constituted in the interactions of agents, institutions and objects (Pinch and Swedberg, 2008, p.1). As such, STS moves beyond the traditional dichotomy between subjects (humans) and objects (non-humans)—a dichotomy that treats objects as passive, gaining “meaning only in symbolic terms in regard to the signification work that humans alone do” (Pinch and Swedberg, 2008, p.2). Instead, STS focuses on the co-production of technoscientific objects and social order, thus giving due weight to the role of science and materiality in constituting the “social” worlds we construct (Latour, 1987; Jasanoff, 2004; Law, 1986). As a field of study, STS has emerged in the 1960s⁴; since then, it has produced a prolific body of research that has opened the many “black boxes” of science and technology to demonstrate the inextricably linked nature of relations between science, technology and social processes (Bijker et al., 1987; Bijker and Law, 1992; Lie and Sørensen, 1996; MacKenzie and Wajcman, 1999; Latour, 2005). Linked to this idea is the important notion that particular sciences and technologies incorporate intentional or unintentional ‘scripts’ that pre-figure users’ identities and experience, while at the same time being shaped by them (Oudshoorn, 2011; Woolgar, 1991; Akrich, 1992, 1995; Hyysalo, 2009).

The contributions in this special issue make use of this rich conceptual background, and bring its value to bear on the study of science, technology and ageing. Together, the contributions create empirically grounded theoretical insights into how material culture and materiality have shaped the constitution of later life. The core themes are examined in a coherently connected set of substantial, empirically-researched and strongly theorized topics across a range of socio-material domains including: complex telecare systems; Ambient Assisted Living

(AAL) environments; mundane devices such as home shopping terminals, teapots, eyedrops and walkers; social gaming; welfare technology; regenerative medicine and tissue engineering; Information and Communication Technologies (ICTs), and service robot platforms. The STS perspective put forward in these contributions is important for the audience of *Technological Forecasting & Social Change* for two reasons:

First, the special issue explores the mechanisms through which explicit and implicit ideas about later life that inform innovation policy, such as “active ageing”, “ageing in place” or “living independently”, are embedded in science projects and technological designs through which they affect the lives of older persons. To this end, the first 7 articles in this collection focus on the locales and discourses of science and technology production, and investigate how certain ideas of ageing are constructed along with technoscientific objects. Together, these contributions unveil how policy objectives are articulated into often contradictory “scripts” (Akrich, 1992) for later life in socio-material practices. The STS perspective thus highlights design processes as arenas where policy objectives take shape and unfold their intended and unintended consequences as they materialize into obdurate objects (cf. Bijker, 1995). In this sense, these contributions throw into question the widespread gerontechnological belief that user involvement is the panacea to the problems of addressing older technology users (see Peace and Hughes, 2010). Instead, they open the black box of user involvement, and highlight how involving users is a structured process itself, characterized by context, premises, methodological choices, stereotypes and discourses that together shape its outcome (see Peine and Herrmann, 2012).

Second, using STS insights about the various roles of users and user-producers relationships in innovation processes (see Nahuis et al., 2012), the special issue sheds light on the intricate ways in which older persons themselves, as well as their peers, care givers and family members, transform and articulate ideas about later life through active engagements with technoscientific objects, including health technologies. Hence, the second part in this collection focuses on the use and domestication of science and technology as part of everyday culture. These papers contribute to the emerging body of research that throws into question existing stereotypes of older persons as passive recipients of science and technology (see for instance Mort et al., 2012; Joyce and Mamo, 2006; Joyce and Loe, 2010; Östlund, 2011; Östlund and Linden, 2011; Loe, 2011; Peine et al., 2014), and bring into sight older persons as *agents* that create and develop meaning for later life as they interact with technology. At a specific level, they further extend our knowledge about how practices of care are re-defined, but also disciplined, when older persons, care workers, other professionals and family members appropriate care technologies (see Pols and Moser, 2009; Mol et al., 2010; Mort et al., 2013). At a general level, contributions in this second part delve into the socio-material practices in homes and communities; they explore how older persons and their social networks construct meaning and identity through the use of technology; how they are constrained in this by the obduracy technology can unfold; how they innovate unexpected forms of use; how they struggle to establish continuity in the life course; and how they adapt technology to their evolving needs.

⁴ The first volume of the STS Handbook that consolidated the state of the art in the field was published in 1977 (Spiegel-Rösing and Price, 1977). The most recent volume of the handbook, with 38 chapters, is from 2005, and provides a comprehensive overview of STS themes, concepts and insights (Hackett et al., 2008).

Finally, this collection of articles not only presents original STS contributions to questions of science, technology and ageing. It also presents research of social gerontologist, nursing scientists and design researchers that have used the STS perspective successfully in enriching their own fields of study. While such attempts are still scarce, they demonstrate the value of *applied STS research* in a range of fields. We shall return to this point in the concluding section below.

3. Overview of contributions

The first 7 contributions investigate the arena of science and technology production. They explore how certain ideas about later life and ageing become part of technoscientific objects, and which mechanisms account for such inscription processes. Hence, [Lassen et al. \(2014\)](#) relate their experiences and findings as participants in a Danish public–private partnership aimed at developing technologies for the aged. The paper highlights the tensions and negotiations inherent to the development of welfare technologies in Denmark's public welfare state. We are shown how there is no fixed relationship between designers and aged people as users; rather, varying interests and perceptions are brought into uneasy alignments by creating collective 'doable problems', inevitably amounting to compromise both in the different visions of the stakeholders and in the designed artefacts themselves. Thus older people's everyday life collides with engineers' prototype development and in the process particular characters of end-users are constituted and co-produced. Is the public–private partnership a 'building-block' or is it simply a means by which certain engineers can obtain feedback by which to tweak their designs? Ethnographically investigating and mediating development of two types of technologies to enable active ageing, first through mental fitness and social interaction stimulation, and second through self-monitoring of painful conditions, the authors reflect on their own role as ethnographers, raising issues of 'representing' the intended users, and themselves questioning the legitimacy of this role. The advocacy that they found themselves involved with provoked tensions in the innovation partnership of which they were part.

[Compagna and Kohlbacher \(2014\)](#) reflect on their involvement as social scientists and ethnographers in a three-year Ambient Assisted Living (AAL) research project. Their paper focuses on the problems and contradictions of participatory technology development, and especially scenario-based design. Existing stereotypes about older persons, they argue, led project participants to prefer mediated forms of user participation to direct participation, and this led to a distorted way of involving older persons. Subsequently, the authors put the process of scenario development under scrutiny, and show how the choice and constitution of relevant use scenario was shaped by the need to balance social desirability with technological feasibility. Using an ethnographic analysis of the methods deployed in the project, they unravel a number of fundamental problems in the communication the developers had with different kinds of users, i.e. carers and residents of a care facility. We are shown how these problems together with unbalanced power-relations led to a situation where the developers had significantly more influences on the selection and formulation of the use scenarios. In that way, the paper specifies user involvement as a highly structured process in which "epistemic

objects", in this case the use scenarios, are created as "obligatory passage points" ([Callon, 1986](#)) that are difficult to defy in future design steps. Their ethnographic approach enabled the authors to demonstrate how developers rather than users were controlling the constitution of these obligatory passage point—something that, according to the authors, a purely STS analysis could not have done. The authors conclude with the insight that extensive stakeholder participation also bears the risk of distancing developers from the (social) contexts of use.

[Neven \(2014\)](#) explores the link between the often expressed desire of older people to remain living in their own home, and technological innovations as a way of enabling this. Drawing on actor-network theory and other theorization of representations of users, the paper analyses the development and test use of a telecare system—an Ambient Intelligent Monitoring System, using sensors placed round the home environment to detect movement etc.—for older people with severe health problems, in the Netherlands. Data were obtained via interviews with designers, a state-sponsored evaluator and care workers, and extensive documentary analysis. It is shown how engineers and care workers adopted a complex and strongly moralized alignment process between their work and the users. The author shows how 'older-people-want-to-live-at-home' was constructed as a normative, dominating discourse structuring the innovation and testing process. Such technologies, the author argues, may introduce 'age scripts' and reconfigure the home. Thus in this case the system introduced a 'passive' age script, and reconfigurations of the physical, social and emotional home were rendered invisible because of the normative force of the older-want-to-stay-at-home mantra, leaving little room for debate.

[Faulkner \(2014\)](#) locates issues of the configuration of users inside the human knee. He analyses the contemporary development of scientific understandings of knee cartilage injury or 'wear and tear' that may predispose sufferers to develop osteoarthritis, one of the world's most burdensome diseases of ageing. By analysing a range of scientific claims about emerging cell-based 'regenerative' therapies, Faulkner shows how the testing and trialling of these technologies are predominantly carried out in relatively youthful, fit people, while the claims about the market for these products focus mainly on the ageing population. Pointing to the development of an 'anti-ageing' medicine and transhumanism movements, Faulkner uses this case to argue that debate about technological innovation in ageing must be grounded in specific cases, that ageism may be present in science's configurations of usership and markets, and that regenerative medicine in this case is targeting quality of life rather than extension of life.

[Cuijpers and van Lente's \(2014\)](#) article about early diagnostics of Alzheimer's disease is a clear demonstration of how different discourses result in different ways of understanding and handling a disease. By an empirical study of two settings in which early diagnostics of Alzheimer's disease is brought into being, the authors unfold a set of 'interpretative packages' which at the one hand give meaning to the early diagnostic and on the other hand creates room for a range of positions. In one setting (a health technology assessment project) the early diagnostic mainly has the meaning of an important step to cure the disease while in the other setting (Alzheimer's Cafés) the early diagnostic primarily has the meaning of preparing the social network to take care of the patient. Recently, the cure

and the care discourses are described as two very different ways to understand Alzheimer's disease and in this way as a dichotomy. However, this study reveals that a much more nuanced understanding of the disease is constituted in both settings. Given the analysis the authors show that, instead of two opposite discourses, a variety of interpretative packages can be identified. Based on this nuanced understanding of the disease, the result of the study opens for a much broader variation in the ways to handle the disease in the lives of older persons.

Peine and Moors (2014) focus on the tensions in ICT-driven personal health systems (PHS), when such systems move into the homes and social networks of older people. The authors suggest conceiving of PHS as configurational technologies that need to strike a balance between providing standardized health care, on the one hand, and personalized solutions, on the other. The authors draw on the notion of “generification work” (Pollock et al., 2007) to show how knowledge about later life and older persons often enters design when the detailed insights obtained through user involvement need to be balanced with the need to define generic solutions. Their paper explores two research projects of PHS service robot platforms. Building on Callon's notions of ‘prosthesis’ and ‘habilitation’ (Callon, 2008) they identify two generification strategies in the projects, and demonstrate how the project designers were often unconsciously led into a prosthetic strategy. The paper concludes by arguing that in an ageing society innovation of personal health systems needs to address prosthesis and habilitation simultaneously. By making different mechanisms of generification work explicit, the paper provides interesting cues for policy makers and innovation managers to strike that balance.

Östlund et al. (2014) from their perspective of design studies, present a number of design projects in which STS insights and methods have been used to enrich the design processes of welfare technology. Their work represents a much-needed domain of applied STS, where STS theory is used by industrial designers and rehabilitation engineers to enrich thinking about users and use, and user representations (Akrich, 1992, 1995). The authors present examples from their experience in design science, and single out three important phases in design processes where STS knowledge can be particularly useful: the selection of older subjects, the understanding of the “social” in going from a laboratory context to real-life settings, and meaning making in product design. They specify how STS knowledge can enrich these phases. STS, the authors continue, bears the potential for a paradigm shift to foster the design and uptake of meaningful and pro-active technologies for older persons. This papers underpins and specifies how the designers' engagement with STS theories led to a richer imagination about prospective usership, and how methods of user involvement can thus benefit from taking STS insights and approaches on board.

The following 6 contributions take us into the homes and everyday lives of older persons. López Gómez (2014) engages with STS theory to problematize the notion of autonomy in active ageing policies and the ontological status of autonomy-enabling innovations in the lived experience of older persons' everyday lives. Drawing on ethnographic research conducted in the late 2000s in Catalonia, López Gómez analyses the process of installation and user-adoption of a telecare social alarm service, focusing on instances of friction with the service

reported by users. By attending to the material and pragmatic ‘little arrangements’ of spatial, caring and subjective aspects of everyday life, he argues that policy and practice should be more sensitive to the nuances of people's experience of and attitudes toward technology introduced into home life, showing how users incorporate or resist the technology (a pendant) in highly variable ways involving carers and their social networks and families. López Gómez thus concludes that the introduction of telecare technologies is inevitably also an interactive and evolving engagement with the social and cultural worlds of the users with all their infirmities, abilities and constant re-inventions.

In an ethnographic study of a telecare system in older people's home in Spain, Aceros et al. (2014) discover a clash between two modes of ‘good ageing’. It turns out that in the practice of the telecare system an understanding of older people as a fragile and homebound person is supported. However, this understanding clashes with the practice of some of the older people, who actively participated in their social network and thus came out of reach of the telecare system. Given this finding the investigation reveals that the telecare system was not designed to handle the practice of socially active older people. Instead the telecare system was used to domesticate the later life of active users. As such, the authors unravel the contradictory identities, activities and needs associated with the two modes of “active ageing” and “ageing in place”, and how these contradictions manifested in the practices of engaging with the telecare system. Based on these findings the authors suggest that future telecare devices should either be designed for use outside of the home or even located in the social network of the users as a part of a community care package.

With a background in reflexive ethnography, Suopajarvi (2014) investigates the intra-action (Barad, 2003) between older ICT users and the ubiquitous computing technology of the smart city of Oulu in Finland. Drawing on an ethnographic analysis of biographical interviews with older ICT users, she reveals how the socio-cultural environment and the older ICT users' earlier experience with technology influence how citizens handle the technology. In particular, her work highlights how existing discourses about older persons as inept ICT user frame the self-perceptions of study participants in mostly negative ways, and how this contrasts with the multiple ways the same participants were using ICT in their lives. Given this finding Suopajarvi discusses how designers of big technological systems can make use of this knowledge in the further design processes. Suopajarvi suggest that design of new technologies can greatly be enriched by the knowledge of the earlier experience of the users.

Pritchard and Brittain (2014) explore how social relations both mediate the functioning of alarm pendants as assistive devices for the care of older persons and in turn are mediated by these devices. Alarm pendant devices are often being promoted as a convenient and cost-saving alternative to more traditional human centred care. But these devices do not always work effectively. Provision can lead to feelings of stigma, discrimination and dehumanization and older people have a limited ability to resist the rationalization associated with these telecare devices. This paper identifies some negative side effects of pendants alarm provision, using insights from STS theories and building on Ritzer's McDonaldization of Society thesis to illustrate how rational systems, which are intended to

streamline older people's care through greater levels of efficiency, predictability, calculability and external control, often produce unanticipated and adverse social outcomes. The research shows that alarm pendants can imply low efficacy as well as increased work for older people and their carers. The authors argue that alarm pendants can unintentionally lead to dehumanizing feelings. They conclude by discussing the capacity of older people to resist dehumanization effects by using the device selectively, or not at all.

Saborowski and Kollak (2014) focus on care workers as users of assistive technology. Coming from a background in nursing studies, they explore how STS insights can enrich the education of carers, and make care technologies more acceptable for care workers. Their paper uses the ideas of domestication and “domesticability” (Peine and Neven, 2011) to highlight how an STS perspective resonates well with carers' need for tinkering and adjusting assistive devices with their daily routines and practices. Based on interviews with carers and care service managers, they show how this need for tinkering is often suppressed when assistive technologies are implemented. The authors also demonstrate how financial and legal constraints often add to this suppression, and how the “domesticability” of care technology is at cross-purposes with policy makers' and care managers' need to provide efficient solutions. By making the elements of this uneasy relationship explicit, the paper demonstrates how a notion of efficient implementation also needs to create space for tinkering and adjustment work. One way to foster such an enhanced idea of efficiency would be to incorporate knowledge about it, based on STS insights, in the education of carers, nurses and care managers.

Loe (2014), finally, examines how a group of 30 individuals aged 85–102 who are actively ageing at home negotiate health and illness on a daily basis, and how technology already figures in this process in important ways. Combining STS with medical sociology, Loe's study highlights how these “oldest old” use technologies of various kinds, ranging from walkers and pills to teapots and stoves, in order to construct meaningful lives. Her work demonstrates how later life is already interwoven with the often creative use of technology. Even the “oldest old”, Loe concludes, should then be seen as *technogenerians* whose lived realities shape and are shaped by technical objects in numerous ways. She urges gerontologists and gerontechnologists to attend more carefully to the forms in which creative encounters with technological artifacts constitute a resource for a meaningful later life. This may be particularly helpful in understanding older persons' use or non-use of biomedical interventions as deliberate and informed decisions in negotiating the boundaries between health and illness, something that Loe calls “biotech ambivalence”. (biotech ambivalence).

4. The socio-material constitution of later life

The contributions in this special issue put under scrutiny how science, technology and ageing are inextricably linked. Together, they explore the mediating effects of epistemic and material objects on what social and cultural gerontologists have called the social constitution of later life—the insights that individual ageing arises from “the reconstitutive and dialectical interplay of individual action and social processes that occur continuously in everyday life” (Dannefer and Daub, 2009, p. 17). Bringing to bear insights from STS on the study of

ageing, the special issue extends this notion of the social constitution of later life into the realm of science and technology to theorize the *socio-material constitution of later life*.

By this we mean that *materiality* matters if we want to understand the constitution of norms, role structures, institutions and discourses that together shape the forms and practices of ageing. And it matters in a sense that transcends the “accommodationist view” (see Dannefer, 2008) on science and technology that is prevalent in both gerontology and gerontechnology research—a view that sees science and technology as responding to otherwise largely independent age-related needs and limitations. The term socio-material constitution, by contrast, emphasizes that these needs and limitations themselves arise from interactions between actors, institutions, and material objects. STS approaches used in this special issue allow for zooming in on these interactions, and thus for grasping the use and production of science and technology as arenas in which ideas, conceptualizations and practices of later life take shape and evolve. In sum, therefore, this special issue demonstrates how STS insights and approaches are necessary to understand the ongoing transformation of later life in modern societies, where science and technology, as well as consumer lifestyles, are defining elements.

The articles in this collection illuminate the range of themes, questions, and challenges that are relevant for studying ageing with an STS perspective. Yet, more research is necessary to further develop the value of such an STS perspective for the study of ageing, for the design of gerontechnological innovation, and for innovation policymaking more generally. We want to highlight three such lines that we deem important for future inquiry:

First, different articles in this collection have begun to open the “black box” of user involvement. While user involvement has become a *sine qua non* for many gerontechnological innovations across different domains (Peace and Hughes, 2010), it has so far received little attention as an epistemic process itself. STS provides the means to grasp user involvement as a process of knowledge creation that is structured by materiality, epistemic styles and cultures, practices, power relations, stereotypes and available methods. Following the approaches deployed in the papers by Lassen et al., Compagna and Kohlbacher, Neven, Faulkner, Cuijpers and van Lente, and Peine and Moors will contribute to further understand how user involvement, like other epistemic processes, creates objects and representations, rather than an unfettered view on users and their needs. Further opening this black box will allow gerontechnology to move beyond the claim that users should be involved (and that more user involvement automatically leads to better knowledge about users), to a detailed understanding of how, when and why they should be involved (and also when and how they should probably *not* be involved). In fact, the studies in this collection suggest that the challenge is not so much the absence of knowledge about older technology users and later life; rather, it is to find the tools and channels to keep innovation processes focused on this knowledge. In particular the paper by Östlund et al. underlines how such an STS-enriched approach to design research can help avoiding common pitfalls when designing for older persons.

Secondly, articles in this collection explore the use of science and technology as arenas in which ideas and practices

of later life are re-articulated and negotiated. These studies are attentive to materiality in the everyday lives of older persons, carers, service operators, etc. They explore technoscientific objects and systems as things that act and interact. STS thus complements existing studies on consumer cultures in later life by highlighting that materiality is not comprised of (more or less) neutral objects, but that it re-arranges existing socio-technical orders for later life. By investigating the emerging socio-technical arrangements, and the distribution and configuration of agency that they engender, STS unfolds a fine-grained understanding of the disciplining and empowering aspects of materiality in later life. Following the approaches used by Aceros et al., Lopez, Soupajärvi, and Pritchard and Brittain will help ageing researchers to grasp how the products of science and technology 'act' to redefine problems, identities and norms of ageing. In other words, as Loe's and Suopajärvi's articles remind us, older persons already use technology in many creative ways, and STS research has the potential to bring this insight fully to bear on our understanding of shifting definitions of ageing. The article of Saborowski and Kollak demonstrates the practical value of such a perspective by highlighting how it is able to enrich the implementation of care technology as well as nursing curricula.

Finally, the socio-material constitution of later life perspective will allow policy makers and innovation managers to better grasp the future of ageing, and to address the challenges of innovating for older users on a more comprehensive basis. We argue that moving beyond an "accommodist" view that sees science and technology as mere solutions is crucial for designing technologies that allow for meaningful encounters in homes and communities, that are appealing to older persons (and their care givers), and that can address emerging health problems without primarily speaking to the biomedical aspects of later life. The various articles in this special issue are a testimony to how STS can help rethink the relations between science, technology and ageing in ways that do justice to the ongoing transformation of later life in socio-material practice. We hope that the studies in this collection inspire readers of *Technological Forecasting & Social Change* to explore further the socio-material arrangements that constitute later life, as we grow older *with* science and technology.

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