

Chapter 4

Technology and Ageing—Theoretical Propositions from Science and Technology Studies (STS)



Alexander Peine

Abstract In this chapter, I explore new grounds for theorizing ageing and digital technology. I do so by summarizing insights from critical studies of science and technology, i.e. the field of Science and Technology Studies (STS), in relation to ageing. The discussion revolves around three major insights that can be derived from the STS literature on ageing and technology: (i) that ageing and technology mutually shape each other, (ii) that older persons often are agents and co-creators in innovation processes and that (iii) design paternalism still often leads to ageist assumptions in technology projects. The sections are illustrated with empirical examples and together provide pertinent insights into the relevance of digital technologies in relation to theories of ageing and gerontechnology.

Keywords Gerontechnology · Active ageing · Design paternalism
Innovation

Highlights

- Summarizes insights from STS about ageing and technology
- Links digital technologies to theories of ageing
- Critically explores the notion of design paternalism

4.1 Introduction: The Technification of Later Life

The last few decades have witnessed an increasing interest in ageing and technology, especially in the context of innovation policy. In the European Union, large-scale innovation and technology programmes have focused on digital innovations to support what is often referred to as active and healthy ageing.

A. Peine (✉)
Utrecht University, Utrecht, Netherlands
e-mail: A.Peine@uu.nl

© Springer Nature Singapore Pte Ltd. 2019
B. B. Neves and F. Vetere (eds.), *Ageing and Digital Technology*,
https://doi.org/10.1007/978-981-13-3693-5_4

For instance, programmes like the 7th Framework Programme or the Ambient Assisted Living Joint Programme have funded research into digital technologies for older people with over a billion Euros between 2008 and 2013.¹ These programmes are European examples for a global trend to invest in *technological* solutions to the perceived challenges of demographic ageing, which is widely seen to be a threat to the sustainability of existing health and care systems, to pensions schemes, to the innovative capacity of economies and for the social relations between age groups more generally (Peine, Faulkner, Jæger, & Moors, 2015).

In academia, these developments are mirrored in the field of Gerontechnology, which is an interdisciplinary research domain that has explored new technologies and innovations in relation to the needs and practices of older persons (Burdick & Kwon, 2004; Charness & Schaie, 2003; Fisk, Rogers, Charness, Czaja, & Sharit, 2009; Graafmans & Taipale, 1998; Kwon, 2017). This paper is not the place to provide an extensive discussion of Gerontechnology (we have done so in the field's core journal, see Peine & Neven, 2011). Rather, I would like to focus on a twofold challenge that the field and relevant policy initiative face today, and that indicate a theoretical lacuna (Peine et al., 2015): On the one hand, it is widely recognized that the uptake and scale of Gerontechnologies, or, as it is more specifically phrased in current policy debates: "digital solutions" to the problems of ageing, have so far remained disappointing, when they run up against acceptability problems when meeting the muddled realities of everyday life and complex market forces (European Commission, 2017; Sixsmith, 2013). Their interventionist potential has not been realized because the complexities of human-machine interactions are both under-theorized and over-instrumentalized in technology projects (Neven & Peine, 2017). At the same time, with the global rise of digital infrastructures and new cohorts moving into retirement, the use of digital devices (including smartphones, tablets and PCs, fitness trackers, pedometers and other wearables) has become pervasive among all age groups (Loos, Haddon, & Mante-Meijer, 2012; Nimrod, Janke, & Kleiber, 2016; Pew Research Center, 2014; Rosales & Fernández-Ardévol, 2016).

Theories of this increasing *technification* of later life, however, have remained under-developed (Joyce & Mamo, 2006; Joyce, Peine, Neven, & Kohlbacher, 2017; Sixsmith, 2013). Most gerontologists, for instance, have long-ignored technology as an important theme for the social study of ageing. This has changed recently, with dedicated articles in gerontology's core handbooks and journals (Cutler, 2006; Jones, 2015; McCreddie, 2010; Schulz et al., 2015). These social science discussions have generally taken a more critical approach towards technology and ageing and ask important questions about the ethical, cultural and social consequences of technology in relation to ageing (Mort, Roberts, Pols, Domenech, & Moser, 2013). At a more fundamental level, they have raised the question in how far it is possible

¹Source: <http://ec.europa.eu/digital-agenda/en/research-and-innovation-ageing-well-ict> (accessed May 2018).

to grasp and theorize ageing and later life without attending to the role of digital and non-digital technologies in it.

Likewise, Gerontechnology, over the last 10–15 years has increasingly refined its methodological repertoire towards user involvement. It has considerably broadened its original focus on human factors engineering and usability (Czaja, Sharit, Charness, Fisk, & Rogers, 2001; Fisk et al., 2009), with fine-grained ethnographic accounts of later life and elaborate participative methods (Bailey, Foran, Scanail, & Dromey, 2011; Neves, Franz, Munteanu, & Baecker, 2017; Waycott et al., 2012). What remains, however, is a continued pre-figuration of technology as a possible solution. The analysis of users and user needs (however sophisticated) is framed by this and contextualized in relation to technological innovation and policy discourses around the “problems” of demographic change (Marshall & Katz, 2016). What has remained occluded behind these technology-driven and instrumentalized approaches are more fundamental changes in the nature of ageing and later life, where digital devices are becoming ubiquitous. Neither Gerontology nor Gerontechnology have yet provided the theoretical and empirical insights needed to understand later life itself as an already technologically mediated construct (Joyce et al., 2017; Sixsmith, 2013).

As a consequence, the current discussion meander between two poles (Neven & Leeson, 2015): On the one hand, policy debates widely position the *technification of later life* as something that needs to be established, and that has the potential to solve problems of ageing. At the same time, critical perspectives tend to focus on the negative potential impact of new technologies and ponder in how far they can or should be avoided (Pritchard & Brittain, 2015). What falls out from these debates is a careful attention to the technification of later life as an already ongoing development that can be studied without necessarily attending to new or modified technology. In our special issue on science, technology and ageing, we have called attention to what we term the *socio-material constitution of later life*: the fact that later life is increasingly permeated with digital objects, and that these are likely to change the ideas of “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” (Peine et al., 2015, p. 2).

In this chapter, I discuss three important insights from studies into the *socio-material constitution of later life*, and show how these insights are pertinent for conceptualizing ageing and digital technology, and to develop richer and probably more realistic ideas about older technology users. These insights are informed by critical studies of science and technology, a field widely known as Science and Technology Studies (STS, which is the branch of social sciences that acknowledges social existence as constituted in the interactions of humans and non-humans (Pinch & Swedberg, 2008).

This chapter is a critical reflection, collating insights from previous literature, based on their relevance in theorizing the ageing and technology relation. In this sense, it is a narrative rather than systematic review of the existing STS literature, focusing on what I deem to be key texts. I use empirical examples from earlier studies to highlight pertinent points for developing new theoretical grounds at the

intersection of STS and Gerontechnology. More specifically, to illustrate how science, technology and ageing should not be seen as separate domains. In fact, the most interesting theoretical questions and insights emerge where scholars have analysed these dimensions as inextricably linked and entangled in the “socio-material constitution of later life”.

4.2 Three Insights from Science and Technology Studies

4.2.1 *Mutual Shaping of Ageing and Technology*

STS studies have investigated how new technologies change the geography of homes and spaces (Mort, Roberts, & Callen, 2012). There is a rich body of scholarship that has used ethnographic research to meticulously trace changing practices, responsibilities and roles that crystalize around the introduction of TeleCare technologies like alarm pendants or remote monitoring in the homes of older persons. Taking a critical stance on the evaluation of TeleCare in terms of efficiency and effectiveness, these studies have brought to the fore how the introduction of TeleCare technologies shifts the networks and relations between people and technology (Oudshoorn, 2011). In this perspective, technology itself is seen as an inherent part of the social, and thus gives rise to new socio-technical arrangements at home and in the wider care system (Milligan, Roberts, & Mort, 2011). Hence, remote monitoring systems not only contribute to solving existing problems of their users or in existing care systems, they also introduce new actors—such as installers or monitoring centre operators—and new practices into the care systems. Sanchez-Criado, López, Roberts, and Domenech (2014), for instance, have demonstrated how installers decide where to put sensors in the homes of older persons. They show how such decisions were frequently based on routine and technical concerns, rather than aesthetic, personal or privacy reasons. As such, they could critically disturb the emotional appeal of a home. As an overarching theme in these studies, technology is analysed and evaluated in the wider array of socio-material practices to which it gives rise, and in which it is entangled (Joyce et al., 2017). TeleCare systems then matter beyond efficiency concerns, as they can delicately disrupt sense of home, power relations at home and opportunities for maintaining and developing a sense of self. They can of course also contribute to all these aspects—which then becomes a crucial consequence of how such systems are designed and implemented.

The main insights from these studies are that TeleCare systems, while probably helping us to age in place, also disrupt how we experience the place in which we age (Neven, 2015) and the many small arrangements we rely on in order to lead autonomous lives (López Gómez, 2015). TeleCare systems require constant care by those using them to make the systems meaningful, and to attune them with the existing practices, routines and arrangements that make up our homes. Above all, therefore, this scholarship has critically questioned the narrative of technology and

innovation as solutions to otherwise independent problems that occur in home environments (Oudshoorn, 2011). Instead, it has highlighted how such “solutions” re-arrange the relations between people, space and technologies that constitute such environments.

There is a broader theoretical lesson implicit to these studies, which have, by necessity, focused on the rather mundane TeleCare technologies that are already available to us, like monitoring devices and alarm pendants: It is highly problematic to talk about gerontechnologies as solutions or interventions and evaluate them one-sidedly in terms of their efficiency or effectiveness, as it is widely done in ongoing policy discourses (Neven & Peine, 2017). Such a perspective runs the risk to overlook the more fundamental changes the ongoing technification of later life has had and will have on our home environments, and the intricate work needed to incorporate new technologies into these environments in meaningful ways.

4.2.2 Older Persons as Agents and Co-creators

A second important line of STS reasoning has highlighted technology use (and implementation) as an innovative process itself, thus questioning the very notion of a “user” (Peine & Herrmann, 2012). In particular, the STS metaphor of “domestication” is pertinent in this regard and has recently been studied in relation to ageing and later life. Domestication research explores in detail how newly acquired technical objects gradually become part of everyday routines, practices and identities (Silverstone, Hirsch, & Morley, 1992). Through domestication, originally alienating technical objects, once entering a home, are turned into something familiar so that domestication “quite literally involves a taming of the wild and a cultivation of the tame” (Oudshoorn & Pinch, 2008). Domestication is a process where users create a physical space and temporal routines for a new technology and establish its particular meaning and relevance. The key insight from domestication studies highlights how innovation reaches well into the domain of technology use. Designs are propositions to users who can and will respond in situated, often unforeseen but meaningful ways. The tradition of domestication research is a valuable source of inspiration: mostly using ethnographical methods, it has explored the often intricate ways in which users put new technologies to use, thus inventing unforeseen forms of use and sometimes also altering the technology itself.

In a domestication perspective, important questions regarding the agency of older people in relation to technology become visible. For instance, the implementation studies above have highlighted that TeleCare systems don’t, or only partially, exist in a generic form, but come into being only through an intricate process of implementation (Pols & Willems, 2011; Sanchez-Criado et al., 2014). The underlying ethnographic approach has brought to the fore the intricate work older persons (often together with their caregivers) perform in order to domesticate and “tame” TeleCare systems (Pols & Willems, 2011). This relates to a long-standing tradition in social gerontology that has highlighted older persons as

agents of their own life (cf. Dannefer & Daub, 2009): older persons are not just passive respondents to their social and physical environments, and the norms and symbolic values embodied in them, but also pro-actively interact with their environments to reconstruct them in the light of changing life circumstances. This line of empirically grounded theorizing has highlighted that many negative images about older persons as passive and frail are rooted in ageist stereotypes that permeate the public imagery about later life (Featherstone & Hepworth, 2005; Vines, Pritchard, Wright, Olivier, & Brittain, 2015), rather than in actual empirical findings about the experience of ageing at home.

STS scholarship has also focused on older persons as active participants in processes of technoscientific change. It has critically questioned widespread notions of older persons as technologically inept and vulnerable technology users. Across a range of domains, including robots, TeleCare systems, electrical bikes, mundane devices like teapots and walkers and more sophisticated AAL systems, this scholarship has demonstrated how older persons pro-actively engage with technologies—new and old—in their home environment, often modifying them in innovative ways (Joyce & Mamo, 2006; Loe, 2015; Neven, 2015; Peine, van Cooten, & Neven, 2017). Notably, these insights are not confined to younger and healthy elderlies, those typically associated with the experience of the 3rd age (see Moen & Spencer, 2006), but include people with dementia (Brittain, Corner, Robinson, & Bond, 2010) and women in their nineties (Loe, 2010). Or, as Joyce and Loe have concisely in their notion of *technogenarians*: “[...] old people are not passive consumers of technologies such as walking aids and drugs. Elders creatively utilise technological artifacts to make them more suitable for their needs even in the face of technological design and availability constraints” (Joyce & Loe, 2010, p. 172). In the light of these insights, ageist representations of older persons as new to technology, or largely incompetent and easily overburdened seem to be grounded in ageist assumptions rather than actual observations of their everyday life, which already contains many relationships with technical objects (Joyce & Mamo, 2006).

Bringing the insights from all the above together, a critical challenge emerges at the intersection of technological innovation and the societal imagery of older persons. On the one hand, recent insights into ICT-driven innovation processes, including those about TeleCare discussed above, have shown that there is an ongoing transition in the kind of technologies that proliferated to home environments. Instead of single devices, technological systems are becoming a focal point of innovation activities where different products and services interoperate in an integrated environment. Prominent examples are already available systems, such as flat-screen televisions that are integrated with internet services as video on demand or more sophisticated and emerging concepts, such as the Smart Home or Ambient Intelligence. The distinctive feature of these systems is that they cannot be purchased and used off the shelf. Rather, their definite set-up or configuration depends on the inputs of end-users, and the situated practices and routines with which they are arranged (Peine, 2009).

Hence, we see a shift of home-based technologies away from single devices and services to more comprehensive digital environments that are ongoing personal projects, specific to local circumstances and evolving over time. This shift commands new roles for consumers that have increasingly become co-creators and “innosumers” of their digital home environments (Peine, Rollwagen, & Neven, 2014). The above studies into the domestication of Gerontechnology have demonstrated that older persons already act as such co-creators in many ways. Many gerontechnologies of today, however, seem to be limited in addressing such agentic and active notions of later life, and rather proceed on a rather narrow imagery of what users should be doing with them (Aceros, Pols, & Domènech, 2015; Neven, 2015; Peine & Neven, 2011).

The key question therefore seems to be if Gerontechnology design is ready to address older technology users in more proactive and competent ways? This is linked to a third line of relevant STS insights, which has critically analysed technological design in terms of the ideas of older people that it creates. Hence, in the following section, I compile the emerging evidence to demonstrate that the Gerontechnology domain still struggles with what we have called “design paternalism” (Peine et al., 2014)—an often implicit assumption that older persons need not be bothered by technology.

4.2.3 Design Paternalism

STS has a long tradition in studying how technology developers and designers arrive at ideas about their future users, how they “inscribe” them into technological objects, and how these ideas thus “act” upon society through the materiality in which they are embodied. Research has addressed the practices of designers in constructing representations of users and use (Akrich, 1992, 1995). The essence of such studies is that designers imagine what their users will be like, and how they will integrate technologies into their lives. They thus represent and imagine future users (Akrich, 1995). To varying extends design, choices are based on such representations and images thus making more accessible certain forms of use rather than others. Processes of representing and inscribing are problematic. Because they exert power on possible forms of engagement with a technology; they are not innocent.

In relation to older persons, processes of representing and inscribing might prove to be particularly problematic as these processes—whether or not they are based on formal or informal forms of user involvement—are often influenced by publicly shared stereotypes. As Neven (2011) has shown, when designing for older people, there is a risk that designers resort to stereotypes, i.e. to standardized images and simplified notions of what ageing and older technology users are. As highlighted above, stereotypes about ageing can be, and often are, particularly problematic. They frequently position older persons as a homogeneous group that can easily be linked to discourses about vulnerability and illness, as work about ageism and the

public imaginary of later life has comprehensively shown (Bytheway, 2005). Designing for older people, in particular when paired with a view of technologies as solutions to problems, has a particular risk of incorporating, implicitly or explicitly, such stereotypes, and thus reinforcing them by giving them a material form.

An interesting cue that has emerged from such studies is the fact that ageist stereotypes seem to permeate many designs despite elaborate attempts to involve users and understand their needs and life circumstances. To address this puzzle, recent scholarship has investigated user involvement as structured processes of knowledge creation, influenced by context, premises, methodological choices, stereotypes and discourses that together shape its outcome (Peine & Herrmann, 2012). Indeed, while user involvement has apparently become a *sine qua non* for many gerontechnological innovations across different domains (Peace & Hughes, 2010), it has so far received little attention as an epistemic process itself.

Following a theoretical sampling approach to identify the relevant subset of studies published in all issues of the journal *Gerontechnology*, Peine and Neven (2011) analysed all studies that discussed user involvement and user needs. What becomes apparent from this analysis is an implicit theoretical assumption about the position of needs vis-à-vis new technology, i.e. that older persons' habits, routines and needs pre-exist new technology. In this perspective, good Gerontechnology is technology that fits an identifiable set of needs; the more is known about these needs, the better the technology will suit the lives of older persons. This implies a particular division of labour between designers and users: the needs of users have to be understood before technology can be designed to meet them. It is thus within the domain of designers that user needs have to inform choices that need to be made about how to meet these needs. In this sense, all three modes seem to leave the authority of designers intact over how to determine and to meet the needs of older technology users.

Following along these lines, the concrete mechanisms have been studied of how processes of user involvement create certain imaginaries of later life with technology, while downplaying others, and thus opening the "black box" of user involvement. For instance, collaborative projects need to define doable problems (Lassen, Bønnelycke, & Otto, 2015). User involvement thus involves a translational process by which often complex knowledge about the situated nature and diversity of lived realities needs to be conveyed into well-specified problems and associated needs as an input and target for design. Disabilities or illnesses seem to be the low hanging fruit in this regard, which can be translated most conveniently into doable cues (Lassen et al., 2015; Malanowski, 2009). What is more, reducing complexity and diversity into sets of needs is vulnerable to imbalanced power relations between users and designers (Compagna & Kohlbacher, 2015), as well as preconceptions about older persons. Having sophisticated knowledge about the lived realities of older persons is thus not a guarantee that this knowledge will also overwrite competing ageist assumptions in design processes. In an earlier study, we have highlighted therefore that smart processes of generification work seem to be more important than user involvement per se (Peine & Moors, 2015). That is, smart processes by which often prolific and diverse knowledge about ageing and later life is translated and simplified in order to make it productive in design processes.

These studies have illuminated the closure mechanisms by which competing types of knowledge about older persons are foregrounded or sidelined in different stage of user-centred design—thus questioning the assumption that user involvement per se enriches the imagery of later life in design. Together, they provide a rich repertoire to understand how user involvement, like other epistemic processes, creates objects and representations, rather than an unfettered view on users and their needs. Having opened the “black box” of user involvement has underpinned that it is important to move beyond the mere claim that users should be involved (and that more user involvement automatically leads to better knowledge about users) and to arrive at and proceed on 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, this set of studies suggests 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, it seems, when older persons are considered as end-users.

This discussion highlights that and how Gerontechnology is still influenced by what we have called “design paternalism” (Peine et al., 2014). This notion highlights that technology is still widely framed, often implicitly, as having to meet and support already existing needs and practices. While this can be an important approach in some cases, design paternalism bears the risk to downplay and sometimes downrightly hamper the possibilities of older persons to creatively engage with technological environments. In other words, design paternalism caters to certain images and aspects of later life, but it does not do justice to the fact that the lived experiences of old age are highly diverse, including new aspirations, learning and creativity. In that sense, it still involves an uncomfortable framing of older technology users as passive recipients of technology—recipients that are not expected to go beyond existing preconceived needs, whose playful engagement with technology is positioned within a rhetoric of overburdening and error, and that have to be comforted rather than challenged by new technology. STS studies into design paternalism have demonstrated the sources for such framing, which often prevails despite intentions to the contrary (Peine & Moors, 2015).

4.3 Conclusions

In this paper, I have explored three contributions that STS studies can make to the ageing and digital technology domain, and to *theorizing* this domain, in particular. STS has only recently begun to investigate the technology and ageing domain, and its impact on Gerontechnology has so far been limited. In this chapter, I have tried to identify key themes from the STS literature that may constitute new frontiers for Gerontechnology theorizing. These new frontiers pertain to both how we should understand later life with technology and how we should address and engage with older users in design processes. They can be summarized in the following three points.

Firstly, digital technology and innovation do not provide solutions to the alleged problems and challenges of ageing, but they contribute to the way we define, think about and address these problems and challenges. In fact, technology has already contributed significantly to contemporary experiences of later life (Peine et al., 2015), and with more digital innovation underway this process is becoming much more significant. The STS scholarship discussed in above has demonstrated the importance of studying in detail the social life worlds of older persons with technology. One particularly important theme that transpires from these studies is that technology and innovation are important yet under-researched domains in which ageist representations of later life still often prevail. In fact, STS studies have shown that design and innovation processes can be vulnerable to resorting to publicly available images about older persons as technically inept and vulnerable despite often elaborate attempts to involve users (Peine & Moors, 2015). If designed with such imagery in mind, technologies like new TeleCare systems can indeed contribute to strengthen such images through the way they are designed. Detailed, micro-level studies about older persons and their use of technology in everyday life, and about their often hidden work to “domesticate” new digital technologies, constitute an excellent starting point for a new and probably more realistic imagery of older persons and their relation with technology. STS work has highlighted, in particular, that older persons, like all users and consumers (see Oudshoorn & Pinch, 2008), are agents in processes of technological change even when facing severe medical conditions (Peine et al., 2014). Incorporating such a perspective into a new and richer imagery of later life with technology then emerges as a central yet under-researched factor in combating ageism—a key challenge recently identified in the WHO Global Strategy on Ageing and Health.²

Secondly, *digital technologies designed in the context of active and healthy ageing meet their end-users at home and in the community*. Hence, it becomes important to realize that we design places rather than devices or solutions. The scholarship discussed above has impressively shown how new technologies reshape responsibilities and roles at the level of homes or care networks. For home environments, it thus becomes difficult to assess TeleCare technologies in terms of their efficiency and effectiveness regarding isolated conditions or problems. In fact, whether these technologies are experienced as empowering and enriching, or to the contrary as “dehumanizing” or alienating, depends on how they interact with the many little arrangements that we call “home” (López Gómez, 2015). For home-based digital health technologies, this challenges existing notions of “evidentiality” (Faulkner, 2009) that stem from the place in which health and care have traditionally been developed, such as hospitals, care homes or doctor’s offices. For Gerontechnology, it is thus a key challenge to ponder and develop new types of

²See the WHO’s “Global Strategy and Action Plan on Ageing and Health”, <http://www.who.int/ageing/global-strategy/GSAP-ageing-health-draft.pdf> (last accessed: 12 November 2015).

evidence and criteria that take the complexities of digital home environments on board and provide insight into how well a digital home allows for a meaningful and enriching engagement with the physical and social environments.

Finally, *there is need to re-conceptualize the nature of Gerontechnology and the underlying innovation processes*. Recent research has demonstrated that and how ICT at home constitutes dynamic digital environments that change over time and that are specific to cultural and personal circumstances. Digital homes, including health and care technologies, are ongoing personal projects that exist as specific representations and variants of a broader idea (Peine, 2009; Pols & Willems, 2011). This development has engendered new roles of users and consumers as active co-creators and “makers” of their digital environments which provide important configurational work to maintain and develop these environments. As a final challenge and indeed opportunity, this highlights the need to take a more forward-looking perspective on digital technologies of the future and scrutinize how people of all ages co-create digital environments to navigate the life course on their own terms, seizing new opportunities for creativity, learning and social engagement.

References

- Aceros, J. C., Pols, J., & Domènech, M. (2015). Where is grandma? Home telecare, good aging and the domestication of later life. *Technological Forecasting and Social Change*, *93*, 102–111.
- Akrich, M. (1992). The description of technical objects. In W. E. Bijker & J. Law (Eds.), *Shaping technology/building society—Studies in sociotechnical change* (pp. 205–224). Cambridge: The MIT Press.
- Akrich, M. (1995). User representations: Practices, methods and sociology. In A. Rip, T. J. Misa, & J. Schot (Eds.), *Managing technology in society: The approach of constructive technology assessment* (pp. 167–184). London: Pinter Publishers.
- Bailey, C., Foran, T. G., Scanaill, C. N., & Dromey, B. (2011). Older adults, falls and technologies for independent living: A life space approach. *Ageing & Society*, *31*(05), 829–848.
- Brittain, K., Corner, L., Robinson, L., & Bond, J. (2010). Ageing in place and technologies of place: The lived experience of people with dementia in changing social, physical and technological environments. *Sociology of Health & Illness*, *32*(2), 272–287.
- Burdick, D. C., & Kwon, S. (Eds.). (2004). *Gerontechnology—Research and practice in technology and aging*. New York: Springer Publishing Company.
- Bytheway, B. (2005). Ageism. In M. L. Johnson, V. L. Bengtson, P. G. Coleman, & T. B. L. Kirkwood (Eds.), *The Cambridge handbook of age and ageing* (pp. 338–345). Cambridge: Cambridge University Press.
- Charness, N., & Schaie, K. W. (Eds.). (2003). *Impact of technology on successful aging*. New York: Springer Publishing Company.
- Compagna, D., & Kohlbacher, F. (2015). The limits of participatory technology development: The case of service robots in care facilities for older people. *Technological Forecasting and Social Change*, *93*, 19–31.
- Cutler, S. (2006). Technological change and aging. In R. H. Binstock & L. K. George (Eds.), *Handbook of aging and the social sciences* (pp. 258–276). Burlington: Academic Press.

- Czaja, S. J., Sharit, J., Charness, N., Fisk, A., & Rogers, W. (2001). The center for research and education on aging and technology enhancement (CREATE): A program to enhance technology for older adults. *Gerontechnology, 1*(1), 50–59.
- Dannefer, D., & Daub, A. (2009). Extending the interrogation: Life span, life course, and the constitution of human aging. *Advances in Life Course Research, 14*(1&2), 15–27.
- European Commission. (2017). *Blueprint digital transformation of health and care for the ageing society*. Available online <http://bit.ly/2j4gxCG>. Accessed January 8, 2018.
- Faulkner, A. (2009). *Medical technology into healthcare and society: A sociology of devices, innovation and governance*. Basingstoke: Palgrave Macmillan.
- Featherstone, M., & Hepworth, M. (2005). Images of ageing: Cultural representations of later life. In M. L. Johnson, V. L. Bengtson, P. G. Coleman, & T. B. L. Kirkwood (Eds.), *The Cambridge handbook of age and ageing* (pp. 354–362). Cambridge: Cambridge University Press.
- Fisk, A. D., Rogers, W. A., Charness, N., Czaja, S. J., & Sharit, J. (2009). *Designing for older adults—Principles and creative human factors approaches*. Boca Raton: CRC Press.
- Graafmans, J., & Taipale, V. (1998). Gerontechnology—A sustainable investment in the future. In J. Graafmans, V. Taipale, & N. Charness (Eds.), *Gerontechnology—A sustainable investment in the future* (pp. 3–6). Amsterdam et al.: IOS Press.
- Jones, I. R. (2015). Connectivity, digital technologies and later life. In J. Twigg & W. Martin (Eds.), *Routledge handbook of cultural gerontology* (pp. 438–446). London: Routledge.
- Joyce, K., & Loe, M. (2010). A sociological approach to ageing, technology and health. *Sociology of Health & Illness, 32*(2), 171–180.
- Joyce, K., & Mamo, L. (2006). Graying the cyborg: New directions in feminist analyses of aging, science, and technology. In T. Calasanti & K. Slevin (Eds.), *Age matters: Realigning feminist thinking*. Taylor & Francis Group, Routledge: New York, London.
- Joyce, K., Peine, A., Neven, L., & Kohlbacher, F. (2017). Aging: The socio-material constitution of later life. In U. Felt, R. Fouché, C. Miller, & L. Smith-Doerr (Eds.), *The handbook of science and technology studies* (4th ed., pp. 915–942). Cambridge: The MIT Press.
- Kwon, S. (Ed.). (2017). *Gerontechnology: Research, practice, and principles in the field of technology and aging*. New York: Springer Publishing.
- Lassen, A. J., Bønnelycke, J., & Otto, L. (2015). Innovating for ‘active ageing’ in a public–private innovation partnership: Creating doable problems and alignment. *Technological Forecasting and Social Change, 93*, 10–18.
- Loe, M. (2010). Doing it my way: Old women, technology and wellbeing. *Sociology of Health & Illness, 32*(2), 319–334.
- Loe, M. (2015). Comfort and medical ambivalence in old age. *Technological Forecasting and Social Change, 93*, 141–146.
- Loos, E., Haddon, L., & Mante-Meijer, E. (Eds.). (2012). *Generational use of new media*. Adlarshot: Ashgate.
- López Gómez, D. (2015). Little arrangements that matter. Rethinking autonomy-enabling innovations for later life. *Technological Forecasting and Social Change, 93*, 91–101.
- Malanowski, N. (2009). ICT-based applications for active ageing: Challenges and opportunities. In M. Cabrera & N. Malanowski (Eds.), *Information and communication technologies for active aging—Opportunities and challenges for the European Union* (pp. 107–127). Amsterdam: IOS Press.
- Marshall, B. L., & Katz, S. (2016). How old am I? Digital culture and quantified ageing. *Digital Culture & Society, 2*(1), 145–152.
- McCreadie, C. (2010). Technology and older people. In D. Dannefer & C. Phillipson (Eds.), *The Sage handbook of social gerontology* (pp. 607–617). London: Sage.
- Milligan, C., Roberts, C., & Mort, M. (2011). Telecare and older people: Who cares where? *Social Science and Medicine, 72*(3), 347–354.
- Moen, P., & Spencer, D. (2006). Converging divergences in age, gender, health, and well-being—Strategic selection in the third age. In R. H. Binstock & L. K. George (Eds.), *Handbook of aging and the social sciences* (pp. 127–144). Amsterdam: Elsevier.

- Mort, M., Roberts, C., & Callen, B. (2012). Ageing with telecare: Care or coercion in austerity? *Sociology of Health & Illness*, 35(6), 799–812.
- Mort, M., Roberts, C., Pols, J., Domenech, M., & Moser, I. (2013). Ethical implications of home telecare for older people: A framework derived from a multisited participative study. *Health Expectations*.
- Neven, L. (2011). *Representations of the old and ageing in the design of the new and emerging: Assessing the design of ambient intelligence technologies for older people*. Enschede: University of Twente.
- Neven, L. (2015). By any means? Questioning the link between gerontechnological innovation and older people's wish to live at home. *Technological Forecasting and Social Change*, 93, 32–43.
- Neven, L., & Leeson, C. (2015). Beyond determinism: Understanding actual use of social robots by older people. In D. Prendergast & C. Garattini (Eds.), *Ageing and the digital life course* (Vol. 3, pp. 84–102). New York: Berghahn.
- Neven, L., & Peine, A. (2017). From triple win to triple sin: How a problematic future discourse is shaping the way people age with technology. *Societies*, 7(3), 26–37.
- Neves, B. B., Franz, R. L., Munteanu, C., & Baecker, R. (2017). Adoption and feasibility of a communication app to enhance social connectedness amongst frail institutionalized oldest old: An embedded case study. *Information, Communication & Society*, 1–19.
- Nimrod, G., Janke, M. C., & Kleiber, D. A. (2016). Leisure and aging qualitative research 15 years into the third millennium. *Journal of Leisure Research*, 48(1), 12–14.
- Oudshoorn, N. (2011). *Telecare technologies and the transformation of healthcare*. Basingstoke: Palgrave Macmillan.
- Oudshoorn, N., & Pinch, T. (2008). User-technology relationships: Some recent developments. In E. J. Hackett, O. Amsterdamska, M. Lynch, & J. Wajcman (Eds.), *The handbook of science and technology studies* (3rd ed., pp. 541–565). Cambridge: The MIT Press.
- Peace, S., & Hughes, J. (Eds.). (2010). *Reflecting on user-involvement and participatory research*. London: Center for Policy and Aging.
- Peine, A. (2009). Understanding the dynamics of technological configurations—A conceptual framework and the case of smart homes. *Technological Forecasting and Social Change*, 76(3), 396–409.
- Peine, A., Faulkner, A., Jæger, B., & Moors, E. (2015). Science, technology and the 'grand challenge' of ageing—Understanding the socio-material constitution of later life. *Technological Forecasting and Social Change*, 93, 1–9.
- Peine, A., & Herrmann, A. M. (2012). The sources of use knowledge: Towards integrating the dynamics of technology use and design in the articulation of societal challenges. *Technological Forecasting and Social Change*, 79(8), 1495–1512.
- Peine, A., & Moors, E. H. M. (2015). Valuing health technology—Habilitating and prosthetic strategies in personal health systems. *Technological Forecasting and Social Change*, 93, 68–81.
- Peine, A., & Neven, L. (2011). Social-structural lag revisited. *Gerontechnology*, 10(3), 129–139.
- Peine, A., Rollwagen, I., & Neven, L. (2014). The rise of the “innosumer”—Rethinking older technology users. *Technological Forecasting and Social Change*, 82, 199–214.
- Peine, A., van Cooten, V., & Neven, L. (2017). Rejuvenating design: Bikes, batteries, and older adopters in the diffusion of e-bikes. *Science, Technology and Human Values*, 42(3), 429–459.
- Pew Research Center. (2014). *Older adults and technology use*. Retrieved March 17, 2017, from <http://pewrsr.ch/2mAljr9>.
- Pinch, T., & Swedberg, R. (2008). Introduction. In T. Pinch & R. Swedberg (Eds.), *Living in a material world: Economic sociology meets science and technology studies* (pp. 1–26). Cambridge: The MIT Press.
- Pols, J., & Willems, D. (2011). Innovation and evaluation: Taming and unleashing telecare technology. *Sociology of Health & Illness*, 33(3), 484–498.
- Pritchard, G. W., & Brittain, K. (2015). Alarm pendants and the technological shaping of older people's care. *Technological Forecasting and Social Change*, 93, 124–132.
- Rosales, A., & Fernández-Ardévol, M. (2016). Beyond WhatsApp: Older people and smartphones. *Romanian Journal of Communication and Public Relations*, 18(1), 27–47.

- Sanchez-Criado, T., López, D., Roberts, C., & Domenech, M. (2014). Installing telecare, installing users: Felicity conditions for the instauration of usership. *Science, Technology and Human Values*, 39(5), 694–719.
- Schulz, R., Wahl, H. W., Matthews, J. T., De Vito Dabbs, A., Beach, S. R., Czaja, S. J., et al. (2015). Advancing the aging and technology agenda in gerontology. *Gerontologist*, 55(5), 724–734.
- Silverstone, R., Hirsch, E., & Morley, D. (1992). Information and communication technologies and the moral economy of the household. In R. Silverstone & E. Hirsch (Eds.), *Consuming technologies—Media and information in domestic spaces* (pp. 15–31). London: Routledge.
- Sixsmith, A. (2013). Technology and the challenge of aging. In A. Sixsmith & G. Gutman (Eds.), *Technologies for active aging* (pp. 7–25). New York: Springer.
- Vines, J., Pritchard, G., Wright, P., Olivier, P., & Brittain, K. (2015). An age old problem: Examining the discourses of ageing in HCI and strategies for future research. *ACM Transaction on Computer-Human Interaction*, 22, 1, Article 2. <https://doi.org/10.1145/2696867>.
- Waycott, J., Pedell, S., Vetere, F., Ozanne, E., Kulik, L., Gruner, A., et al. (2012). Actively engaging older adults in the development and evaluation of tablet technology. In *Proceedings of the 24th Australian Computer-Human Interaction Conference* (pp. 643–652).

Alexander Peine (Ph.D.) holds a tenured position as Assistant Professor of Science, Technology and Innovation Studies at Utrecht University. He serves as a Vice President of the European Construction Technology Platform, chairing the Active Ageing and Design Committee. He is also on the advisory board of the EU’s Joint Initiative “More Years, Better Lives”, and convenes a pan-European commitment on “Active Ageing and the Built Environment” in the European Innovation Partnership on Active and Healthy Ageing. Alexander’s research analyses innovation dynamics in the ICT sectors and the built environment, covering Internet of Things, Smart Homes and Active and Assisted Living (AAL).