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# From Intervention to Co-constitution: New Directions in Theorizing about Aging and Technology

Alexander Peine, PhD,<sup>1,\*</sup> and Louis Neven, PhD<sup>2</sup>

<sup>1</sup>Innovation Studies, Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, The Netherlands. <sup>2</sup>Active Ageing Research Group, Avans University of Applied Sciences, Breda, The Netherlands.

\*Address correspondence to: Alexander Peine, PhD, Copernicus Institute of Sustainable Development, Utrecht University, P.O. Box 80115, 3508 TC Utrecht, The Netherlands. E-mail: [a.peine@uu.nl](mailto:a.peine@uu.nl)

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## Abstract

We propose directions for future research on aging and technology to address fundamental changes in the experience of later life that come with the “digitization” of societies. Our argument is contextualized by the massive investments of policy makers and companies in gerontechnologies and their failure to create scale and impact. Partly this failure is due to an *interventionist logic* that positions new technologies as interventions or solutions to the problems of aging. What has been overlooked – at least *theoretically* – is how aging is already co-constituted by gerontechnology design, the socio-material practices it enacts, and the policy discourse around them. Goals are (a) reviewing elements of the current aging and technology agenda, (b) demonstrating how the *interventionist logic* has hampered theory development (and practical impact), (c) pulling together key insights from the emerging body of empirical literature at the intersection of social gerontology and Science and Technology Studies (STS), with the objective of (d) providing directions for future research on aging and technology. Our argument presents the theoretical gains that can be made by combining insights from STS and social gerontology to research the co-constitution of aging and technology.

**Keywords:** Technology, Innovation, Science and technology studies, Gerontechnology

## Introduction: A Brief History of the Aging and Technology Agenda

When [Schulz and colleagues \(2015\)](#) introduced the notion of the aging and technology agenda in this journal, they provided an overview of current technologies for older people and research about their effects on later life. They also pointed out a lack of theory that links technology more closely to mainstream research on aging (p. 732). In this article, we engage critically with the state of the art in *theorizing* about aging and technology. We use the term aging and technology agenda as an apt denomination that includes research, practice and policy in the field. Our main point is that this agenda is constrained by an *interventionist logic* that analytically separates technology from aging, and thus ignores how aging and technology are co-constituted.

Research on aging and technology dates back to the 1980s when human factors engineers and gerontologists started to collaborate on questions at the intersection of technological and demographic change ([Robinson, Livingston, & Birren, 1988](#)). The overriding concern in these early days was practical: how can technological environments be adapted to the needs of older people ([Charness & Bosman, 1990](#); [Clark, Czaja, & Weber, 1990](#); [Zandri & Charness, 1989](#))? Gerontologists participated in this cross-disciplinary dialogue with models and measurements of aging that could be processed in human factors engineering ([Charness, 2008](#)). Theoretically, these attempts led to a focus on age-related declines in sensory, cognitive or motor capability, and on technological interventions (new designs or design modifications) that could help mitigate their

effects (Fisk, Rogers, Charness, Czaja, & Sharit, 2009). Technologies were analyzed as interventions to compensate for age-related bodily changes (Rogers & Fisk, 2003).

During the 1990s, the attempts to establish research on aging and technology were consolidated into a research field that is now widely known as Gerontechnology (Bouma & Graafmans, 1992). The original focus on individual capabilities was broadened to include social and psychological aspects of aging (Fozard, Graafmans, Rietsema, Bouma, & van Berlo, 1996). In the 2000s, the field has produced different matrices that link the effects of technological interventions to various domains of later life (Cutler, 2006; Czaja, Sharit, Charness, Fisk, & Rogers, 2001; Dishman, Matthews, & Dunbar-Jacob, 2004; Fozard & Wahl, 2012; Sixsmith, 2013). While the range and labels of interventions and life domains slightly differ between studies, the underlying logic analyzes the (potential) effects of technology on various areas of gerontological insights such as health, mobility, social connectedness, and others (Schulz et al., 2015). In this development, the scope of relevant gerontological insights that is deemed relevant for the aging and technology agenda has broadened. But the position of gerontological knowledge has not changed: gerontology delivers insights as an input to measure the impact of technologies (Graafmans, 2017) or to understand the preconditions for their acceptability (Peek et al., 2016).

In a parallel movement, the aging and technology agenda has come to embrace a ubiquitous concern for user needs. Today, user involvement, participatory design, and co-creation are *sine qua non*s in gerontechnology design (Peine, Faulkner, Jæger, & Moors, 2015). So, while gerontologists have provided a knowledge base about aging as an input to design, the design community itself has explored methods to involve older people since the mid-2000s (Peace & Hughes, 2010; Vines, Pritchard, Wright, Olivier, & Brittain, 2015). These methods include nuanced and ethnographic analyses of aging in its social contexts, such as homes or communities (Bailey, Foran, Scanaill, & Dromey, 2011). At the same time, they have continued to aim at an understanding of user needs as an input for design (we have analyzed this “paternalistic stance” more extensively in Peine and colleagues (2014).

It is thus fair to say that knowledge about aging that informs the aging and technology agenda has become more nuanced and gerontologically informed over the years. Theoretically, however, and despite this nuancing, an interventionist logic has prevailed. This logic is grounded in the overridingly practical rationale of the aging and technology agenda as it stands today. That is, while gerontologists have participated since its inception, their involvement has been ancillary to the practical demands of designing for and marketing to the growing amount of older people. But in gerontology itself, technology has remained a marginal topic (Cutler, 2006), which continues to be both under-theorized and over-instrumentalized (Joyce, Peine, Neven, & Kohlbacher, 2017; Sixsmith, 2013).

This leaves us with the somewhat paradoxical situation that, in times when technology and materiality have become pervasive elements in societies and social theory at large (Pinch & Swedberg, 2008), gerontology has not developed the theoretical tools to grasp technology as an already inherent aspect of later life. In what follows, we unpack the interventionist logic to make visible its implicit theoretical assumptions about the relations between aging and technology. In “The Latourian Divide in Studies of Aging and Technology” section, we demonstrate that the interventionist logic has been fueled by and has further enforced a particular division of labor between scholars of aging and scholars of technology that has rendered technology largely invisible in theories of aging. To establish this point, we turn to the field of Science and Technology Studies (STS), and to the work of French philosopher Bruno Latour in particular. In “The Co-constitution of Aging and Technology: Six Propositions” section, we explore a new and exciting literature at the intersection of STS and social gerontology that has critically questioned the interventionist logic. We crystallize six key insights from this literature, to show how moving from intervention to co-constitution is pertinent to making theoretical progress on the aging and technology agenda.

### The Latourian Divide in Studies of Aging and Technology

To analyze the interventionist logic, and to shed light on some of the problems it creates, we turn to the work of French philosopher Bruno Latour. In his famous book “We have never been modern” (Latour, 1993), he has challenged the idea that technology and society are distinct realms of existence that need distinct types of scientific inquiry. For Latour, modern thought since the enlightenment has been fueled by a *divide* between the natural and engineering sciences, on the one hand, and the social sciences on the other. The former attend to the objects of the material world including animals, plants, atoms, bodies, cars, power plants, phones, etc.; the latter attend to the objects of the social world including values, norms, institutions, habits, feelings, etc. Natural and engineering scientists, then, explore the relations between inanimate, nonhuman objects, and thus unravel and exploit the secrets of the material world as it is. Social scientists, on the other hand, explore society and culture as created by human actions and interactions: they unravel the secrets of the social world as a human construct.

For Latour this divide was problematic. For him, the key challenges of our societies are constituted by material and social factors together and cannot be split into the neat compartments of technology and society: How can we understand complex problems, such as mobility, without attending to the social processes that led to the dominance of car-based transportation in the early 20th century? And how can we, in turn, understand the tenacity of car culture

without attending to the sturdy material objects like cars, motor sounds and highways that have come to express it? For Latour, car culture, design, and infrastructure are inextricably linked and reinforce each other. The modernistic divide has prevented scholars from grappling with these co-constitutive relationships between technology and society. As such, it has expelled technology from the theories of the social sciences (Pinch & Swedberg, 2008).

To rectify this, Latour has proposed a socio-material approach that analyzes technology and society and their relationships together: (Latour also suggested a radically symmetrical perspective in which both humans and nonhumans are *analytical* equals (Latour, 1993, p. 94ff). Although this deeper ontological matter is a pertinent aspect of Latour's work, introducing it properly is beyond the scope of this article.) To give another example: In the case of climate change, a socio-material approach can analyze how computer-based scientific models, and the specific ways in which they are and can be designed, create certain versions of climate change that then structure policy responses to them; it can further trace how environmental policy, in turn, has come to influence how climate models are designed and interpreted (Beck, Forsyth, Kohler, Lahsen, & MahonyBeck, 2017). A socio-material approach highlights how computer models and climate change policies are not separate realms but linked in the versions of climate change they create and address. Hence, for Latour, the modernistic divide needed to make way for an approach that includes technological objects, as outcome and constituent, in the analysis of society.

We have used this brief discussion of Latour's book as a shortcut to summarize basic ideas of Science and Technology Studies (STS), an academic field that has made the co-constitution of science, technology, and society its central topic (A good introduction to the field of STS can be found in Sismondo (2010). Since the 1970s, STS has been successful in exploring and theorizing various aspects of the interactions between science, technology, and society. Only relatively recently has aging become a topic of interest in STS (Joyce et al., 2017).). We argue that, although STS at large has been vastly successful in delivering the socio-material program outlined by Latour, the aging and technology agenda still struggles with a divide as described by Latour that impedes theoretical and practical progress. Under this *Latourian divide*, gerontologists deliver knowledge about aging and later life as targets for interventions. Technologists and designers, on the other hand, then execute what is presented to them, and create interventions that deliver (in measurable degrees of success) upon these targets.

Of course, the reality of aging and technology is messier and more nuanced. But our interest here is *conceptualization*. And in terms of gerontology's theories and concepts, the Latourian divide is still intact: We have the diverse and messy reality of aging as a social, institutional or bodily process, on the one hand. And we have the clean and controlled reality of technological interventions that, if they

are accepted and used properly, realize predefined effects (or are in need of re-design or additional user education otherwise).

Theoretically, therefore, the Latourian divide has reduced the role of technology to an instrument (cf. Loe, 2015; Mortenson, Sixsmith, & Woolrych, 2015). We argue that this is problematic for theoretical and practical reasons: First, it is becoming increasingly clear that aging and technology have been intertwined for a long time (Jones, 2015; Loe, 2010). Current theories of aging, however, are not prepared to address how technology is changing and has already changed the way we age, for instance when older people use social media to maintain social relations (Beneito-Montagut, Cassián, & Begueria, 2018). To the contrary, we would argue that the Latourian divide has allowed aging scholars to remain firmly in the realm of social interactions, exactly because technologists claim their responsibility for the realm of technology.

Secondly, the Latourian divide has allowed a naïve idea of older people as technology-averse and illiterate to flourish. Because aging scholars have not provided the vocabulary to describe aging and later life *with technology*, it has remained a default assumption in many technology projects that technology is alien to older people, and that older people are not interested or technology literate *in principle*. Under this assumption, acceptability problems, for instance, are easily framed as the consequence of technology-skepticism. Under a socio-material approach, in contrast, we would be invited to scrutinize more carefully the practices and arrangements that establish acceptance or use in specific instances, for specific design and in specific contexts.

## The Co-constitution of Aging and Technology: Six Propositions

In recent years, an interesting body of studies has emerged at the intersection of STS and Gerontology that has critically questioned the validity of the Latourian divide (see Joyce et al., 2017; Moreira, 2017; Peine et al., 2015). In what follows, we pull together six key insights from this emerging but scattered literature. We have synthesized these insights from our own involvement with this new literature, (Next to our own empirical studies, we have organized conference sessions at both STS and aging conferences since 2010, edited special issues (Peine et al., 2015) and produced review articles (Joyce et al., 2017).) and present them as relevant propositions for future research on aging and technology:

1. Aging and technology are co-constituted. They cannot be seen as separate realms but need to be studied together. TeleCare technologies, for instance, not only support living longer at home (or fail to do so), but change the very experience of the home itself (Milligan, Roberts, & Mort, 2011; Mort, Roberts, Pols, Domenech, & Moser, 2015; Neven, 2015). Hence, Berridge (2016) has explored the effects of passive monitoring systems on

privacy from a co-constitutive perspective. These systems did not simply invade privacy (or respect it), but they created opportunities for older people to renegotiate the boundaries of privacy, and what infringement thus means to them. Likewise, technology projects or innovation policy not only respond to an understanding of aging, but they shape and prioritize definitions of aging, while sidelining others (Lassen & Moreira, 2014; Marshall & Katz, 2016; Neven & Peine, 2017). Designers almost constantly, and often implicitly, create and debate ideas about aging together with design features, and these ideas are frequently narrowed down to those associated with frailty and impairment (Peine & Neven, 2011; Vines et al., 2015). “Parameterization” is an important element of this narrowing down: Aspects of aging are prioritized that can easily be translated into quantifiable design requirements (Lassen, Bønnelycke, & Otto, 2015; Peine & Moors, 2015). Hence, aging is not a stable target for interventions, but specific versions of aging are *made* into targets for interventions. *By replacing an interventionist logic with a co-constitution perspective, the ways in which certain images of aging are foregrounded in design can be challenged, along with the constraining and enabling effects of such technologies on the everyday lives of older people.*

2. To grasp the *co-constitution of aging and technology*, STS theories can fruitfully be combined with theories of aging. For instance, STS theories can critically engage with ageism (Joyce & Mamo, 2006; Neven, 2010). Peine and colleagues (2017) have combined theories of innovation diffusion with theories of the third age and fourth age. Analyzing the diffusion of e-bikes, they showed how innovation theories themselves are often *ageist* (they implicitly assume old age to be the fourth age, and thus older people to be late adopters). They also showed how, contrary to common stereotypes, older people who could be classified as belonging to the fourth and third ages were important early adopters that allowed e-bikes to evolve from a stigmatizing assistive device to a stylish commodity widely used by all age categories. *Further advancing dialogues of concepts, theories, and methodologies from STS and social gerontology is pertinent to theorizing about aging–technology relations.*
3. At present, the aging and technology agenda is biased toward new technologies and innovation. But older people already constantly used technologies and they have their own skill sets and technology literacy (Giaccardi, Kuijer, & Neven, 2016). Mundane artifacts, such as teapots, walkers, landline telephones, and dish washers are central to older people’s self-care routines (Loe, 2010), and many older people own and use digital technologies like smartphones, tablets, and social media (Rosales & Fernández-Ardèvol, 2016). The technologies that older people already have and use are an important resource for studying aging, as in Milligan and colleagues (2011) or Berridge (2016) discussed above; they are also a central element of the social and material arrangements in which new technologies need to find a place (Greenhalgh et al., 2013; López Gómez, 2015). Typically, studies on “interventions” ignore these preexisting arrangements, when, for instance, ICT interventions to reduce loneliness and social isolation ignore the use of common social technologies, such as smartphones or social media among older people (Beneito-Montagut et al., 2018). *Instead of focusing on the possible impact of new technologies on aging, studying the use of existing technologies by older people is empirically and theoretically illuminating and offers opportunities for attuning the design of innovations with existing technologies, skill sets, and technological literacy.*
4. Further to this, technology is often used in unexpected ways. Alarm pendants that are meant to be constantly “on” are used selectively (they are often not used in bathrooms, for instance Aceros, Pols, & Domènech, 2015), or, vice versa, everyday technologies such as tablet computers are repurposed to take over care functionality (Greenhalgh et al., 2013). Studying such unexpected uses from a co-constitution perspective, rather than framing them as mistakes or deviant behavior, emphasizes the agency of older people in negotiating a meaningful space for technology in their lives (Joyce & Loe 2010; López Gómez, 2015; Pols, 2017). This agency can be an important stimulus for design (Östlund & Linden, 2011; Peine et al., 2017). It also throws into question the idea that the impact of new technologies can be evaluated against pre-defined yardsticks, yardsticks that are typically defined and used by designers, engineers, and policy makers, but not older people (Neven, 2010). *Instead of focusing on acceptance or impact as qualities that can be defined a priori, studies in aging and technology need to explore how they are created in interaction with technology.*
5. Technology projects or innovation policy do not simply address otherwise unfettered insights about aging but are themselves important arenas in which societally shared definitions of aging are created. Policy discourses prioritize certain definitions of aging over others, for instance when they combine innovation, economic growth and the alleged costs of demographic aging to problematize older people (Marshall & Katz, 2016; Neven & Peine, 2017). Moreover, the study of Peine and Moors (2015) discussed above is an example of how requirements of design projects privilege deficit models of aging. *Studies in aging and technology would benefit from extending their scope beyond the traditional sites of gerontological inquiry and embrace technology projects and innovation discourses as significant sites for the constitution of aging, too.*
6. Finally, we argue that moving beyond the interventionist logic to embrace the co-constitution of aging and



technology is pertinent to enriching technology projects and innovation policy discourses. Technological innovations and their relations with aging are complex and contingent, and studying them from a co-constitution perspective means to study them “in the wild” (Hutchins, 1995), both at the conventional sites of gerontology research (homes, neighborhoods, care homes, rural areas, etc.) but also at new locations (design labs, innovation discourses, telecare operation centers, etc.). Insights thus gained will add to those derived from direct forms of user involvement or gerontological insights a richer imagery of older people as technology users and more nuanced ideas of “user needs” as context-specific and emergent. *Engaging co-constitution studies with the work of policy makers, designers, engineers and other practitioners will, hopefully, help create innovation policy and design that overcomes simplistic and often ageist ideas about older people and their relations with technology that have prevailed in gerontechnology practice and policy so far* (Neven & Peine, 2017).

## Conclusions

A divide between the study of aging and the study of technology has limited progress of the aging and technology agenda. This divide has been fueled by and then reinforced an interventionist logic, whereby aging is framed as a target for technological interventions. In this article, we have invited aging and technology scholars to move beyond the interventionist logic and study how the contemporary experience of aging is already co-constituted by gerontechnology design, the socio-material practices it enacts, and policy discourses around innovation and aging. Design, engineering, and innovation policy thus become new arenas for gerontological research. An equally important arena is the study of older people not as technologically incompetent laggards, but as actors who use, modify, and sometimes produce technologies. These arenas are increasingly studied in a new line of “socio-gerontechnological” literature, cited extensively in this article, which has emerged at the intersection of STS and social gerontology. In it, simplistic notions such as “intervention,” “impact,” “acceptance,” or “solution” are replaced with a richer vocabulary that highlights and theorizes the co-constitution of aging and technology.

## Conflict of Interest

None reported.

## 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. doi:10.1016/j.techfore.2014.01.016
- 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*, 829–848. doi:10.1017/S014686X10001170
- Beck, S., Forsyth, T., Kohler, P. M., Lahsen, M., & Mahony, M. (2017). The making of global environmental scance and politics. In U. Felt, R. Fouché, C. Miller, & L. Smith-Doerr (Eds.), *The handbook of science and technology studies* (4th ed., pp. 1059–1086). Cambridge: The MIT Press.
- Beneito-Montagut, R., Cassián, N., & Begueria, A. (2018). What do we know about the relationship between internet-mediated interaction and social isolation and loneliness in later life. *Quality in Ageing and Older Adults*, *19*, 14–30. doi:10.1108/QAOA-03-2017-0008
- Berridge, C. (2016). Breathing room in monitored space: The impact of passive monitoring technology on privacy in independent living. *The Gerontologist*, *56*, 807–816. doi:10.1093/geront/gnv034
- Bouma, H., & Graafmans, J. A. M. (Eds.). (1992). *Gerontechnology* (Vol. 3). Amsterdam: IOS Press.
- Charness, N. (2008). Aging and human performance. *Human Factors*, *50*, 548–555. doi:10.1518/001872008X312161
- Charness, N., & Bosman, E. A. (1990). Human factors engineering and aging. In K. W. Schaie & J. E. Birren (Eds.), *Handbook of the psychology of aging* (pp. 446–464). New York: Academic Press.
- Clark, M. C., Czaja, S. J., & Weber, R. A. (1990). Older adults and daily living task profiles. *Human Factors*, *32*, 537–549. doi:10.1177/001872089003200504
- 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*, 50–59. doi:10.4017/gt.2001.01.01.005.00
- Dishman, E., Matthews, J., & Dunbar-Jacob, J. (2004). Everyday health: Technology for adaptive learning. In R. W. Pew & S. B. van Hemel (Eds.), *Technology for adaptive aging* (pp. 179–208). Washington, D.C.: The National Academies 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.
- Fozard, J. L., Graafmans, J. A. M., Rietsema, J., Bouma, H., & van Berlo, A. (1996). Aging and ergonomics: The challenges of individual differences and environmental change. In K. A. Brookhuis, C. Weikert, J. Moraal, & D. de Waard (Eds.), *Aging and Human Factors - Proceedings of the Europe Chapter of the Human Factors and Ergonomics Society Annual Meeting 1993* (pp. 51–65). Haren: University of Groningen.
- Fozard, J. L., & Wahl, H.-W. (2012). Age and cohort effects in gerontechnology: A reconsideration. *Gerontechnology*, *11*, 10–21.
- Giaccardi, E., Kuijter, L., & Neven, L. (2016). Design for resourceful ageing: Intervening in the ethics of gerontechnology. *Proceedings of DRS 2016, Design Research Society 50th Anniversary Conference. Brighton, UK, 27–30 June 2016*.
- Graafmans, J. A. M. (2017). The history and incubation of gerontechnology. In S. Kwon (Ed.), *Gerontechnology: Research, practice, and principles in the field of technology and aging* (pp. 3–11). New York: Springer Publishing.

- Greenhalgh, T., Wherton, J., Sugarhood, P., Hinder, S., Procter, R., & Stones, R. (2013). What matters to older people with assisted living needs? A phenomenological analysis of the use and non-use of telehealth and telecare. *Social Science & Medicine*, *93*, 86–94. doi:10.1016/j.socscimed.2004.12.001
- Hutchins, E. (1995). *Cognition in the wild*. Cambridge: MIT 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*, 171–180. doi:10.1111/j.1467-9566.2009.01219.x
- 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*. New York, London: Taylor & Francis Group; Routledge.
- 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., 915–942). Cambridge: The MIT Press.
- 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. doi:10.1016/j.techfore.2014.01.006
- Lassen, A. J., & Moreira, T. (2014). Unmaking old age: Political and cognitive formats of active ageing. *Journal of Aging Studies*, *30*, 33–46. doi:10.1016/j.jaging.2014.03.004
- Latour, B. (1993). *We have never been modern*. Cambridge: Harvard University Press.
- Loe, M. (2010). Doing it my way: Old women, technology and wellbeing. *Sociology of Health & Illness*, *32*, 319–334. doi:10.1111/j.1467-9566.2009.01220.x
- Loe, M. (2015). Comfort and medical ambivalence in old age. *Technological Forecasting and Social Change*, *93*, 141–146. doi:10.1016/j.techfore.2014.04.013
- López Gómez, D. (2015). Little arrangements that matter. Rethinking autonomy-enabling innovations for later life. *Technological Forecasting and Social Change*, *93*, 91–101. doi:10.1016/j.techfore.2014.02.015
- Marshall, B. L., & Katz, S. (2016). How old am I? Digital culture and quantified ageing. *Digital Culture & Society*, *2*, 145–152. doi:10.14361/dcs-2016-0110
- Milligan, C., Roberts, C., & Mort, M. (2011). Telecare and older people: Who cares where? *Social Science & Medicine* (1982), *72*, 347–354. doi:10.1016/j.socscimed.2010.08.014
- Moreira, T. (2017). *Science, technology and the ageing society*. New York: Routledge.
- Mort, M., Roberts, C., Pols, J., Domenech, M., & Moser, I.; EFORTT investigators. (2015). Ethical implications of home telecare for older people: A framework derived from a multisited participative study. *Health Expectations: An International Journal of Public Participation in Health Care and Health Policy*, *18*, 438–449. doi:10.1111/hex.12109
- Mortenson, W. B., Sixsmith, A., & Woolrych, R. (2015). The power(s) of observation: Theoretical perspectives on surveillance technologies and older people. *Ageing and Society*, *35*, 512–530. doi:10.1017/S0144686X13000846
- Neven, L. (2010). ‘But obviously not for me’: Robots, laboratories and the defiant identity of elder test users. *Sociology of Health & Illness*, *32*, 335–347. doi:10.1111/j.1467-9566.2009.01218.x
- 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. doi:10.1016/j.techfore.2014.04.016
- 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*, 26–37. doi:10.3390/soc7030026
- Östlund, B., & Linden, K. (2011). Turning older people’s experiences into innovations: IPPI as the convergence of mobile services and TV viewing. *Gerontechnology*, *10*, 103–109. doi:10.4017/gt.2011.10.2.003.00
- Peace, S., & Hughes, J. (Eds.). (2010). *Reflecting on user-involvement and participatory research*. London: Center for Policy and Aging.
- Peek, S. T., Luijckx, K. G., Rijnaard, M. D., Nieboer, M. E., van der Voort, C. S., Aarts, S., ... Wouters, E. J. (2016). Older adults’ reasons for using technology while aging in place. *Gerontology*, *62*, 226–237. doi:10.1159/000430949
- Peine, A., van Cooten, V., & Neven, L. (2017). Rejuvenating design: Bikes, batteries, and older adopters in the diffusion of E-bikes. *Science, Technology & Human Values*, *42*, 429–459. doi:10.1177/0162243916664589
- 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. doi:10.1016/j.techfore.2014.11.010
- Peine, A., & Moors, E. H. M. (2015). Valuing health technology – habitating and prosthetic strategies in personal health systems. *Technological Forecasting and Social Change*, *93*, 68–81. doi:10.1016/j.techfore.2014.08.019
- Peine, A., & Neven, L. (2011). Social-structural lag revisited. *Gerontechnology*, *10*, 129–139. doi:10.4017/gt.2011.10.3.002.00
- Peine, A., Rollwagen, I., & Neven, L. (2014). The rise of the “innovator” - rethinking older technology users. *Technological Forecasting and Social Change*, *82*, 199–214. doi:10.1016/j.techfore.2013.06.013
- 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. (2017). Good relations with technology: Empirical ethics and aesthetics in care. *Nursing Philosophy*, *18*, e12154. doi:10.1111/nup.12154
- Robinson, P. K., Livingston, J., & Birren, J. E. (Eds.). (1988). *Ageing and technological advances*. New York: Plenum Press.
- Rogers, W. A., & Fisk, A. D. (2003). Technology design, usability, and aging: Human factors techniques and considerations. In N. Charness & K. W. Schaie (Eds.), *Impact of technology on successful aging* (pp. 1–14). New York: Springer Publishing Company.
- Rosales, A., & Fernández-Ardévol, M. (2016). Beyond WhatsApp: Older people and smartphones. *Romanian Journal of*

- Communication and Public Relations*, 18, 27–47. doi:10.1080/02614367.2012.697697
- Schulz, R., Wahl, H. W., Matthews, J. T., De Vito Dabbs, A., Beach, S. R., & Czaja, S. J. (2015). Advancing the aging and technology agenda in gerontology. *The Gerontologist*, 55, 724–734. doi:10.1093/geront/gnu071
- Sismondo, S. (2010). *An introduction to science and technology studies (1)*. Chichester: Wiley-Blackwell.
- 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 Transactions on Computer-Human Interaction*, 22, 1–27. doi:10.1145/2696867
- Zandri, E., & Charness, N. (1989). Training older and younger adults to use software. *Educational Gerontology*, 15, 615–631. doi:10.1080/0380127890150606