Aging, embodiment, and datafication: Dynamics of power in digital health and care technologies

BY NICOLE K. DALMER[1], KIRSTEN L. ELLISON[2], STEPHEN KATZ[3] &
BARBARA L. MARSHALL[3]

Abstract

As a growing body of work has documented, digital technologies are central to the imagining of aging futures. In this study, we offer a critical, theoretical framework for exploring the dynamics of power related to the technological tracking, measuring, and managing of aging bodies at the heart of these imaginaries. Drawing on critical gerontology, feminist technoscience, sociology of the body, and socio-gerontechnology, we identify three dimensions of power relations where the designs, operations, scripts, and materialities of technological innovation implicate asymmetrical relationships of control and intervention: (1) aging bodies and the power of numbers, (2) aging spaces and the power of surveillance, and (3) age care economies and gendered power relations. While technological care for older individuals has been promoted as a cost-effective way to

[1]Nicole K. Dalmer, Department of Health, Aging and Society, McMaster University, Hamilton, Canada
[2]Kirsten L. Ellison, Department of Communication, Media and Film, University of Calgary, Calgary, Canada
[3]Stephen Katz & Barbara L. Marshall, Department of Sociology, Trent University, Peterborough, Canada

enhance independence, security, and health, we argue that such optimistic perspectives may obscure the realities of social inequality, agist bias, and exploitative gendered care labour.

Keywords: aging, care, datafication, embodiment, gerontechnology, power.

Introduction

In many Western nations, digital technologies play a central role in the imagining and shaping of aging futures – optimistically portrayed as a "new era" of technologically enhanced or "connected" aging (Ghosh et al. 2014). Some digital tracking and monitoring technologies are marketed directly to consumers as products that encourage active, risk-averse lifestyles, while others form part of the growing e-health economy, enabling more home-based, efficient and cost-effective management of older age care. Taken together, what has been dubbed "Age Tech" is described by venture capitalist Dominic Endicott as "digitally-enabling the Longevity economy" (Woods 2019). The future imaginaries of Age Tech are expansive, encompassing digital health-tracking technologies, sensors for digital home care, assisted living technologies, and more, co-located in a landscape of data-emitting connectedness. Ghosh et al. (2014), for example, map the body, home, community, and spaces of care as domains to be organized through technologies that support older adults' health and wellbeing through tracking and monitoring. When partnered with insurance and data industries, government budget-cutting austerity programs, and residential care planning around growing aging populations, it is a sector bound for global financialization, with predictions that "age-tech for the silver economy will be a multi-trillion-dollar global market within the next half decade" (Kutney & Wilson 2019). Case studies of a wide range of technologies have made it clear that these developments have been dominated by what Peine and Neven (2019) term an "interventionist logic," where aging and aging populations are framed by Age Tech as problems for which technological innovation promises solutions. In particular, emerging reports on health, home, and community technologies related to older age care (Aging Analytics 2019; Kutney & Wilson 2019; Smith 2014) are fueled by an idealized vision of a "triple win" of

technological innovation simultaneously benefiting the government, the market, and older users (see Neven & Peine 2017).

At the same time, academic and professional gerontology has increasingly recognized technological innovation as having growing importance in later life, drawing attention to the digital divide between young and old, concerns about data privacy for older adults, and the promise of technology to respond to issues of older adults' isolation, inactivity, and loneliness (Dominguez-Rué & Nierling 2016; Moreira 2017; Neves & Vetere 2019; Prendergast & Garattini 2015; Taipale et al. 2018). This reflects what Peine and Neven (2021) have termed the "Latourian divide," where designers, engineers, and industry promoters focus on the devices and gerontologists focus on the social worlds into which those devices are introduced.

Age Tech designers, whose vision of aging is often limited to stereotypes of frailty, disability, and decline, have demonstrated a narrow understanding of older users and their negotiation of technological relationships, and have not fully considered how gender, class, ethnicity, or ability might impact how technologies are used (if at all). In response, gerontological researchers advocate more co-design initiatives with older users, more research attuned to social inequalities and diverse populations, and more qualitative approaches to the subjective experiences of growing older. Yet, as noted by Peine and Neven (2019), we are in a paradoxical time in that "gerontology has not developed the theoretical tools to grasp technology as an already inherent aspect of later life" (p. 2). We interpret this claim to mean that while gerontology has certainly been engaged in technological applicability to problems of aging, as mentioned above, the critical and often unsettling approaches to technology stemming from the literature outside of mainstream gerontology, such as those in the growing field of socio-gerontechnology, have yet to be adapted. Rather, gerontologists have found a common ground in a more traditionally optimistic vision of technological promise (Moreira 2019). Therefore, while Age Tech and gerontology share this optimistic vision, there remain crucial gaps in understanding how, for example, self-tracking, digital monitoring, tele-intervention, and bio-data collection can constitute aging subjects in devalued and, as we shall argue, socially and gender-divisive ways. Such problems are further related to the broader terrain of austerity-influenced neoliberal healthcare

regimes in many Western welfare states that have reconfigured care relationships, spaces designated for older adults, and human-machine infrastructures according to market-driven priorities.

In this study, we address these gaps by building on Peine and Neven's (2021) call for a turn to the *co-constitution* of aging and technology, which contends that design produces not just technologies, but "*ideas about ageing and older people*" (p. 2856, emphasis in the original). We sketch a framework aimed at nurturing critical research on aging and digital technologies, as well as the further development of conceptual and theoretical approaches, by highlighting three dimensions of power relations deserving further attention: (1) aging bodies and the power of numbers, (2) aging spaces and the power of surveillance, and (3) age care economies and gendered power relations. In these cases, the aging body and the role of datafication are key themes. In taking aging bodies as a unique entry point for understanding technologies and the datafication of care, we seek to make visible the shift from conventional gerontological ideals of healthy and successful aging to future imaginaries of technologically enhanced and coordinated life courses. Datafication, as described by Mejias and Couldry (2019), renders human behaviour analyzable through quantification and extracts value in the form of "predictive insights." As they note, "issues of power permeate apparently neutral forms of datafication" (p. 4); however, power relations and their effects are frequently rendered invisible.

We critique this ostensible neutrality with an analysis of the ways in which the datafication of aging and care expresses relations of power in technical and embodied ways (Martin et al. 2015). First, aging bodies and the power of numbers come together in ways that monitor and quantify older people through the datafication of their bodies, while aggregating and circulating personal data through standards of numerical risk. Here, technological industries can exacerbate agist cultural divisions of later life in "third" and "fourth" ages by associating the former with "active" consumer and lifestyle technologies and the latter with "passive" technologies of surveillance, assistance, and management. Second, aging spaces and the power of surveillance are deeply interconnected within care residences and programs and discourses of aging in place, whereby technological interventions are promoted as agents to transform living spaces into "smart" homes through tracking, connectivity, and safety surveillance. Third, in care economies where the presence of technological

inputs is increasing, gendered power relations are becoming more evident. The demands and expectations on mostly female healthcare workers and domestic partners to integrate body care with the data care of collecting, interpreting, recording, and relaying monitoring information adds to the long-standing invisibility and devaluation of care work.

Across these domains, power is an expression of the neoliberal governance and stratification of late life within and through the predominance of technical relationships of care, whereby human and non-human agents constitute each other in particularly productive ways. Our examples further identify how the lived experiences of the datafied older person surveilled resident, and gendered healthcare worker refract both wider biopolitical forces and negotiated possibilities beyond them. The focus on power also allows us to explore why current gerontological and policy strategies addressing growing aging populations, and programs for healthful longevity, active well-being, and aging in place, have become sites of technological interest and investment.

The three dimensions of power that we propose as a framework for advancing critical research at the intersection of aging and digital technologies are grounded in our collective reflections and analyses of the current landscape of gerontechnological innovation and research. In sketching this framework, we draw on published work in both aging studies and technology studies, including lines of research that the authors have, both collectively and individually, contributed to, as well as examples from policy documents, Age Tech advertisements and corporate texts. We turn now to an elaboration of the three dimensions of power identified, attending to the multiple arenas in which these originate and manifest.

Aging Bodies and the Power of Numbers

Digital health and care technologies create new priorities in the lives of older people based on numerical quantification. Some activities are found to be more beneficial than others, in what Pols et al. (2019: 106) term "turning events into numbers." Historically, bodily measurement and quantified profiles have been integral to the medicalization of aging, where monitoring and recording heart rate, blood pressure, cholesterol levels, memory test results, muscle tone, and weight have been key features of health assessments in, and of, old age (Katz & Marshall 2018). However, increasing

concern over an aging demographic in the current healthcare climate has framed the promotion of technologies such as wearable self-tracking devices to enlist aging subjects themselves in self-tracking and production of data (Katz & Marshall 2018; Marshall & Katz 2016; Neff & Nafus 2016). These types of technologies are akin to what Lupton (2016) calls "pushed technologies" that "involve encouragement for people to monitor themselves from other agencies" (p. 103). The seductive magic of the self-tracking device is to create standards of personal success by measuring the activity and inactivity of the user in the form of numbers, such as steps and active minutes, compared with sedentary time (Marshall 2018; Oxlund 2012; Pickard 2011). Wellbeing and independence in old age require the health-literate subject to keep the body in constant motion, given that "the risks of inactivity, in addition to indicating irresponsibility, ground an ethical imperative for aging bodies to move, be active, and be tracked by wearable devices that both measure and motivate" (Katz & Marshall 2018: 65).

As Beer remarks, "measurement is powerful not just for what it captures and the way it captures it, it is also powerful because of what it conceals, the things it leaves out, devalues, or ignores" (2016: 60). For example, self-trackers and home surveillance monitoring systems cannot quantify contentment, leisure, emotional support, mutual dependency, social inclusion, collective activities, or overall fulfillment in life. Instead, older bodies are increasingly reduced to numerical outputs of activity/inactivity embedded within trackable divisions between fit/frail, independent/dependent, and risk-averse/risk-prone. And for older female bodies, already cast as weaker, needy, and fragile, Sanders' (2017: 38) statement, "that the rise of wearable biometric technologies has significant implications for the augmentation and co-extension of biopower and patriarchal power" is particularly apposite.

The numbers produced through tracking create a *data double*, a numerical entity of biometric data through which self-knowledge and self-care are organized as a kind of techno-phantom identity (Haggerty & Ericson 2000; Ruckenstein 2014). The status of the data-double is based on a neoliberal view of the self-as-enterprise, assuming that more data equal more knowledge and control in an ever-expanding horizon of self-improvement and optimization. This doubling effect risks alienating meaningful self-care experiences, since intimate bodily data itself become unbodied and turn "the self-tracker's attention away from the

signals and sensations of the embodied sensorium toward a technical sensing apparatus that privileges algorithmic analytics" (Smith & Vonhethoff 2016: 9). Whether the relationship between the user and the tracker is disciplinary and regulatory (Toner 2018) or messy and disruptive (Marshall 2018; Nafus & Sherman 2014; Pantzar & Ruckenstein 2017; Sharon & Zandbergen 2016), the authority of the power of numbers in digital health technologies prevails over other priorities, indicators, and experiences of bodily life. As Sanders (2017) remarks, "the personalized nature of this technology makes the relation of normalizing power to individuals seem so physically intimate and confidential that they eventually may no longer experience normative and disciplinary imperatives as issuing from external authorities" (p. 53).

The technological personalization of numbers becomes resources by which older adults are expected to use data to manage lifestyle behavioural modifications and interventions (Fotopoulou & O'Riordan 2016). For example, some European countries explicitly promote the use of self-tracking through mobile health applications as a lifestyle input to prevent and manage disease in later life.[1] Jeannette Pols and colleagues cite the Dutch minister of health as aiming "to have 75% of elderly and chronically diseased people – if they want and are able – to use health apps" (Pols et al. 2019: 98). Thus, technical self-care through data management is a form of labour one performs both for personal worth and as an enactment of responsible aging citizenship. As one respondent in a Canadian study of older users of fitness trackers argued, "if you're community-minded, you generally want to cost your community as little as possible in health care costs" (Marshall 2018: 209). Thus, numbers not only represent fitness, performance, needs, risks, and capacities but also frame the practical truths by which important decisions are made regarding the allocation of resources and support. In this context, numerical authority and technical measurement are crucial resources in informing healthcare

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[1] In the Nordic context, tracking, telehealth, and surveillance technologies are grouped together under the label of *welfare technologies*, a term that makes explicit the policy context that views such technological innovations as central to managing the problem of "increasing public expenses on labour intensive care in sectors that are burdened by the increasing numbers of elderly and chronically ill" (Kamp et al. 2019: 2).

policies for older people, such as those around aging in place or health promotion. In summary, as stated by Oxlund and Whyte (2014), the goals of measurement in the lives of older people are threefold: "to reveal hidden truths about the body in order to make treatment decisions; to assess need for care and services; and to track and manage health at home" (p. 218). The next section elaborates this third goal by looking at how surveillance devices and systems are used to manage health and safety in aging spaces and the residential experience in later life.

Aging Spaces and the Power of Surveillance

Aging in place has become an important social, economic, and political objective and generally refers to a person aging in their own home for as long as possible and avoiding institutional relocation. With changing demographics and geographically dispersed families, technologies in the home are promoted as ensuring greater autonomy and safety for "at risk" older adults as they age in place, while concurrently promising a reduction in cost, time, and burdens for their families and/or caregivers. These technologies include wearable and ambient monitoring devices that work in the background to track, collect, and calculate multiple data outputs into measured assessments of risk based on established routines of movement, activity, and location. Roberts et al. (2019) refer to the home of ambient-assisted living as "a preclinical space, a kind of waiting room serviced by sensors and systems of monitoring," inhabited by those who are not quite "sick enough" to be brought into the clinic, yet not "well enough" to be metrically unaccounted for (p. 125). Monitoring technologies designed to support aging in place differ from those for self-tracking as discussed above, in that they are designed and marketed to enable data surveillance by others. Roberts and colleagues (2019) suggest that these remote monitoring systems have contributed to a form of "dys-tracking," "connoting the passive, disconnected, frail and vulnerable subject bodies" to which these devices are attached or remotely monitored (p. 130). Caregivers can check in remotely to keep track of care-recipients' comings and goings, their eating, sleeping and bathroom habits, whether they are taking their medication, their location in or out of the house, their gait, their heartrate, and the length of time they are standing, sitting, or lying down. Deviations from normalized patterns of predictability signal the need for

a response by a caregiver in the form of adjusted treatment, more involved care, further tracking, or removal from the home. Rather than promoting self-knowledge or health literacy on the part of the user, alarms and alerts are directed to the caregiver or a third party (Aceros et al. 2015; Gilleard & Higgs 2021; Neven 2015).

Such technologies are found to create *smart homes*. In taking up the question of whether smart homes for aging in place live up to their promise of independent living, Peek et al. (2017) define independence along three axes: (1) the ability to look after oneself, (2) the freedom to do what one wants, and (3) not feeling obligated to another. Although some older adults have expressed a great sense of independence with the presence of sensor monitoring, knowing that they always have someone "there" to keep them safe (Pol et al. 2016), for others, their presence has a clear impact on their behaviour in the home and fails to meet one or more of the above criteria (Berridge 2017; Mortenson et al. 2016; Peek et al. 2017). For example, in Berridge's study (2017), some residents avoided deviating from established routines for fear of triggering alert systems, or simply rejected the monitoring systems altogether. Other research reports that participants tried "tricking the system" by turning on the shower or opening the refrigerator without bathing or eating (Mortenson et al. 2016: 110). In one case, a man described swinging his legs in front of a sensor that hangs on his bedframe to increase his movement data for the day (Pol et al. 2016: 489). These and other examples illustrate that while the respondents are acting of their own volition, the presence of the sensors and the looming threat of being institutionalized may have a direct impact on their conduct at home, and hence, undermine their autonomy.

Monitoring technologies inevitably involve some relinquishment of the user's expectation of and right to privacy. As made clear in several research studies, this is one of the most important aspects of the power of surveillance and is often neglected by designers and policymakers as a barrier in the adoption of technology (Berridge 2016; Berridge et al. 2019; Carver & Mackinnon 2020; Chung et al. 2015; Garg et al. 2014). As stated by Berridge and Wetle (2019), for older adults, "privacy is not just an intrinsic value that is valuable for privacy's sake, but rather, it is integral and necessary to enjoy other values like freedom, independence, and identity" (p. 7). In their study, while older adults and their adult children agree on primary definitions of privacy, they did not agree how privacy

would be impeded by passive home monitoring. Older participants worried about being "reprimanded" for not behaving properly or felt that, as one person said, being watched is like, "living in a nursing home in your own home" (Mortenson et al. 2016: 109). One woman developed a "sensor phobia," and was so fearful of being "seen" by the sensors that she started hiding in her broom cupboard (Neven 2015). A number of social workers interviewed by Berridge (2016) admitted their need to be tactful when following up on an alert, recognizing that their clients may be more resistant to remote monitoring in the home if they were aware of the extent to which their activities were being monitored. Many were also aware that their monitoring and knowledge of their clients' activities were uncomfortable invasions of privacy, particularly in relation to bathroom visits. In bathrooms, the risk of falling can be intensified if the time spent there is watched or measured, causing residents to feel rushed while trying to be careful with their footing (Berridge 2017).

A consequence of the power of surveillance embedded in passive remote monitoring is its transformation of the intimacy of home space, with the system itself becoming a kind of material agent (Mortenson et al. 2015; Oudshoorn 2012; Urban 2021). In addition to the physical alterations that come with the installation of sensors, the symbolic divide between private and public life represented by the home is dissolved, whereby older users are stripped of their control of what, how, when, and with whom private information is shared (Garg et al. 2014). Neven (2015) adds that for some individuals, the introduction of sensors can reconfigure the emotional meaning of their home, from being a place of refuge and safety to one that provokes feelings of anxiety and fear. Finally, while sensor monitoring is promoted as a solution to the risks of aging at home, appealing to the image of a home that is equated with independence, autonomy, safety, and control (van Hees et al. 2021), the home may also be an abusive or unsafe environment. In such cases, monitoring devices may contribute to the further victimization of an already vulnerable population (Carver & Mackinnon 2020).

Responding to the assumed passivity of older adults scripted into the design of monitoring devices, Joyce (2021) asks what would it look like if older adults could communicate with those tracking them? Reciprocal monitoring exists in other community contexts (Mortenson et al. 2016), and perhaps could be implemented in home monitoring to complement the need for user control and better address problems of privacy and need

for autonomy. If smart home systems are to be successful in achieving aging in place alternatives to institutionalized care or hospitalization and become more than just "technologies of deinstitutionalization" (Milligan 2009: 89), then the power relations implied by them must be recognized at the points of design, installation, operationalization, and interaction along with the imaginative creation of more reciprocal and relational technological models.

Care Economies and Gendered Power Relations

The third locus of power we explore is that implicated in the gendered and often invisible labour invested in and required by health and care technologies, and upon which smart home life and residence for older people depend. In addition to the care work inherent in tracking bodily activities such as bathroom use, eating, sleeping, and medication schedules, health and monitoring technologies demand a host of other (and new) lines of care work, including discerning deviations in data patterns or moments and responding to emergency calls and alerts.[2] However, strikingly absent from the descriptions of already-existing monitoring gerontechnologies and the promissory visions of future ones in both policy documents and much academic work are questions that ask: who ensures that devices are charged, operating, updated, and being appropriately used? What happens to the data produced? Who is responsible for reviewing and interpreting the data and making practical decisions based on them? Who will receive and manage information, such as notifications? Who will take appropriate actions to intervene, for example, to program reminders for medications? Such questions point to the importance of human actors, predominantly women, who are expected not only to operate but to fulfill and complete the workings of care technologies (see Strengers & Kennedy 2020; Wachter-Boettcher 2017).

As feminists have long argued, women, long-stereotyped as being naturally nurturant, are already burdened with the bulk of caregiving

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[2] Thirty-one percent of caregivers surveyed by Fox et al. (2013) reported that they keep track of their family member's weight, diet, exercise routine, or other health indicators or symptoms, with 23% of those using some form of technology to track another person's health-related data, ranging from health apps to glucose meters.

labour both as private family members and as residential and institutional workers, and today, the management of care technologies also falls disproportionately to them. Thus, for women care workers, managing data care (updating, collecting, recording, interpreting, and relaying) becomes an added, but invisible burden to the already difficult and undervalued work of providing body care to older care recipients. And when they are not replaced by technology, carers' labour, (in)visibility, and conditions of care are reconfigured and redistributed by it (Milligan & Power 2010; Sousa 2013). Monitoring systems and devices implicitly operate with expectations that telecare operators and family care providers can be immediately, skillfully, and virtually available. These expectations assume a capacity and willingness on the part of family caregivers (if they even exist) both to partake in traditional care activities and to take on newer care responsibilities related to technological equipment and its data outputs. As Mol et al. (2010) assert, technologies "do not work or fail in and of themselves. Rather, they depend on care work" (p. 14). Furthermore, the intensification of older age care work through tracking and monitoring devices creates new unequal statuses and relations between skilled technical and "unskilled" non-technical labour (an issue beyond the scope of this article to elaborate).

Technologized gendered older age care labour is also linked to the wider political economy of health, even as it is rendered invisible in designs of smart home and domotic (home automation) devices that promise a reduction of paid and/or unpaid care providers (Milligan 2009; Roberts & Mort 2009).[3] As neoliberal healthcare policies seek cost savings in care delivery for older people, they turn to the promise of technology in various areas that control labour, such as eHealth and telemedicine (Barakat et al. 2013), that further fragments or devalues care work. In their investigation of telecare systems promoted to older individuals living at home in England, Roberts and Mort (2009) suggest that they introduce a "tripartite

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[3] Feminist research has shown that time-saving domestic technologies neither relieved nor displaced women's work in the home, but expanded it (Cowan 1983). Berg's (1994) analysis of early versions of the "smart house" that captured the public attention by offering automated control over lights, heat and security, found these to be designed from the standpoint of the able-bodied, affluent male, while more affective tasks associated with social reproduction (cooking, cleaning, childcare, and social bonds) were largely ignored.

division of care": monitoring, physical care, and social-emotional care. They argue that such care technologies both fragment and impose artificial boundaries around care tasks, ultimately undermining the complexities of care work and oversimplifying both the care experience and the complexities of social-spatial relations of care (see also Sousa 2013).

Assemblages of power, gender, labour, and technology have been problematized by contemporary feminist technoscience research on care (de La Bellacasa 2011; Martin et al. 2015; Murphy 2016). Here, care is positioned as an affective force that cannot be materially separated from instrumental forces of knowledge or technology, but rather frames important forms of knowledge production. Care work organizes technological operations as much as it is organized by them. Yet the invisibility of care work results in care being "othered" from the very thing on which it is acting (Barnes et al. 2016; Dalmer 2020). In practical terms, when cast as opposites, care and technology can keep particular lines of care work occluded or can reify these divisions between technologies and care. In the Canadian context, for example, Marier (2021) highlights a "carer blind" approach that continues to permeate supports for the country's aging population, with services and assessments nearly wholly aimed at the older adult (at the exclusion of the care partner). The Canadian Healthcare Association's 2009 policy brief "Home Care in Canada: From the Margins to the Mainstream" provides an example of how the integration of technologies appears to exacerbate this carer blind practice, as Marier notes. In this document, while the importance of both family care providers and information and communication technologies are separately recognized, curiously, in discussions highlighting the utility of technologies, caregivers are absent; they cease to exist. Their role in using and working the technologies or the additional labour these technologies impose on the carer are notably absent.

Perhaps, this division is mirrored in technological design itself, where most designers are men and script into their products the split between personal care as feminine (warm, loving, nourishing) and technological care as masculine (rational, effective, instrumental) (Mol et al. 2010; Pols & Moser 2009). Yet, as de La Bellacasa (2011) suggests, care also implies concern for those affected by sociotechnical assemblages, but "whose voices are less valued, as are their concerns and needs for care" (p. 92). However, the invisibility of domestic work and social reproduction-related

tasks within care practices for older adults persists, as Chivers (2018) and Storelli (2010) highlight, perhaps exacerbated by an unwillingness to acknowledge that care providers for older adults aging in place are often older adults themselves (Dalmer 2018).

As Sousa (2013) argues, it is crucial "to make visible the ways in which care for older people is (re)constituted through shifting conceptions of care" (p. 134). As new technologies redistribute care spatially and temporally, they intensify some aspects of care labour. They may collapse space and time (Couclelis 2009; Woods & Kong 2020), requiring a full-time vigilance for family care providers to be reached at any time in any location with a beep or buzz that initiates a series of decisions to be made. The vast amount of data requiring digesting and interpreting, where "even filtered data could be overwhelming" (Huber et al. 2013: 444), and the multiple daily routines and habits of older people requiring tracking and quantifying, push caregivers to merge physical and virtual worlds, serving as on-call data and information intermediaries. As a result, tracking technologies for older adults are marketed as – and lauded for – being immediate, continuous, and optimized, without, again, revealing the invisible work needed to compensate for the demands and costs of the device. One smart home company, Forma SafeHome, created ROSIE, a remote monitoring system marketed as providing "invisible companionship to seniors" while "giving their loved ones 24/7 access to critical information" (Forma SafeHome, n.d.). ROSIE,[4] an acronym for "Remote Observation (for) a Secure Independent Living Experience," includes activity tracking, doorbell video surveillance, stove monitoring, fall detection, emergency call buttons and real-time notifications, accessed and managed remotely through the caregiver's smart phone or tablet. The caregiver is described on the company website as being "empowered" with the information needed to "analyze aging patterns and concerns" while the technology is

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[4] Lewis (2015) notes that many AI systems are created with female personae, from The Jetsons' Rosie the Robot Maid, to Amazon's Alexa and Apple's original Siri (whose Norse name means "a beautiful woman who leads you to victory"), whose "helper" roles are often subordinate or submissive. A programmed female voice reportedly enhances users' comfort and confidence with robotic care systems as they feel less threatened or intimidated as compared with a male voice, making the system (or robot) more accepted and welcomed in the home (Eyssel & Hegel 2012; Strengers & Kennedy 2020; Tay et al. 2014).

described as "non-intrusive," "invisible," and yet also a form of (female) companionship to the aging family member being cared for.

By thinking about the labour and gender relations of power compressed into the datafication of care, we can attend to the wider social relations and new boundaries between public and private spheres implied by the calculation and circulation of care data. We can also look more closely at the agency of caregivers for whom resistant and creative opportunities may emerge. For example, Winance (2010) suggests understanding care as a form of tinkering: "to meticulously explore, 'quibble', test, touch, adapt, adjust, pay attention to details and change them, until a suitable arrangement (material, emotional, relational) has been reached" (p. 111). This lens of care-as-tinkering acknowledges that care is not relegated to one body but to the many other people, devices, and tools that we use to regulate and monitor bodies and bodies' actions, inputs, and outputs. It brings into focus the constellation of actors and activities that are knowingly, and at times unknowingly, put into play when people's actions or routines are tracked. As Fotopoulou (2019) argues, "the challenge is thus to reinstate the materiality of data, to think about laboring bodies, invisible human practices, and social relations and activities" (p. 228).

Conclusions

In this study, we have reviewed aspects of self-tracking and surveillance health technologies whose quantification and datafication of care for older people reflect socio-technical power in three areas: (1) aging bodies and the power of numbers, (2) aging spaces and the power of surveillance, and (3) age care economies and gendered power relations. Our arguments urge a tempering of the optimistic claims that these and related technologies are solutions to keeping aging populations healthy and independent, while encouraging more desirable, efficient, and less costly forms of residence and care. We contend that to understand the growing centrality of technology in current systems of care and risk management, analyses should highlight the broader terrain of the neoliberal governance of health systems and austerity politics, and the age relations and gendered care labour relations, which they configure and endorse, including biases of ageism (Rosales & Fernández-Ardèvol 2020). As feminist research has demonstrated, bias and inequality become even more

invisible when technical and design discourses dissolve social inequalities and difference within neutral depictions of beneficial innovation and efficiency (Benjamin 2019; D'Ignazio & Klein 2020; Oudshoorn et al. 2016).

In underscoring the powers that accompany the datafication of aging care as complexly embodied, gendered and socio-technical, we seek to contribute to a view of aging futures that is less device centered and which resists oversimplified or stereotypical understandings of age, aging, and socio-technical power in later life. In doing so, we hope that our framework will foster a research agenda that looks to more creative future imaginaries of old age. In building on Peine and Neven's (2021) model of the *co-constitution* of aging and technology, our proposed framework thus carries implications not only for gerontological research but also for older adults. Promising directions are suggested by recent work that draws on critical age studies and science and technology studies, variously described as new materialist gerontology (Höppner & Urban 2019; Wanka & Gallistl 2018) or socio-gerontechnology (Peine & Neven 2019; Peine et al. 2021), that stresses the manner in which both technologies and aging lives are "co-constituted in a social field, comprised of actors, discourses and power relations" (Wanka & Gallistl 2018: 2). Within this field, not only are technologies social actors but older people and caregivers are technological agents and technogenerarians (Joyce & Loe 2010). In addition to tinkering with technologized care, they create technologies of their own (Bergschöld et al. 2020), make their own "little arrangements" to enhance autonomy within existing socio-material conditions (López Gómez 2015), reframe the nature of technological innovation in professional care practices (Bergschöld 2018), do repair work to ensure digital systems function appropriately (Schwennesen 2019), challenge negative aging images scripted into care technologies, such as companion robots (Neven 2010), contest demeaning age-based digital divide stereotypes (Neves et al. 2018), organize living spaces to prevent falls in imaginatively technical ways (Mahler & Sarvimäki 2010), and based on different social status identities, refuse remote passive monitoring technologies (Berridge et al. 2019). These and other studies provide a glimpse into the opportunities for a more diverse and co-participatory gerontechnological culture. As the power relations shaping aging futures become increasingly located and expressed in technical ways, understanding the agential interactions between material, technological, human, design, and environmental

relationships becomes more vital in contesting the health regimes and gender inequalities gathered into Age Tech datafication, tracking, and surveillance systems.

Acknowledgments

Corresponding author

Nicole K. Dalmer, Department of Health, Aging and Society, Kenneth Taylor Hall, Room 230A, 1280 Main Street West, McMaster University, Hamilton, Ontario, Canada L8S 4M4. Email: dalmern@mcmaster.ca

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