Graying the Cyborg Revisited

How Age Matters when Technologies Move under the Skin

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Abstract: Feminist scholars were among the first to argue for the importance of including ageing and later life in STS research. Remarkably, most studies on technoscience and ageing only address technologies external to bodies. Although this scholarship has provided important insights into the many different ways in which technologies intersect with ageing I suggest that it is important to expand our analyses to technologies inside bodies. How can we understand ageing and agency in times when technologies become increasingly implanted in our bodies? In this article I will present three conceptual approaches that correspond to growing discussions at the cross-roads of STS, age and disability studies, and feminist scholarship, including cyborg theory, constructivist perspectives on vulnerability and resilience, and intersectional approaches. I will build on some of my previous theoretical and empirical work on pacemakers and implantable cardioverter-defibrillators to discuss how age matters when technologies move under the skin.

Keywords: technology and ageing; graying the cyborg; technologies inside bodies; pacemakers and cardioverter-defibrillators; vulnerability and resilience.

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1. Introduction

Cyborgs are ageing. This applies to bodies implanted with technologies, the people we study, and the very notion of cyborg itself. In her seminal *Cyborg Manifesto*, Donna Haraway (1985) appropriated the

cyborg figure to call for a critical engagement with the politics of techno-science and for taking responsibility for technology (Gray, 2011). Criticizing approaches that merely celebrate or condemn the increasing dependency of humans on technology, she challenged us to rethink human ontology to grasp what constitutes our contemporary life. In a world permeated by techno-science, bodies and technologies should no longer be considered as ontologically separate but as co-producing each other (Oudshoorn 2020). In her feminist intervention into cyborg discourse, Haraway not only challenged the rigid binary opposition between organisms and machines but also other long-standing dualisms such as nature/culture and male/female (Balsamo, 1996). By redefining the meaning of cyborg from a technical metaphor[1] into a concept that can be used to subvert and displace troublesome dualisms, Donna Haraway urged us to create alternative views, languages, and practices of techno-science and hybrid subjects.

In this article I will discuss three conceptual approaches to understand the agency of old people living with technologies inside their bodies. Although Donna Haraway did not attend to the ageing of cyborgs, understanding the relationship between technology and ageing has become an important, emerging theme in Science and Technology Studies (STS). Feminist scholars were among the first to argue for the importance of including ageing and later life in our research agenda. In *Graying the Cyborg*, Kelly Joyce and Laura Mamo (2006) argued that new research in STS should address the intersection between age, science, technology, and gender. Age should no longer be neglected because older people are increasingly targeted as consumers of new technologies such as assisted living devices, entertainment technologies and pharmaceuticals. Equally important, developments in biomedicine, including the rise of anti-ageing medicine, construct and redefine the ageing body as a "set of age-related diseases as well as a site for continual restoration and improvement" (Joyce and Mamo 2006, p. 99). In this important and very timely call, Kelly Joyce and Laura Mamo developed a research agenda that is still valid today. They encourage us to study the ways in which technoscience constitutes the experiences and meaning of ageing, the ageism underlying the design, marketing and use of technological devices, as well as the ways in which older people give meaning to and negotiate technological applications in their daily life.

More recent studies on the relationship between ageing and technoscience draw the attention to policy discourses which create a 'triple win narrative' in which technological innovation is portrayed as the ultimate solution to diminish the socio-economic consequences of ageing populations. In this promissory narrative, technological innovation emerges as a crucial actant in improving the life of old people, generating new businesses and stimulation economic growth (Joyce et al. 2017; Neven 2011, 2015; Neven and Peine 2017; Peine et al. 2015; Robert and Mort 2009). These scholars argue that this discourse is problematic

because it reinforces a negative rhetoric about ageing and old people such as frailty and impairment (Peine and Neven 2011; Vines et al. 2015). Moreover, it embraces a perspective in which ageing and technological development are understood as separate processes, thus neglecting how technoscience is already inextricably intertwined with the definition, meaning and practices of ageing (Loe 2010; Peine et al. 2015). By introducing the notion of "socio-material constitution of later life", Alexander Peine and his colleagues encourage us to study how the interaction between ageing and technoscience both shape and is shaped by a wide range of social, institutional, economic, policy, and material settings, relationships and practices that surround ageing (Peine at al. 2015).

Similar co-constitutive approaches to theorizing ageing and technology[2] underly many STS studies on ageing and later life. This research has created important insights of how sociotechnical imaginaries construct ageing[3], the ways in which these imaginaries[4] are represented and incorporated into design practices, and how elderly people are included or excluded in technological design[5]. The latter studies highlight how "design paternalism" is a key characteristic of many design practices (Peine et al. 2014). This notion refers to practices in which designers construct old people as passive, technology-averse, or technologically illiterate users "who should follow what designers offer them" (Peine et al. 2017, 927). This approach is very problematic because it leads to technological objects that are useful for a very limited group of elderly people (Bergschöld et al. 2020; Peine et al. 2017; Peine and Neven 2019). Scholars therefore aim to go beyond the one-size-fits-all approach in design practices by emphasizing the importance of taking into account and accounting for the diversity of old people (Östlund 2005; Peace and Hughes 2010; Peine et al. 2017). Equally important, feminist scholars have provided a critical intervention into practices of design paternalism by conceptualising old people as active agents of technological change or "technogenarians": "individuals who create, use, and adapt technologies to negotiate health and illness in daily life" (Joyce and Loe 2010, 171)[6]. This important research shows how old people often are early adopters of new technologies, actively engage in tinkering with objects which inspires innovation in technological design, participate in developing Do It Yourself (DIY) technologies, or negotiate a meaningful space for technology in their daily lives. These studies thus challenge long-standing imaginaries about old people and innovation[7].

Remarkably, Kelley Joyce's and Laura Mamo's agenda-setting article *Graying the Cyborg* only addresses technologies external to bodies. Although they shortly mention technologies implanted in bodies, particularly cardiac implants, they don't include any further reflections on how human-technology relations may change when technologies move under the skin. More recent studies on ageing and technology show a similar preference for studying technologies external to bodies, including rolling walk-

ers and drugs[8], care robots[9], and assisted living and telecare technologies, such as remote alarms, sensors and automated pill dispensers[10]. Although this scholarship has provided important insights into the many different ways in which technologies intersect with ageing I suggest that it is important to expand our analyses to technologies inside bodies. How can we understand ageing and agency in times when technologies become increasingly implanted in our bodies? In what follows I will present three conceptual approaches that correspond to growing discussions at the cross-roads of STS, age and disability studies, and feminist scholarship, including cyborg theory, constructivist perspectives on vulnerability and resilience, and intersectional approaches. I will build on some of my previous theoretical and empirical work on pacemakers and implantable cardioverter-defibrillators (Oudshoorn 2015; 2020) to discuss how age matters when technologies move under the skin.

2. Rematerializing the Cyborg

In contrast to the dominant images of the cyborg in science fiction and popular media, hybrids of humans and machines are not only young men (Haddow et al. 2015; Joyce and Mamo 2006; Joyce et al. 2017). Because of the rise of anti-ageing or longevity medicine and gerontology, bodies of older people are increasingly subjected to medical interventions, including implants (Joyce and Mamo 2006; Joyce and Loe 2010). In recent decades we have seen the introduction of more and more technologies that operate under the surface of the body, including artificial hips, knees, and hearts, breast and cochlear implants, prosthetic arms and legs, spinal cord stimulators, pacemakers, implantable cardioverter-defibrillators, and emerging human enhancement technologies such as brain implants and nano-chips for diagnosis and drugs delivery (Oudshoorn 2020). This trend towards developing technologies that merge with bodies is also illustrated by the *Gartner Hype Cycle for Digital Government Technology* (Moore 2018), in which five of the technologies that are expected to have "the most transformational benefit for government organizations over the next 10 years" concern techniques that blur the boundaries between humans and machines, including bio-chips, artificial human tissues, and brain-computer interfaces (Moore 2018; Noort 2018). Although some of these technologies are used by people of all ages, older people constitute the major 'users' of these medical devices.

As anthropologists of medicine have argued, the increased attention to ageing in biomedicine has constructed old age as a medical problem and shaped and reinforced cultural ideals of ageing as undesirable, abnormal and even pathological, as well as the cultural belief in extending life[11]. Medical interventions in older people have increased substantially over the past decades, as exemplified by the ICD, a life-extending heart implant that has become a routine and standard treatment of older people in

wealthy, industrialized countries (Jeffrey 2001). As Sharon Kaufman and her colleagues have described, the growing use of these medical devices also includes the very old, particularly but not exclusively in the U.S., where twenty percent of ICDs are implanted in persons aged 80 and above (Kaufman and Fjord 2011). In contemporary medicine saying no to life-sustaining technologies has become extremely difficult (Kaufman 2015). Decisions about appropriate medical treatment are driven by the availability and values given to technological interventions, particularly the newest and most advanced technologies. This 'treatment imperative' (Fuchs, 1968) has increasingly become a moral obligation for clinicians to continue medical interventions in ever older persons (Kaufman and Fjord 2011; Koenig 1988; Shim et al. 2008).

For many older people, cyborgs are therefore not just fictional or speculative imaginaries of the future but a lived reality, they are "everyday cyborgs". Gill Haddow and her colleagues introduced this term as a heuristic to acknowledge the importance of the "participant voice currently missing in existing cyborg literatures and imaginations" (Haddow et al. 2015, 484). But how can we understand the agency of people living with medical implants? At first glance we may think that technologies inside bodies assume a passive role of everyday cyborgs because they work automatically inside their bodies, taking them beyond the control of their hosts. Technologies implanted in bodies thus challenge a long-standing tradition of theorizing human-technology relations in STS and the philosophy of technology that only address external technologies that can be used at specific moments and places and are more or less under the control of humans[12]. However, most devices that operate under the surface of the body delegate no agency to its "users" in terms of how they are supposed to interact with these technologies[13]. Pacemakers and ICDs, for example, are designed in such a way that agency is delegated only to the device. Pacemakers give electric pulses to the heart when the heartbeat is too slow. The ICD is designed to do the opposite. It may give very fast pulses or small or larger electric shocks to intervene into very fast, life-threatening heart rhythms. These programs of action thus concern the interactions between the heart and the device rather than with their users (Oudshoorn 2020). Compared with external devices, most people living with technologies inside their bodies cannot decide when, where, or how to 'use' them. Although pharmaceuticals also intervene in the body, one can decide to stop taking medicines. In contrast, people living with medical implants such as pacemakers and defibrillators cannot turn these devices off (Oudshoorn 2020). Equally important, most of these medical implants are inserted into bodies to stay there until the end of life. Or, as Sherry Turkle (2008, 12) phrases it: "becoming cyborgs is not a reversible step". Technologies implanted in bodies are thus not bounded by a temporality of use, but should be understood as continuous devices, which is in sharp contrast to STS theories that conceptualize the interactions between humans and technologies as finite and limited temporal events,

such as Actor-Network approaches and the Social Construction of Technology (SCOT)[14].

Although pacemakers and ICDs are designed in such a way that agency is delegated only to the device, the absence of programs of action for its users still raises the question of whether everyday cyborgs are really so passive. As I argued in *Resilient Cyborgs* (2020), any discourse or policy that assumes a passive role of implanted persons silences the fact that keeping cyborgs alive involves their active engagement. Many of them participate in a lifelong trajectory of specialized monitoring to check whether the devices still function properly, whether they need replacement, and to adjust the agencies of the devices and to the agencies of the body. Moreover, they have to learn to cope with the vulnerabilities of their technologically transformed bodies, which may involve changes in daily routines and social relations and a re-appropriation of how they experience their bodies. To understand the work involved in sustaining hybrid bodies, it is important to rematerialize the cyborg. As feminist scholars have argued, the linguistic turn in cyborg studies and other fields neglects the materiality of bodies (Dalibert 2014; 2016; Jain 1999; Sobchack 2006). According to Vivian Sobchack, who lives with a prosthetic leg, the use of the cyborg or prosthetic figure as a metaphor has resulted in a discourse in which "the literal and material ground is forgotten or even disavowed" (Sobchack 2006, 20). Cyborgs have thus lost their materiality. Recent feminist post-humanist studies on the intimate relationships between bodies and technologies, therefore call for new conceptual tools to recognize and account for the intimacy of human-technology relations as material and normative as well as the agency of cyborgs (Alaimo and Hekman 2008; Dalibert 2014; 2016; Lettow 2011; Oudshoorn 2015; 2020).

One way to account for agency of everyday cyborgs is to look at their sensory experiences. As Jones (2006) suggested, experiences with one's body are not just discursive or linguistic but include sensory experiences. Most importantly, technologies may participate in creating new sensory experiences (Dalibert 2014; Jones 2006). People living with pacemakers or defibrillators, for example, face new sensory experiences mediated by electric pulses and shocks that countermand or take over their heartbeats. A focus on how people living with internal devices use their sensory experiences as a resource to sense and make sense of their technologically transformed bodies thus provides an important approach to conceptualize the agency of everyday cyborgs (Oudshoorn 2020). Because older people are a major target group of many new and emerging implants, understanding how sensory experiences shape later life and vice versa is important to include in future research.

3. Constructivist Perspectives on Vulnerability and Resilience

Technologies often do much more than they are supposed to do. Acknowledging these unintended consequences, scholars in STS, medical sociology and anthropology emphasized the transformative potential of medical technologies that contributes to a remaking of bodies that has important implications for what it means to live with disorders and to be human (Brown and Webster 2004; Clarke 1995; Lehoux 2006; Rose 2007). This transformative quality of technology is also important to take into account if we want to understand what it means to live with technologies implanted in bodies. Through the years, ageing bodies may become more vulnerable. This also concerns people living with technologies inside their bodies. However, these everyday cyborgs may experience a multi-layered vulnerability because there may be something wrong with their bodies, their implants and/or the interactions between them. Although there exist high expectations and promises about what medical implants can do, technologies, like humans, can fail. These implants not only contribute to solving or diminishing specific health problems, thus reducing the vulnerability of everyday cyborgs, but may also introduce new vulnerabilities. First, everyday cyborgs face new kinds of vulnerability because they have to live with the continuous, inextricable intertwinement of technologies with their bodies. Take the example of pacemakers and ICDs. Although wired heart cyborgs, as I call them, are already familiar with their heart problems, internal heart devices transform their awareness of the fragility of their heart. The proper working of the heart now depends on the adjustment of the electric pulses of their implants to the malfunctioning electric stimuli of their heart. Crucially, an improper programming of the pacemaker or ICD may not only result in a decreased quality of life but may even lead to an untimely death (Tseng 2015). The vulnerability of these heart cyborgs can thus be conceptualized as the harm caused by a disturbance of the delicate balance between the material agencies of bodies and internal devices. Second, people living with implants may experience new vulnerabilities because their devices can fail. Compared with many technologies external to the body, anticipating the harm caused by malfunctioning implants may involve other kinds of anticipation because you can never run away from a technology implanted in your body. Medical implants thus constitute a sense of being at the mercy of the agency of the implant, including its failures (Oudshoorn 2020).

Technologies inside bodies thus not only challenge dominant views on agency but also invite us to rethink dominant approaches to vulnerabilities. Medical discourses on the fragility of humans often adopt an instrumental or essentialist view that consider vulnerabilities as given or static characteristics of humans and technologies. However, STS scholars have convincingly argued that vulnerability should not be considered as an "an intrinsic and static characteristic" (Bijker et al. 2014, 14) of technological

systems or human existence. This constructivist approach invites us to view vulnerability as an "emergent property" (Bijker et al. 2014, 6) that results from and depends on specific circumstances in technological cultures rather than on the inherent capacities of technologies or humans. Given the vulnerabilities everyday cyborgs may face, building resilience becomes a key concern for people living with implants and medical professionals and is important to include in technology and ageing studies as well. As vulnerability, resilience should not be considered as pre-given or fixed. Whereas early psychological studies of resilience adopted an essentialist view in which resilience was conceptualized as a personality trait, constructivist approaches no longer consider resilience as static but as something that unfolds over a person's life time, as a multi-faceted process. This shift in approaching resilience is important because the essentialist perspective runs the risk of blaming the individual for not being able to cope with stress or trauma, and turns resilience into an extraordinary capacity of people who survive in times of crises (Graber et al. 2015).

The conceptualization of resilience as a process rather than a fixed personality trait provides an important heuristic for understanding what it takes to become a resilient cyborg. However, there is one conceptual hurdle to take because technology is largely overlooked in theorizing resilience. As I argued in Resilient Cyborgs (Oudshoorn 2020), we can distinguish two ways in which technologies matter. On the one hand, technology may contribute to resilience by making people aware of the vulnerability of human existence. On the other hand, technical devices may provide important resources that people can draw from to build resilience. Inspired by Noortje Marres (2012), I argue that technological objects make a distinctive form of resilience possible. Any understanding of what makes people resilient or not should acknowledge that technologies may provide important resources for adapting positively to potentially traumatic events and the risks people face in everyday life, including threats posed by technologies. A focus on the materiality of resilience thus enables us to go beyond the view that people living with medical implants are passive 'victims' of their implants. To do so I introduced the notion of techniques of resilience (Oudshoorn 2020). In addition to sensory experiences, techniques of resilience provide an important heuristic for understanding the agency of everyday cyborgs in coping with the vulnerabilities of their hybrid body.

But what about ageing? I suggest that adopting an age lens is crucial because older, everyday cyborgs may not have equal access to the resources that enable them to become resilient cyborgs. During my interviews with people living with ICDs I learned that older people may experience more difficulties in developing techniques to build resilience. Let me take one example. When heart cyborgs visit the cardiology policlinic for a yearly check-up of their device, technicians run several tests to investigate the non-human parts of the hybrid, including the lifetime of the battery. When it is empty, it cannot be charged from the outside: people

have to undergo surgery again to get a new implant. Controlling the lifetime of the battery is crucial because heart devices simply fail to work when the battery is weak or empty. For people implanted with an ICD it may imply the risk of an untimely death because their implant does not have enough power to give a shock, or it will take longer to become active because of a longer charging time. When technicians notice that a battery will soon be empty, they tell patients to return to the hospital for an extra control visit within several months. However, the responsibility to detect empty batteries is not only delegated to technicians. Wired heart cyborgs are expected to monitor the lifetime of the battery as well. When the battery is almost empty, the implants will give beeps at a pre-set time, usually at 8 or 9 o'clock in the morning. These beeping sounds introduce new sensory experiences: bodies with ICDs (and pacemakers) can produce machine-like beeps. People have to learn to listen, in this case literally, to their hybrid bodies.

Detecting the alarm signals is not an easy task, because they need to be distinguished from the beeps of many other electronic devices in our increasingly densely populated technical soundscape. Most people I interviewed did not notice the beeps immediately because they thought the sound was caused by someone or something else: the cell phone of someone nearby, or an ambulance passing the home, or their own watch. However, wired heart cyborgs can also be very creative in developing techniques to detect the beeps. These resilience techniques included switching off all the electronic devices at home to make sure whether the beeps were not caused by another device, or going to more quiet places such as the bathroom to detect the beeps. Importantly, the sounds are not just a feedback signal of electronic devices that happen to be inside bodies. For wired heart cyborgs they create an awareness of the existence and vulnerability of their hybrid bodies that can cease to function if one does not detect the beeps in time and take the appropriate action. Whereas many wired heart cyborgs experience difficulties in detecting the alarm signals of an empty battery, but eventually learn the techniques to do so, elderly people may not be able to develop these resilience techniques due to hearing loss[15]. Because weak or empty batteries produce a rather quiet high frequency sound, many older people may not be able to hear them. Age-related hearing loss thus constitutes a serious constrain in building resilience for people living with ICDs and other medical implants that use beeps as signals for the proper working of the device.

This is just one example of the problems older people may face in keeping their hybrid bodies alive. Because older, everyday cyborgs may face other vulnerabilities as well and may engage in other practices to live with their technologically transformed bodies, studying techniques of resilience is an important theme for future studies of how technologies co-constitute ageing and later life.

4. Intersectionality: Gender, Age and Passing

An important contribution of feminist studies of technology is that age is not the only dimension that matters if we want to understand how technology shapes later life and vice versa. In *Graying the Cyborg*, Kelly Joyce and Laura Mamo (2006) argued that adopting an intersectional lens is crucial to understand how the meaning, access, and use of technologies is constituted not only by age but also by gender, race, class and sexuality. The intersectional approach, introduced by the feminist African-American legal scholar Kimberlé Crenshaw (1989), emphasizes that socially and culturally constructed categories such as gender, race, ethnicity, sexuality, and disability do not act independently of one another but interact on multiple levels. The intersectional perspective is important as well to understand how everyday cyborgs build resilience. In *Resilient Cyborgs* I describe how gender and age intersect in the ways in which women learn to live with pacemakers and ICDs. During my fieldwork I learned that scars resulting from the implantation of pacemakers and ICDs constitute a major problem, particularly for women. Although these heart devices are inserted under the skin, they leave their marks on the body. Pacemakers and ICDs are visible as a roundish quadrangular shape near the (usually left) collarbone, and scars may mark the site of the implant as well. After implantation, people are thus confronted with a visibly changed body. As scholars in medical sociology and disability studies have described, learning to live with a marked body can be very consequential because one's physical appearance is no longer how it used to be. Visible traces of surgeries and implants act as continuous reminders of the physically changed body, making it more difficult to forget what happened to your body (Slatman et al. 2016; Dalibert 2014; 2016; Pollock 2008).

Although all wired heart cyborgs have to learn to live with their marked bodies, women may face more difficulties because their bodies are more subjected to the gazes of others than male bodies (Bordo 1997). As feminist scholars have described, western cultural norms on femininity continue to mold women's bodies into idealized imaginaries of how a woman should look, emphasizing their smooth bodily contours (de Boer 2016; Dalibert 2014). Moreover, women's clothing makes it more difficult to hide the implant from the inquiring looks of others. In this respect, the very site of the implant, near the collarbone, reflects an unintended gender bias because the scars and the implant can be more easily concealed by men's than women's clothes. To conceptualize how women learn to live with their visibly marked bodies, it is important to expand the intersectional lens with the theory on passing developed by disability scholars. According to Jeffrey Brune and Daniel Wilson, passing is an important part of the everyday life of people living with disabilities. Passing refers to the ways in which "people conceal social markers of impairment to avoid the stigma of disability and pass as 'normal'" (Brune and Wilson 2013, 1).

As Robert McRuer (2006) has suggested, passing as normal is crucial because of the 'compulsory able-bodiedness' that governs Western culture in which able bodies are valued over other forms of embodiment. The preference for able-bodiedness constitutes a cultural and social imperative to conceal traces of disability and illness. Consequently, many people who deviate from what is considered normal engage in developing multiple techniques of passing in order to not be differentiated from others (Siebers, 2008).

Importantly, passing techniques are not restricted to physically disabled people but are enacted by wired heart cyborgs as well. Women living with pacemakers and defibrillators often engage in concealing their scars and the bulges of their implants, a practice that can be considered as a very specific form of creating resilient cyborgs. In women's accounts of how people respond to their visibly marked bodies, age emerges as an important trigger of reactions. Many women share their experiences with talking to people who simply don't want to believe that they are implanted with a pacemaker or defibrillator. Or as one of them described: "YOU have a pacemaker? Aren't you TOO YOUNG??" (Oudshoorn 2020, 165). It can easily be imagined that these kinds of questions from strangers are not particularly helpful for women trying to become resilient cyborgs because they emphasize the vulnerability of their bodies, which may make their lives more stressful. The casual remarks of strangers only add to increasing these anxieties and vulnerabilities because they impose a specific disability on women. Young women with scarred bodies implanted with heart devices are told that they are not able to conform to the cultural imperative of having a healthy body with feminine smooth bodily contours. Importantly, the remarks of strangers also convey age-specific messages about the pacemakers and ICDs themselves. Usually the comments not only address the age of the women but also refer to the devices as being only for old people. The example of pacemakers thus shows an intriguing dynamic of the co-constitution of gender, age and technology that creates the image of pacemakers as signifiers of old age[16].

Because women can become pretty desperate from explaining all the time what happened to their bodies, some of them decide to hide the visible traces of their implants. In the online communities I studied, women actively engage in sharing experiences about what they should do to make them less vulnerable to the gazes of others. Adjusting one's clothing is one of these techniques, for example not wearing clothes that show the site of the implant, such as strapless shirts or dresses, or low-cut blouses and tops, or concealing their scars with tattoos. Women use these passing techniques because they enable them to be in control of their bodies as visible objects. This "image management" (Slatman et al. 2016, 1620) is needed in a culture which resists female bodies that don't conform to the highly idealized imagery of femininity and beauty. Or, as Theresy Beery in her study of women living with pacemakers put it: "Can a woman be scarred and still be feminine?" (Beery et al. 2002, 20). Passing techniques

can therefore be understood as a very specific way of enacting femininity as well. The pressure to conform to cultural norms about female bodies is particularly strong for younger women. Pacemakers and defibrillators thus constitute specific gender and age relations in which only older women are allowed to deviate from the cultural norm of healthy smooth bodies. Like other bodies, cyborg bodies are thus not outside the cultural norms of femininity, beauty, ageing, and compulsory able-bodiedness (McRuer, 2006; Dalibert, 2016).

5. To Conclude

My account of how people having medical implants learn to live with their technologically transformed bodies confirms one of the major arguments of feminist studies on graying the cyborg. As elderly users of external technologies, everyday cyborgs are technogenarians. Far from being passive consumers or feeble individuals, elderly women and men should be considered as "knowledgeable technoscience users" (Joyce and Mamo, 2006). In this respect there are no differences between the ways people relate to external or internal devices. However, studying the interrelations between humans and medical implants challenges us to develop heuristic tools to understand what agency may emerge when technologies don't delegate actions to their 'users', which is the case of many medical implants. In this article I introduced three perspectives that enable us to go beyond the view of everyday cyborgs as passive. The rematerializing-the-cyborg approach provides a very useful analytical lens by foregrounding sensory experiences as an important notion to conceptualize the agency of people living with technologies inside their bodies. Given the persistent and increasing presence of medical implants for older people, understanding the agency of elderly everyday cyborgs remains an urgent theme, not only for academic reasons. Ultimately, many medical implants constitute a crucial case for persons having these implants also because the proper working of these devices depends on their active engagement. To study this active participation, the techniques of resilience approach is an important heuristic because it enables us to account for the vulnerabilities of hybrid bodies without turning cyborgs into passive victims of their implants. Moreover, accounting for difference is important as well. I argued that a focus on intersectionality provides an important lens for grasping the ways in which age and gender interact and shape one another in building resilience. I suggested that combining the intersectional approach with the concept of passing enables us to understand how age and gender matter in the ways in which everyday cyborgs learn to cope with the vulnerabilities of their technological transformed bodies. Equally important, comparing and contrasting different age groups provides a very useful method to study the complex interactions between age, gender and technology. Although this article did not address other differences, such

as race, ethnicity, sexuality, or disability, these are relevant to include in our research agenda as well.

Finally, I would like to suggest that it is important to include the last phase of cyborg life in ageing studies. Accounting for dying and death is crucial because the passage from life to death of everyday cyborgs is not the same as for those who live without internal devices. Medical implants may introduce new vulnerabilities and anxieties about whether implants should be turned off before death and/or removed after death. They may also make everyday cyborgs and their close relatives anxious about whether they will be able to die with an active implant. Equally important, medical implants may introduce anxieties about the kind of death everyday cyborgs will experience (Kaufman 2015; Oudshoorn 2020). Dying and death should thus be considered as integral part of future studies of ageing cyborgs.

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[1] The notion of the cyborg was framed as a technical term in the context of the space race during the cold war and referred to a literal fusion of human/animal and machine (Clynes and Kline 1960). See Markussen et al. (2000) and Bjorn and Markussen (2013) for a further reconstruction of the history of the term "cyborg".

[2] For a further elaboration of this approach see Peine and Neven (2019; 2020).

[3] Exemplary studies about how sociotechnical imaginaries construct specific meanings and practices of ageing and later life, include Joye and Mamo (2006); Joyce et al. (2017); Peine and Moors (2015); Peine (2019); Peine and Neven (2020); Higgs and Gilleard (2020).

[4] I borrow this distinction in three lines of research from Kelley Joyce and her colleagues (Joyce et al. 2017).

[5] Exemplary studies include Fischer et al. (2020); Östlund et al. (2015); Neven (2011); Peine and Neven (2011); Peine et al. (2014).

[6] A more detailed discussion of studies of the co-constitution of technoscience and ageing and later life is beyond the scope of this article, but see Joyce et al. (2017), Peine (2019), and Peine and Neven (2020) for an extensive overview and discussion of this literature.

[7] Bergschöld et al. 2020; Berridge (2017); Giaccardi et al. (2016); Gibson et al. (2019); Loe (2010); López Gómez (2015); Östlund and Linden (2011); Peine et al. (2015); Peine et al. (2017); Pols (2017).

[8] Joyce and Loe (2010); Loe (2010).

[9] Joyce et al. (2015); Peine and Moors (2015); Frennert (2020).

[10] For exemplary studies see Callen et al. (2009); Loe (2015); Mort et al. (2015); Oudshoorn (2011); Pols and Willems (2011); Schillmeyer and Domenech (2010).

[11] See Lock (1993) and Shim et al. (2008).

[12] See, for example, Bruno Latour's influential approach to human and non-human agency (2005), in which he used external technical devices such as car seat belts and door keys as key examples to theorize agency.

[13] Some of the more recently introduced implants delegate some agency to their users. Deep brain stimulation implants introduced for the treatment of Parkinson and spinal cord stimulation implants, developed for the treatment of chronic pain, allow patients to interact

with the device in order to raise or lower stimulation levels (Morrison and Bliton 2011; Dalibert 2014).

[14] See Dalibert (2014) and Verbeek (2008) for a similar criticism on STS and the philosophy of technology.

[15] Hearing loss is considered as the third most common chronic health problem in older adults (Newman and Sandridge 2004).

[16] This is in sharp contrast to the pacemaker implantation rates which indicate that women constitute 45,3 % (The Netherlands) to 49% (US) of the total number of pacemaker users (Boorsma and Zaadstra 2011; Williams and Stevenson 2017).