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Circumspect Users: Older Adults as Critical Adopters and Resistors of Technology

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While HCI research has often addressed the needs of older adults, they are often framed as being sceptical of digital technologies. We argue that while many older adults are circumspect users of digital technology, they bring rich and critical perspectives on the role of technology in society that are grounded in lived experiences across their life courses. We report on 20 technology life story interviews conducted with retirees over the age of 60. Our analysis shows how experiences of technology across their life courses significantly undermined participants' sense of competency, independence, resilience, agency and control. Dissonances between what our participants valued and the perceived values of technology have led them to become critical adopters of technology, and resist its intrusion into certain aspects of their lives. We discuss how the critical perspectives of older adults and the value dissonances they experience are valuable for designing future digital technologies.

CCS Concepts: • **Human-centered computing → Empirical studies in HCI**;

Additional Key Words and Phrases: Older adults; Life course; Life story interview; Everyday resistance

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1 INTRODUCTION

The rise in the average age of the world's population [54], and the tendency to interpret this as a social and economic problem [27, 46], have contributed to an increased interest on how technology design might better meet the needs of older adults. A consequence of this has been a rapid growth in HCI research on ageing over the last two decades. This has led to a wealth or work highlighting the possibilities for technology to address the health and wellbeing concerns of older adults (e.g. [3, 26]), to connect elders who may be socially isolated (e.g. [32, 76]), or to respond to the declining physical or cognitive abilities and associated care needs that come with ageing (e.g. [16, 52]).

Recently, a critical stream within HCI research on ageing has called for a broadening of these concerns. It has been noted that much work in HCI tends to portray older people as a relatively homogenous group [75], often defined by their deficits rather than their capabilities [61]. Inspired by critical studies from the field of social gerontology, this body of work rejects the notion of age as a problem to be solved with technology [75], and advocates for a move

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beyond the focus on accessibility and assistance. For instance, Knowles et al. have highlighted the need to increase our understanding of the numerous other factors that make digital technologies less appealing to older adults [44]. Durick et al. have observed that usability alone does not guarantee adoption, and have argued for human-centred approaches to design that consider people's interpretations of *"why and how technologies should be used"* [27]. Vines et al. have called for researchers to engage more deeply with older adults' personal histories of technology use across their life courses [75], and to take seriously their critical positions on technology design and its potentially negative impacts on people's lives [74].

This paper responds to these challenges by situating the study of older adults' attitudes towards technology within the context of their life courses. We draw on studies from the field of social gerontology, which have demonstrated the value of situating people's lived experiences of the present in relation to their individual trajectories throughout their lives. Our main objective was to increase our understanding of how older adults' life experiences relate to post-retirement practices of technology adoption and use. Additionally, we set out to explore conflicts and dissonances between personal values and values attributed to technologies. In order to do so, we conducted a series of life story interviews with 20 people retired from full-time work, with a focus on key life stages and the various technologies (digital and otherwise) they used during different periods of their lives. Our analysis of these interviews highlights how technology changed dramatically over the course of our participants' lives, often in ways that were contrary to the values and commitments they were driven by. Technology was viewed as having counterintuitive logics, as pushing them to be increasingly reliant on the help of others or service providers, as introducing burdensome forms of surveillance and accountability into their lives, and as forcing its adoption on them. Not only did these changes have personal and professional ramifications for participants, but they shaped the ways in which they engaged with, and valued, digital technologies in their lives today.

Through reporting on our participant's life trajectories, we illustrate how past lived experiences of specific techno-historical contexts shape the perceptions and meanings projected onto technological artefacts, as well as the expectations towards them. Furthermore, we demonstrate how the value dissonances experienced by our participants act as starting points for their circumspect usage of digital technology in the present. These, in turn, provide examples of everyday resistances to technology that HCI researchers and designers should take seriously when considering the design of new interactive systems. This paper's contribution to the field of HCI research is three-fold. First, it demonstrates how specific techno-historical contexts influence older adults' attitudes towards new technologies. Second, it builds upon the concept of everyday resistance to uncover aspects of existing digital technologies that could be perceived as problematic by older adults, and which can serve as stimulus for design alternatives that may have benefits for all. Third, it provides an example of how the life course perspective can contribute to HCI research at the intersection of ageing and critical perspectives on technology.

2 OLDER ADULTS, THEIR RESISTANCE OF TECHNOLOGY, AND VALUE DISSONANCES

Research on access, use and adoption of technologies suggest the numbers of older people regularly using digital technologies is growing very quickly. In the UK, home Internet access between those aged 55 and over went from 47% in 2010 [55] to 72% in 2019 [57]; and smartphone use climbed from 11% [55] to 55% [57]. In the US, 67% of those over 65 use the Internet, a 55-percentage-point increase since the year 2000; and 42% own a smartphone, up from 18% in 2013 [20]. These numbers dispel the stereotypes that portray older adults as incapable or unwilling to use digital technologies. Backing them up, recent studies document the degree to which at least some older ICT users have appropriated these technologies and integrated them into their lives (e.g. [15, 19, 46]).

However, many sources also suggest a kind of technological circumspection amongst older adults. Their breadth of technology uptake, and their *"amount and quality of engagement (...) lag behind younger generations"* [42]. Most evidence seems to indicate that older adults engage only in a small set of activities online [71]. For instance, in the UK, Internet users over 65 are less likely to have communicated online over the previous week; to have a social media profile or messaging account; to do their banking, pay their bills and shop online; and to use digital government services [56]. They are also more likely to be less experienced and spend less time online [56]. Kania-Lundholm and Torres observe how the older active ICT users in their study positioned themselves as *"cautious"* in their engagements with digital technologies [39]. Selwyn highlights *"older adult's profoundly ambivalent attitudes"* toward ICT [66], and Light et al. describe their participants as *"selective in what they were prepared to use"* [48]. This technological circumspection is not explained by usability or accessibility deficits alone, and as new cohorts who have experienced more prolonged exposure to digital technologies reach older adulthood, explanations based on the lack of familiarity are also weakened. Other factors must be at play.

Scholars have long argued for the importance of technology non-use and related practices as a meaningful aspect of the socio-cultural production of technological artifacts [7, 62, 78]. Accordingly, both HCI and socio-technical research have studied the reluctant attitudes of older adults towards technology, and have uncovered several factors that seem to contribute to them. These include, for instance, limited relevance to daily life [66]; perceptions of technology as undermining *"personal initiative"* [38]; the stigma attached to technology artifacts seen to substitute for physical or cognitive abilities [13, 38]; negative attitudes towards the Internet [71]; and concerns about the social impact of technology, which approach reluctant attitudes to a form of protest [42, 43, 74]. To borrow language from Baumer and Silberman [8], the implications from much of this work is to *not* design technology for many of these issues and contexts, and to indeed value the absence of technology in the lives of some older adults.

A further productive line of work seeking explanations to older adults' attitudes towards digital technologies connects personal values to those values projected onto technological artifacts. This literature relates to the tradition of value-sensitive design [31], where values are broadly understood as *"what is ultimately important in life"* [34]. Several studies have uncovered which values matter to older adults through a variety of methods such as focus groups [42], design workshops [47], *"questionable concepts"* [74], biographical approaches [73] and in-depth interviews [12]. The list of values that have been revealed as important for older adults include independence (e.g. [13, 38, 47, 53]), control (e.g. [73]), resilience (e.g. [12]), agency (e.g. [12]), competency (e.g. [47]), belonging (e.g. [12, 42, 47, 53]), locality (e.g. [42, 73]), privacy (e.g. [13, 15, 42, 60]) and thriftiness (e.g. [42, 73]).

Some scholars have pushed this line of research forward by introducing the concept of value dissonances in relation to technologies. In their study of older adults choosing to disengage from a technical intervention to tackle social isolation, Waycott et al. conclude that *"recognizing mismatched values provides a valuable opportunity to learn more about our intended users"* [77]. Knowles and Hanson postulate that older adults express *"distrust"* of technologies when they perceive them as in conflict with their own personal values [42]. When identified, these value dissonances can *"draw attention to the trade-offs being made in developing new technologies"* [43], and to what may have been lost through their introduction. If sufficiently understood, it should also become possible to address these value dissonances through design. This would require not just their identification, but also an understanding of how value dissonances emerge and develop. Unfortunately, studies of technology and ageing seldom look into the past. They tell us very little about how older adults' cautious and reluctant attitudes come to be, about how technological artifacts become imbued of certain values, or about how value dissonances appear. When considering context, they focus mainly on personal, social and technological aspects as they manifest at the time of running the study, with only secondary attention - if any - being

paid to past experiences (e.g. [77]). In doing so, they provide us only with a snapshot of the present. A consideration of the techno-historical context within which older adults have lived most of their encounters with technology may shed light on these processes of attitude development and value projection. The life course perspective can provide a useful framework for studies of technology and ageing which would like to consider the impact of past experiences on present attitudes towards technology.

2.1 Life Course Perspectives

The life course perspective provides a theoretical orientation for the study of human lives [29]; one that emphasises the impact of socio-economic, cultural and historical conditions, and of institutional arrangements, in their direction and outcomes [9]. Although life course research is most often based on quantitative data collected through longitudinal surveys [51], qualitative methods such as life story interviews are often deployed in life course studies in order to understand *"meaning and influences"* [35].

Lacking a *"coherent body of theory"* [51], life course perspectives are not prescriptive in terms of which factors must be addressed, relying instead on a set of concepts and research principles. The latter are very much aligned with the viewpoints and arguments put forth by the critical stream of HCI research on ageing. These principles are based on understanding ageing as a life-long process where prior stages and the timing of events have consequences in later life; on emphasising the important influence that socio-historical context and relationships with others have on individuals' lives; and on recognising individual agency while acknowledging that it can only be exercised within the opportunities and constraints established by contextual factors [9, 29], what Diewald and Mayer have called *"agency within structure"* [25].

Key concepts from life course literature include life transitions and trajectories. These concepts are particularly salient for researching technology values and perceptions with older adults since they help to situate people's descriptions of experiences along a continuum of personal and societal change. Transitions are changes in an individual's state, status, role or identity. Examples of transitions include leaving the parental home, marriage, becoming a parent, starting full-time work and retiring [29, 35]. Trajectories are long-term pathways related to a specific area of life that may include several transitions, such as trajectories of schooling, work, parenthood or health [29, 35]. Transitions and trajectories are not new concepts to HCI and CSCW. Both disciplines have *"a long history in transition work"* [17], exploring the role of digital technologies in common life transitions such as parenthood (e.g. [2, 17]), retirement (e.g. [28]), and bereavement (e.g. [18]); as well as more specific identity transitions such as gender (e.g. [36]), and from military into civilian life (e.g. [67]). In this literature, transitions have been defined as *"processes whereby people shift from one life phase to another"* [67], and as a *"period of adjustment"* following a life disruption [17]. Trajectories have been less explored but are still present across the literature, which has looked, for instance, at life trajectories of money and finances [73], learning [1] and philanthropy [37].

Trajectories effectively connect individuals and groups to certain institutional structures and social organisations such as family, schools, labour markets or social welfare. This link between people and institutional structures is fundamental to life course analysis [9]. According to Mayer, individual life courses are *"highly structured by social institutions and organizations"*, which in turn are also changed *"through the manner in which people live and construct their own individual lives"* [50]. When discussing the institutional configuration of postindustrial life courses, Mayer lists *"a manifold of culprits"* [50], between them educational expansion, the women's movement, weakness of trade unions, de-industrialisation, structural unemployment, globalization and the demographic crunch. Technology, however, is conspicuously absent from this list. Furthermore, while the life course perspective has been applied across disciplines

such as anthropology, demography, economics, developmental psychology, and health [51], there are relatively few studies of technology in older adulthood from a life course perspective. They tend to rely exclusively on quantitative approaches based on survey data (e.g. [21, 45, 58, 71]), or review existing literature in an attempt to draw comparisons between older and younger cohorts (e.g. [22]). There are even fewer publications engaging with the life course concepts and principles within HCI, the most salient exception being Foong's work on health trajectories in older adulthood and how they may impact adoption and use of mobile technologies [30]. This is in spite of the fact that the life course perspective is considered particularly well suited to the study of people in *"increasingly changing and unstable contexts"* [72], an expression that quite aptly describes the current technological landscape.

Following Katz, who establishes a clear connection between the postindustrial life course and technology developments [40], this paper suggests looking at technology as an institutional structure, and makes an explicit attempt to surface the individual trajectories of our study participants in relation to it. Our focus was not on identifying the relevant transitions within those trajectories, but on uncovering which aspects of the techno-historical context have shaped our participants' perceptions and understandings of technology. This focus determined the choice of the life story interview as our research method, since it enables the exploration of subjective aspects of people's lives - such as motivations, meanings, representations, emotions and beliefs - and their relation to external factors [72], which means it is well suited to uncover the impact of institutional structures on people [23]. The life story interview is *"the story a person chooses to tell about the life he or she has lived, told as completely and honestly as possible, what is remembered of it, and what the teller wants others to know of it, usually as a result of a guided interview by another"* [4, p8]. According to Atkinson, the life story interview can help explain how individual members of a cohort experience and understand social events; as well as provide insight into how values are acquired, shaped and held onto over time [4]. In the next section, we explain in detail how the life story interview was structured and applied in order to untangle our participants' technology trajectories.

3 STUDY DESIGN

The main goal of this study was to increase our understanding of how older adults' life experiences relate to post-retirement practices of technology adoption and use, and set out to explore conflicts between personal values and values attributed to technologies. In order to do so, we conducted 20 interviews between May and August 2018 with 11 females and 9 males between 63 and 90 years of age who had retired from full-time work. Following Durick et al., our research started from the assumption that older users are *"specialist users"* [27], and that their specialist status derives from their experience in the art of living. Withdrawing from professional life was deemed a key aspect of such experience, which led us to establish retirement as the core criteria for recruitment rather than biological age. Participants were recruited in the United Kingdom through a variety of advocacy groups and referrals, making sure they represented diverse life courses in terms of education, socio-economic status and professional background.

3.1 Interview Protocol

The interviews lasted between 67 and 157 minutes, and were conducted face to face either in participants' homes or in an alternative location of their choice. Our interview protocol was inspired by the personal history *"element"* in technology biographies [11], and based on the life story interview [4, 5].

The interview content focused on experiences of and interactions with technology, following a similar approach to Suoparjarvi's ICT biographies [69] and Selwyn's chronological autobiographies of education, work, and technology use [66]. However, while these examples covered exclusively information and communication technologies, with discussions

centered around landline and mobile telephones, computers and the Internet, our study purposefully broadened the scope of the conversation beyond this understanding of technology. Our intention was opening up the study to the techno-historical context prior to the arrival of digital devices, and to the transitional period between them, in an effort to recognise that if we consider the fast rate of technological development in the 20th century, older adults *"are probably the most experienced users in society, at least in terms of experiencing technological change"* (Östlund, 2005 cited in [27]). The broadening of the technology scope brought the additional benefit of breaking the feelings of alienation older adults often experience when dealing with the subject of technology [49], reassuring participants that they had something valuable to contribute to the subject.

Inspired by qualitative studies that use visual materials as a prompt for discussion (e.g., Vines et al.'s *"Questionable Concepts"* [74], and Kaye et al.'s work on visual prompts in finance [41]), at the start of the interview participants were presented with a set of image prompts showing technological artifacts from the 20th and 21st centuries. Although there was not a strict criteria guiding our image selection, we did set out to find examples that were: 1) from UK / USA markets, to match participants' geography and language; 2) spanning participants' life span (from 1920s to today); and 3) included telephony and computing, plus mass media, consumer electronics, household appliances and office equipment to encompass the pre-computing technology context. As such, the images we collated aimed to convey the breath of appliances, devices, gizmos and gadgets that arrived into the home and the workplace during the past 100 years. In total, 110 images were selected, which can be browsed at https://imgur.com/a/TqBsq. They include computers and telephones - fixed and mobile - but also mass media such as radio and television; consumer electronic devices such as music, photography and video equipment; household appliances such as vacuum cleaners and washing machines; and office equipment such as typewriters and photocopiers. The majority of the selected images are magazine advertisements. These were chosen because they often embed a value statement in their tagline and imagery.

The purpose of the image prompts was two-fold. First, they helped communicate the scope of the study to our participants, loosening the strong association between the word "technology" and digital technologies. The images assisted the researchers in conveying that technology, for the purpose of the activity, referred to more than computers, the Internet and mobile phones. Second, we used the images to elicit discussion about the technological artefacts participants experienced during their lives and to seed conversation points beyond the content of the adverts themselves. They helped participants recall their personal stories of interactions with technology, prepared them for the life story interview, and provided a starting point for conversations about the role technology had played throughout their lives.

The image prompts were colour printed on card and laid out in front of participants at the start of the interview. The interviews began by asking participants to look through the images in order to select five to ten that held meaning for them. The interview proceeded from this by inviting participants to narrate their encounters with technology across key life stages and transitions: childhood, education, family life, working life and retirement. These conversations were scaffolded by the images chosen by participants, and combined with the use of open questions to initiate discussion, e.g.: What is the first piece of technology you remember? Was there any technology at school or university? What kind of technology did you use in work? How has your use of technology changed upon retirement? At the end of the interview, participants were invited to reflect on their experiences in relation to how they imagine technology developments will unfold in the near future.

Participants exercised a high degree of autonomy over their narratives, directing interviews towards areas that were of interest to them. This is in accordance with Atkinson's definition of the life story interview as *"the story a person chooses to tell about the life he or she has lived"* [4, p8], and his description of the role of the researcher as a *"collaborator*

Fig. 1. The printed image prompts used during the interviews.

in an open-ended process" who *"is never really in control of the story actually told"* [4, p9]. The researchers did not ask the same questions to all participants, or in the same order; and each interview was truly unique.

3.2 Participants' Profile

Participants (11 females and 9 males) were between 63 and 90 years old and had retired from full-time work. All of them self-reported to be in reasonably good physical and mental health, led active social lives, and many volunteered with community organisations and activity groups.

In terms of digital technology use, all our participants owned one or more computing devices, and most used them every day. 19 of them liaised with the researchers via email, and 18 out of the 20 clearly fitted Kania-Lundholm and Torres' definition of older active ICT users, i.e. those who engage *"with different types of digital technologies on a daily basis"* [39]. Two of them had developed software professionally; a third had worked in the domestic appliances business, starting his career as a service engineer; and a fourth had an amateur radio license and had acquired significant knowledge and expertise about electronics through this hobby. Although there were individual differences in terms of breath of uptake, frequency of use and interest, as a group our participants were rather comfortable and confident with digital technologies. As such, our participants reported higher levels of familiarity with technology than population-level statistics for older adults [56]. Table 1 provides an overview of our participants' demographic, educational and professional backgrounds.

Table 1. Participants' demographics. Participants were not required to disclose their exact age, and were given the option to provide a 10-year age bracket instead. Their educational and professional history was complex, with several enrolling in third level education during adulthood, and changing roles and professions over their careers.

ID	Gender	Age	Retirement period	Education	Employment
1	F	68	After 2007	Third level	Clerical
2	F	86	1994-2007	Secondary	Clerical
3	M	60-70	After 2007	Third level	Self-employed (consulting)
4	F	73	1994-2007	Third level	Librarian
5	F	76	1994-2007	Third level	Teacher
6	M	73	1994-2007	Third level	Social worker
7	F	81	After 2007	Secondary	Clerical
8	M	72	After 2007	Secondary	Retail
9	F	78	Before 1994	Secondary	Clerical
10	M	65	After 2007	Secondary	Civil servant
11	M	60-70	1994-2007	Secondary	Executive (multinational)
12	F	66	After 2007	Third level	Social worker
13	M	90	Before 1994	Third level	Architect
14	M	74	1994-2007	Third level	Software engineer
15	F	73	1994-2007	Third level	Self-employed (consulting)
16	F	75	1994-2007	Secondary	Self-employed (typesetting)
17	F	86	Before 1994	Third level	Teacher
18	M	71	1994-2007	Third level	Self-employed (media)
19	F	63	After 2007	Third-level	Self-employed (consulting)
20	M	60-70	1994-2007	Third level	Executive (multinational)

3.3 Data Analysis

Interviews were audio recorded, transcribed verbatim and coded following the thematic analysis process described by Braun and Clarke [14]. The first author began this process by performing a close reading of a selection of 10 interviews. As noted by Braun and Clarke it is common to code corpuses of data iteratively to check the clarity and coherence of codes and themes. Coding the first 10 interviews resulted in 199 codes that were used to construct preliminary themes, which were discussed and clarified between authors 1, 2 and 4. Following this, we coded the remaining 10 interviews using the preliminary themes as a guiding reference, but left the analysis open for new codes and themes. No other significant new themes were developed at this stage, but based on the second round of coding the themes were reviewed, redefined and renamed. Quotes and their associated themes were then printed and a secondary coding was performed drawing more explicitly from existing theoretical literature across HCI and life course perspectives. In our secondary coding we paid particular attention to the experience of trajectories [29, 35]. This sensitised us to the specific range of workplace, domestic and leisure experiences associated with technological change over distinct periods of time. This led us to identify "Losing control" as a meta-theme that provided a unifying thread across all others.

4 FINDINGS

Our analysis identified five areas of tension for older adults grounded in their day-to-day material realities and past experiences that contributed to value dissonances associated with technology. These include i) understanding mechanics vs. counterintuitive logics; ii) independent maintainers vs. powerless consumers; iii) repair vs. replacement; iv) autonomy vs. accountability; and v) freedom to adopt vs. obligation to use. These dissonances contributed to our participants'

cautious and circumspect attitudes towards digital technologies within the home, the workplace and in their leisure time. In the following sections, we report on each of these dissonances as articulated by our participants.

4.1 Understanding Mechanics vs. Counterintuitive Logics

Our participants lived the transformation of mechanical machines into computing devices through the proliferation of electronics. This transformation was somehow controversial, because it significantly impacted our participants' ability to understand and operate the tools they used.

Mechanical machines were felt to be transparent: it was possible, through observation, manipulation and use, to acquire a basic grasp of how they worked. As explained by P13, mechanical processes were those *"which your mind can absorb, and understanding the background to it"*. As a result, our participants' relationship to their mechanical tools was built upon the ability to understand their operational principles. Knowledge about machines surfaced during our interviews through detailed descriptions of how things functioned, like this one of a varityper:

> [I]t's like a huge typewriter. It's electric, and it had a split wood roller, and you put your paper in, and wind it up and slide it in, and you could type using different typefaces. Rather like an IBM golf ball, but this had the type on it, semi-circular thing. You had an anvil, and you'd put one typeface to one side, and one typeface to the other, and as you typed the typeface swung around, the thing that was on swung around, and then a hammer came from the back, hit the paper onto the typeface. There'd be a ribbon in there somewhere as well. (P16)

P16 became a varityper operator at the very beginning of her professional career, and thoroughly enjoyed the creative and independent nature of the job. When she was required to leave the position to raise her children, she purchased a varityper machine and started her own typesetting business from home. She chose and bought her own computerised typesetters for years, until the arrival of the Macintosh computer, which contributed to the demise of her typesetting business.

Like P16's varityper description demonstrates, participants were accustomed to a considerable degree of insight into the machines they used. The arrival of computers was seen to change that. Compared to mechanical machines, computers were remarkably opaque. A personal computer was a closed box whose components and mode of operation could not be fathomed through day-to-day use. As P16 put it when recounting the arrival of desktop publishing with a Macintosh computer, you *"hadn't got a first idea of what made it tick"*. Computers changed the terms of engagement in use: since understanding was no longer possible, one had to rely on memorising and following instructions. P10 described the shift: *"before I can sort of use something, I sort of need to understand how it works. Where with computers you mustn't think like that. It doesn't matter how it works. You just do it intuitively"*. P13 used his son's words to explain the change:

> [O]ur son, who was very much into computing, said dad, you'll never be any good, because your brain does not go a, b, c, d. Or 1, 2, 3, 4. Your brain goes 1, 6, 2, 90, back down. He said: you will not go logically through anything. So he said: you won't be suited to computers who liked being logical, you do it, you follow the rules, that will happen. And he said: dad, you will not like it. (P13)

Computers came with their own logic, one that had to be mastered without any insight on how the device actually worked and could appear nonsensical. Recalling the process of learning how to use an Amstrad computer, P19 explained that *"a lot of the instructions seemed to be counterintuitive. You would try to do things that just didn't seem logical"*. As a

result, coming to grips with this new logic involved a lot of trial and error, and inordinate amounts of time. P4, who was a librarian when she first came into contact with computers, described how it happened:

> I didn't understand it. I just do: if I press that, what might happen? I mean, there was this thing where you, if you wanted to call up all of everything, you'd put in star dot star. And I dutifully went on putting in start dot star for months, if not years. It was only ages on that I realised that the star bit meant everything, and then the dot and then everything on the other side of it. (P4)

This shift from a modality of use based on understanding, to a modality of use based on instruction-following and trial and error, undermined our participants' sense of competency and efficacy. Through their interactions with mechanical things, these older adults seemed to have developed certain assumptions as to how much knowledge should be expected from a competent technology user. The mismatch between those assumptions and their perceived own understanding of digital devices fed feelings of inadequacy and a certain anxiety. It also eroded their confidence in their own ability to use and keep their devices in working order. In the next section, we further elaborate on this issue of maintainability, and on how it impacted our participants' much valued sense of independence.

4.2 Independent Maintainers vs. Dependent Consumers

The visibility afforded by mechanical components, together with practice, allowed people not only to achieve a very high degree of mastery, but also to develop coping strategies and workarounds for when machines refused to work. It also brought the ability to do basic maintenance and troubleshooting. P12 had to bring her sewing machine to be serviced only once since she bought it in 1986, between other things because she was able to do the essential upkeep herself: *"I can just use a dust thing to blow out any dust, and I can make sure I've got clean needles and bulbs or whatever. I can do all that myself"*. P6, who had an amateur radio license, used to build his own radio equipment. P8 repaired his cars, a skill that allowed him to still enjoy cassette tapes while driving:

> I still have a lot of cassettes. I prefer a cassette in the car. My present one is broken, but fortunately, every car that I took apart, I kept the old cassette recorder. So I've got about 6 in the garage, and I put them in any new car, in any other car I get, to play there. (P8)

For P6 and P8, the addition of electronics to cars and radios put an end to their ability to repair, make and *"fiddle"* (P8), something that both lamented:

> The car under wraps is from 1933 there. I have an engine for it. It came with an engine and gearbox, but I would like a bigger engine for it. I am busy having some work done on that. The other one is a more modern one. A Suzuki. And if anything went wrong with it I wouldn't have a clue. It's all electronics. Completely. You need even ... you need a programmable computer you plug in, and it diagnoses what's wrong. So you have to buy these packages to do. And I am not into that. I want to go back to the older cars. The older cars I could take apart with a screwdriver and a spanner. Take them apart, put them back together again. (P8)

When it came to computers, lack of understanding meant many of our participants needed assistance from others to set up, configure, manage and troubleshoot their devices. For some, like P2, this reliance on the computer *"whiz-kids"* became a significant source of frustration at work: *"I didn't want to learn all the stuff about their backups, and everything like that. I just wanted to get my thing working, get it started, fix what I wanted."* (P2).

At home, it became necessary to source the required help. Some, like P3, hired professional services. Others, like P1, used the telephone support provided by computing companies. The vast majority also relied on younger family members and friends. The impact of this dependence on participants' self-confidence was such that some no longer felt capable of making purchase decisions by themselves. P10 recruited his sister to help him choose a new smartphone right after our interview took place. P2 delegated that very same task to her cousin. Many avoided purchasing altogether by accepting second-hand devices cast away by family. Others held onto old appliances, concerned about the impact of an update on their ability to use them. P10 fretted about getting a new TV:

> [M]y TV is quite sort of old fashioned, because I mean it's OK, and I just think if I buy a new one now it's going to be full of computer stuff. And I'll have to go through this system, and that system ... and I think how simple life used to be when you just pressed the button and it came on. (P10)

P12 worried that buying a new car would prevent her from listening to music while driving:

> My car is old enough that I can play CDs. I don't want to upgrade my car. (...) I am dreading the day when I have to change it, because all the modern ones are bluetooth, aren't they? (...) See, that's really going to be a problem for me, because I don't have music on my phone. So I have to keep taking the car to a garage, and getting them to keep it going for me. (P12)

The arrival of digital technologies turned our participants from independent maintainers of things they owned to powerless consumers, a shift that undermined their sense of independence and self-worth. Since they were no longer capable of setting up, maintaining and troubleshooting their devices, they had to rely instead on paid services or on informal assistance from family and peers. In addition to the extra cost and hassle involved in sourcing help, this dependency on others left some of them feeling like a nuisance: *"I always ask them if I need help. And then, one of my daughters goes: every time I come to this house you ask me something technical [laughs] So I try and keep quiet a bit now. I think yes, it's not fair."* (P9). Once again, our participants' expectations regarding their ability to keep things going, developed through their interactions with mechanical tools, did not match the reality of living with their new digital technologies.

4.3 Repair vs. Replacement

Our participants struggled with what appeared to them as ephemeral technologies by comparison with earlier things that were *"made to last"* (P15). *"Everything now is so transient"*, lamented P15, *"I find now that so much technology has built-in obsolescence, and I get annoyed with it."* The clearest manifestation of this impermanence was perceived short replacement cycles. P3 had a mobile phone for *"about 10 years or something. Which to my mind was nothing, but everybody said, oh, it's very, very old (...) that's very old now, you need to get a new one. And I said but that's perfectly alright. Ah, yes, but it might go wrong any time and then it's all out of ... people can't repair it"*. P10 was dissatisfied with a smartphone lasting 5 years: *"I have a fairly modern phone, which just packed up, just died on me. I think they are only meant to last about 5 years. So I have to update that."* P12 was not prepared to let go of her 6-year old iPad:

> I took it to the Apple shop, and they said oh, this is an older model. And I said well, it was new when I bought it in 2011 [laughs]. Oh yes, but you know there's been a few since then (...) we would do you a good deal if you wanted to. No, I'll wait, and then when it breaks down I'll go and get another one. (P12)

In sharp contrast with her 6-year old iPad, P12's Kenwood Chef had lasted 40 years; and her sewing machine, 30. However, time to replacement was not the only issue: replacement itself was somehow controversial, because

participants had lived most of their time in a world where things were repaired by default, rather than replaced. When reminiscing about her mother's vacuum cleaner, P15 explained how *"the Hoover man used to come and service it every year. This is what I am saying: you only got these things serviced because they lasted forever."* P11 started his career in the domestic appliances business, working for a repair establishment where they would fix *"virtually anything that came in"*. The arrival of sealed electrical and electronic components of ever increasing complexity, and the drop in manufacturing prices, encouraged a move toward replacement by default. As an appliances service engineer and later a marketing executive in a white goods multinational, P11 experienced these changes first hand:

> [Y]ou repaired a lot of the parts then, you didn't replace them (...) But nowadays they don't do that. It's thrown away now. I don't think there is any attempt now to repair components. It's just too expensive (...) you know, labour costs and breaking down a circuit board and then diagnosing the exact fault on that board and soldering it and getting another one, and then doing all the testing. It's just too time consuming (...) It's just not worth it. (P11)

In spite of portraying himself as a technology enthusiast, P11 still found the move from repair to replacement *"sad (...) Because it's a lot of waste, isn't it? Huge amount of waste. It's just sad that we have to waste so much stuff"*. He expressed hopes of this throwaway trend reversing: *"hopefully as products get more reliable then you don't have to throw away parts so much"*. The move from repair to replacement undermined our participants' appreciation of thriftiness.

4.4 Autonomy vs. Accountability

Our participants shared stories of how technology was involved in constraining their capacity to exercise autonomy, particularly in the workplace. This happened through an increased emphasis on data collection, which made participants feel under surveillance. Data collection was justified in the name of *"accountability. That was what mattered"* (P12). P12, who had been a social worker, explained how these new data collection pressures conflicted with her sense of professional duty:

> [Y]ou are encouraged to write everything on the computer. Because if it's not on the computer, it didn't happen. So one part of your brain is thinking, oh, if ever there was a problem I better put, you know, what happened. But you have this pressure then. You are spending too long on the computer: you should be out doing visits. (P12)

P5, who had been a head teacher, described how this new concept of accountability put into question established notions of professional responsibility and due diligence, and their transference from individuals to organisations:

> I used to track quite carefully results and performance. (...) And I'd always done that, even before we used computers, because you'd like to see what you'd achieved (...) But until such time as [the government regulator] came into being, nobody checked that, nobody would make you accountable for it (...) It was only once the whole system of the national curriculum came in that you were accountable (...) Once the national curriculum came in they were able to track everything. Because you have to report everything. (P5)

For P5, the need *"to report everything"* blended with new oversight practices to engender a strong sense of being under surveillance:

> [The government regulator] would pick [the data] up from the [exam] results. (...) They picked that up, and then they report back to us and I'd get a book, a thick book, telling you all these things that I already knew, but they wanted you to know, me to know, that they knew too. (P5)

Other participants also expressed unease about the consequences of traceability in electronic communications, what Bruce Schneier has called the death of *"ephemeral conversation"* [63]. Discussing the arrival of email to the office, P10 spoke about there being *"a feeling of like big brother, of being monitored, because I discovered that you could check whether the recipient had opened her email. You could set something, you know, before you sent it. And that was a feeling of we are starting to spy on each other a bit, you know what I mean. I know you haven't opened my email [laughs]"*. P1 described how the *"electronic trails"* [63] left by email demanded extra care and vigilance in the workplace: *"obviously people had to understand that what was on an email, you know, some times you'd send something and you hadn't screened the email, and somebody hadn't realised there was something below and someone else saw something they shouldn't have seen."*

Finally, participants also experienced the arrival of digital technologies as coinciding with an increase in work pressures. For P19 and P20, this manifested as an encroaching of professional life into the personal sphere. P19, who had worked as a housing consultant for charities and public organisations, refused to set up email on her phone in an attempt to preserve boundaries. P20, who had been an executive in a multinational corporation, described the role mobile phones played in intensifying the already strenuous demands of highly distributed work environments:

> [I]f I had closed my shop in [Europe], the telephone in the United States started to ring (...). And it was so damn easy to be there in the office 24 hours a day. (...) I would start around ... well before 8, and would be leaving the office at 9. And mobiles made that life even worse (...) The fact is that, if you are not careful, it's eating your life away. (P20)

For our participants, digital technologies constrained the space available to exercise autonomy in the workplace, brought about feelings of being under constant surveillance, and reduced their ability to establish boundaries between the personal and the professional spheres.

4.5 Freedom to Adopt vs. Obligation to Use

Our participants felt they no longer had a choice in terms of technology adoption and non-use. They spoke about technology as something *"inevitable"* (P13) and unavoidable. When describing their relationship to it, they used expressions like *"accepting"*, *"coming to terms"*, having to *"adapt"*, *"trying to catch up"* (P10); *"keep up"* (P11, P9); *"get by"*, *"get through"* (P9); *"latching on"* (P2); and being *"able to cope"* (P5). This language reflects a reactive position with respect to technology. Participants felt they didn't have a choice on this matter: technology use had become the only available option. Up to the 1990s, it was still possible to exercise a certain degree of agency in terms of adoption. P13, who had been an architect and partner in his firm, resolved not to learn computer-aided design when his architectural practice introduced it four years before his retirement. After a bad experience with an Amstrad computer in 1985, P18 got rid of it *"and never got a computer again until 1995. In many ways I didn't need to (...) I'd write long hand, and sometimes I would dictate. I had staff. I had a secretary."* The days in which one could decide not to use technology were now at an end: *"Today (...) you can't ignore technology. It's no good burying your head in the sand and say: oh, I don't understand all that, I don't want to do it."* (P11). With non-use out of the question, technological resistance manifested itself as sharp boundaries - *"I still do not, I will not buy tickets on the Internet. Train tickets, or tickets to go to see a concert. I will always go to the box office, or the ticket office in the train station"* (P3) - and reaffirming use in one's own terms: *"I don't use it to*

its full potential, I know. But I use it for what I want, and that suits me" (P12). As P8 explained: *"It's not that I've closed my mind to it, but I want the technology to do what I want it to do, not for me to be led by the nose to do other things"*.

Pressures to adopt technology arrived from everywhere: relatives, friends, co-workers, volunteering activities and institutions. Families prodded and nudged, heavily influencing the selection of devices and platforms. P12's son *"encouraged"* her to buy an iPad. P15's husband determined she *"should have one as well"*, as did P9's daughters. P5's children purchased her Kindle and her first computer because *"they decided I needed to get with it"*. P8's wife bought him a computer, as *"she was trying to drag me into the 20th century, she said, not just the 21st"*. P9 joined Instagram to *"keep up with the kids"*. P6 was on Facebook because *"My daughter put me on it (...) she thought I should be on it to keep in touch with people [laughs]"*. While this family arm-twisting was joked about and even enjoyed, institutional pressures were much despised. The move to establish online channels as the default way to transact with companies and organisations felt like an imposition, and was resented by many:

> They forget that there are people who are not, there are some people who are not online. A lot of seniors are not online. But it's accepted now, you know, that this is the way you do it. And sometimes there is no alternative! Which I think is wrong, but there you go, it's the way the cookie crumbles. (P2).

Participants provided examples of how it was no longer possible to perform certain tasks, or engage with certain institutions, other than through digital means, between them requesting a garden waste bin, buying exhibition tickets, being a justice of the peace, volunteering with befriending phone services, liaising with energy companies, accessing documents such as bills and statements, and applying for government benefits. This push towards digital transactions prompted fears of exclusion: *"we are disenfranchising some people (...) we are leaving people behind, and if you don't want to come on board, kinda tough."* (P1). Anxiety about exclusion was exacerbated by technology's terrifying pace, which was experienced as a *"quantum leap"* (P10): *"It's a bit like a friend's grandmother who saw the first car in the village, (...) and then the landing on the moon, in the same lifetime. It's incredible. It's so fast."* (P16).

Overall, participants seemed overcome by a sense of technological powerlessness that was reflected in depictions of technology futures that did not include them and could not be fathomed. P12 didn't *"think you can predict (...) it's almost as if things come out of the blue, don't they?"*. For P15, *"these things seem to develop, they seem to have a mind of their own, and suddenly occur"*. For our participants, the world moved inexorably forward, without them having any say on it: *"it just wasn't there yesterday, it is today. And you just gotta get over it (...) This is the future! Whether you like it or not."* (P10).

5 DISCUSSION

Our findings clearly intersect with some of the values that the literature has shown to be important for older adults, such as competency, independence, resilience, agency and thriftiness. In our participants' technology trajectories, these values were woven together through a narrative of control. Our participants felt they were losing control over their own lives, but they also expressed a sense of lost control across society, in part driven by digital technologies.

In the accounts shared above we can see the ways that technology was felt to have reduced the degree of control participants had over certain parts of their lives. Digital technologies and personal computers were viewed as hiding their workings in ways that meant you could not decipher how they operated, you were reliant on others to mend and fix them, and afforded less independence and autonomy at work and at home. As P16 explained, with computers, *"the control is taken away from you, I think that's the thing. You can only do certain things on it, you can't adapt things."* P14, who developed software for most of his professional career, described modern computer applications as taking *"control away"* from those who use them by detaching them from the operating system and making it virtually impossible to

interact beyond the prescribed functionality. This sense of lack of control was felt most keenly in workplaces, where new practices, underpinned by digital systems, were perceived as acts of control through surveillance and ongoing accounting of work.

The sense of losing control extended beyond specific devices and personal lives: our participants felt it was not just them who had lost control in relation to technology, but society at large. In the words of P15, *"technology seems to call the tune now. People have to fit in with the technology"*. Many expressed concerns about the relationship between humankind and their technological offspring. They marvelled at the pace of change, which they believed to be exponential and the fastest in human history; and at the capabilities of computers, which they saw as far exceeding human abilities. But this combination of speed and computational power made them wonder whether humans were relinquishing control over to the machines they had created, and were becoming too dependent on them. P10's concern was that *"gradually, we could be sleepwalking into a world where we've passed so much responsibility onto machines, something will happen"*. P12 found things *"a bit frightening. It's that control element. If humans lose that control over things they've made, goodness knows what will happen. I believe that things could go wrong."* P1 wondered whether we haven't *"gone a little bit too far"* in our technological endeavors, *"and we'll have to kinda stop"*. P13 believed technology developments lacked an overarching plan and vision, with experts understanding only specific silos, and without anybody *"strong enough to say: enough, stop, rethink, throw this away, and let's start again."* P5 felt there was a lack of reflection about the consequences of technological advance: *"you need to stand back and really think about it as well some times, what the implications are of change"*. Against this backdrop, our participants' circumspection towards technology becomes an appropriate and coherent reaction to their perceived lack of control over it.

One reaction to our participants views would be to consider them "laggards", or indeed unnecessarily suspicious of digital technology as a result of not understanding how it works. However, we must remember that all of our participants were active users of digital technology: but they did so with a weariness, suspicion and circumspection. Their views did not come from an unfounded dislike of technology, but from wider concerns about how it was affecting the lives of individuals and society at large. What they valued had come into sharp contrast with what they perceived to be the values inscribed in modern technologies. We unpack this in more detail in the following sections of the Discussion, drawing out insights for the design of digital technologies and wider implications of life course approaches within the field of HCI.

5.1 Value Dissonances as a Design Material

The technology trajectories of our participants also show that the way they think about digital technologies is grounded on notions and expectations built upon encounters that took place before those technologies were introduced. For instance, P16's expectations for desktop publishing with computers were based on her experiences with varitypers and earlier typesetters. Based on their interactions with mechanical contraptions, our participants expected to understand in great detail how their digital devices worked. Failing to do so contributed to the feelings of inadequacy, lack of confidence in one's ability and anxiety reported by the literature (e.g. [42]). Knowles and Hanson perceptively linked such feelings to *"situated elderliness"* [42], i.e. technology encounters that make older adults question their own ability. We can appreciate here that such questioning is built upon personal experiences that individuals have had in their deep past. Their frame of reference for determining what means to be "able" or confident with technology is based on past interactions with non-digital technologies and the degree of understanding they afforded. To address those feelings of inadequacy, training on how to use digital devices will not be enough: it would also be necessary to reset older adults' expectations in terms of the degree of knowledge needed to be a confident user of digital technologies.

This opens up a different interpretation of older adults' feelings of inadequacy towards digital technologies: it could very well be that our participants' expectations in terms of technology understanding are not too high, but rather that the degree of understanding we have come to expect from confident users of digital technology may be too low. Our participants struggled with digital technologies because they found themselves on the losing side of a computing culture that, as explained by Douglas Thomas, divides people

> into two classes: programmers/engineers and end-users. By definition, the programmers and engineers know how things work, and the end-user does not. (...) When things go perfectly, the philosophy of the end-user works. However, when things work less than perfectly (that is, most of the time), the philosophy of the end-user positions that user as helpless. [70, pp. 64-65]

In this computing culture, the idea of users who are completely oblivious to the inner workings of their devices has become naturalised. The estrangement and dependency derived from the lack of understanding about how computers work becomes visible only to those who, like our participants, have experienced a different relationship with their tools. This positions our older participants' feelings of inadequacy not as a user problem, but as a design problem: the opaqueness of our digital technologies contributes to the dependency and powerlessness of their users. This in turn poses the question of how to design digital systems, services and devices that reveal themselves through use and tackle users' helplessness through understanding.

We find a similar pattern in most other areas highlighted by our findings. Having to rely on others in order to perform even the most basic maintenance tasks on your devices turns into an issue only after enjoying the independence of being able to maintain things yourself, as P6 did with his amateur radio equipment, P8 with his cars, and P12 with her sewing machine. The degree of repairability and the life expectancy of digital devices become contested only by comparison to the same characteristics in earlier artifacts. When you have seen your sewing machine lasting 30 years and requiring service only once in that lifespan, replacing your iPad after a meagre six years (let alone every one or two years, as many smartphone manufacturers imply) appears simply ludicrous. Being forced to transact via online channels is perceived as problematic only by those who had the luxury of choosing from a wider set of options, including engaging by phone or face-to-face, as our participants did with institutions like utilities, public services or banks. Being subjected to continuous supervision and surveillance through data collection in the workplace is experienced as an attack on professional autonomy only by those who relished the prowess of exercising personal responsibility and integrity in their work lives, as P5 did as a head teacher, and P12 as a social worker, early in their careers. These experiences bring up and legitimise design questions about specific aspects of digital technologies, such as transparency, reliability, maintainability, durability, data collection and processing.

The examples above also illustrate how technology trajectories can shed light on why and how certain technologies come to be perceived as in conflict with personal values. These value dissonances emerge through notions and expectations built upon past experiences of technology. In order to fully unravel them, we must delve into people's personal histories and the techno-historical contexts within which they took place.

5.2 Circumspection as Everyday Resistance

The concept of value dissonances poses the question of whether older adults' circumspection towards digital technologies could be interpreted as a political stand [74] or a form of protest [42]. It is indeed possible to draw parallels between older adults' circumspect attitudes and James Scott's concept of everyday resistance, the *"disguised forms of struggle"* [65] deployed by the weaker party to a power relationship when more organised forms of collective action become

inaccessible or simply dangerous. According to Scott, strategies of everyday resistance include *"foot-dragging"* and *"feigned ignorance"* [65], attitudes of a similar nature to our participants' circumspection. The purpose of these resistance strategies is to avoid detection: those who use them are trying not to draw attention to themselves in order to minimise risk. This provides an explanation for what Knowles and Hanson have called *"playing the age card"* [43], the way older adults hide behind societal stereotypes and expectations of their technology use in order to *"cover for their prevailing sense of social responsibility"* [43].

Finally, everyday forms of resistance are the strategies deployed when no other forms of protest are possible, either because open defiance would entail physical danger, or because the structures being resisted are *"inaccessible"* or *"alien"* [65]. Scott uses the relationship between the peasantry and the laws of the state as an example of the latter, observing that collective action to change the structure of the law is out of their reach and *"confined largely to the literary middle class"* [65]. The position of the peasantry in this example is not dissimilar to that of older adults with regards to digital technologies, since they also find themselves systematically excluded from their production processes and unable to access them. Inaccessibility ultimately determines the objective of everyday resisters, which is not to bring about structural change, but to *"work the system to their minimum disadvantage"* (Hobsbawm, cited in [64]). In other words: to minimise the impact on their lives of that which they resist. To achieve this goal, older adults have no other option but to defend their interests *"at the enforcement stage"* [64], which in their case is at the point of technology use. It is possible to see parallels here with the forms of resistance formed by other groups who can feel marginalised by technology and don't identify with the labels and expectations assigned to them by others. For example in the case of LGBT young people who creatively resist simplified labels of vulnerability in reporting hate crime as described by Gatehouse et al. [33], or workers who resist particular surveillance practices by developing workarounds for non-use [6, 59].

Literature has often portrayed resistance as linked to categorical non-use. For Wyatt, the *"resisters"* were those *"who have never used the Internet because they do not want to"* [78]. For Satchell and Dourish, *"active resistance"* involves the steadfast refusal to adopt a technology [62]. Other works on resistance in HCI have associated it with complaint, for example when expectations around relied upon technologies are felt to be violated [24]. However, our participants' form of everyday resistance demonstrates that resistance to technology can also happen in use. As Scott points out [65], active resistance is often restricted to a privileged few and may be out of reach for most. It is therefore important to acknowledge resistance in use as an active and legitimate constituent within the range of attitudes and practices that shape cultural interpretations of technology [62].

Our parallel with everyday forms of resistance has obvious limitations. Older adults' reluctant attitudes towards digital technologies are most certainly not a form of *"class struggle"* [65]. However, looking at older adults' "foot-dragging" as a form of everyday resistance opens the possibility for designers to ask meaningful questions about what is being contested; and helps them fulfill their responsibilities towards taking users' actions, statements and interpretations seriously [62]. Arguing that older adults' resistance is addressed towards technology in general is clearly an oversimplification. In the same way that Scott's peasants do not resist power or the state, but the unjust collection of a specific form of taxation [64, 65], older adults do not resist technology, the future, or change, but specific consequences derived from the introduction of technology into certain contexts that they perceive as unfair. It is the work of designers to uncover and address those specific consequences that trigger the backlash, and to develop strategies that can support the expression of resistance. Blythe et al.'s *"seriously silly workshops"* [10] with older adults point to possible methodological directions for the latter.

Connecting older adults' attitudes towards technology to more political forms of resistance also changes the discourse from one of blame to one of legitimacy. Resistance to digital technology stops being equivalent to resistance to change or

to a *"(largely irrational) attachment to the status quo"* [68], and becomes a justified response to shifts in the technological landscape [68] perceived as unfair by those who resist them. Once the critical stances of older adults have been legitimised, value dissonances become a useful design material. They uncover controversial aspects of existing technologies that may not be obvious to designers due to familiarity or habit. In the case of our participants, these included the operational obscurity of computing devices; their short life span; their lack of repairability; their constant updating; their enabling of data collection and surveillance practices; and their tendency to replace all other organisational contact channels.

It now becomes possible to develop guiding sensitivities for the design of digital systems better aligned to their personal values. Such systems would be transparent in their operation, revealing themselves through use; they would be durable, reliable and capable of withstanding heavy use; they would promote independence by supporting maintenance and troubleshooting tasks without requiring third-party assistance; they would prioritise repair over replacement by implementing modular architecture with widely available components and non-permanent attachments; they would provide a carefully curated feature set, striking the right balance between power and ease of use; they would minimise data collection and discourage surveillance practices; they would insert themselves into a network of organisational contact channels, complementing rather than replacing them; and they would be designed to enhance feelings of control in adoption and use. Such digital systems would not only be more attuned to our older participants' values: they would be better technology overall and for all.

5.3 The Life Course Perspective and HCI

Our research illustrates the value of incorporating the past into studies of technology and ageing. In order to do so, researchers must meaningfully engage with older adults' life experiences and particular techno-histories. Life story interviews complemented with visual materials proved an effective means of engagement, eliciting personal accounts of a wide range of meaningful and rich technological experiences. Many of our participants derived great enjoyment from looking through the technology images and selecting some for discussion. The images acted as a catalyst not just for reminiscence, a technique often used with older adults, but for surfacing and specifying the concrete ways technologies had or were being used.

Unforeseen by the researchers was the appropriation of the broad historical concept of "technology" to include further relevant examples beyond the image prompts provided. Participants extrapolated from the set of images we presented to them and brought up for discussion other artefacts, some of which were completely unknown to the researchers. They included varitypers, computerised typesetters, the IBM golf ball, minicom telephones, amateur radio equipment, telephone switchboards, sewing machines, longarm quilting machines, Tannoy public-address systems, dictaphones, stenomasks, teleprinters, the mimeograph, and sun printing. This list illustrates the remarkable extent of our participants' technological expertise, which allowed them to appropriate the original technology scope and drive the conversations towards meaningful artifacts within their personal trajectories. The diversity of the image prompts - across time and use - opened up conversations and reflections that began to be driven by participants themselves, rather than locking them into discussing only the examples selected by the researchers.

Telling their life stories also provided participants with an opportunity for self-reflection [4], and for some it uncovered new and unexpected aspects of their technology trajectories. For instance, as the interview progressed P16 realised how her *"life seems to be bound up with machines! (...) the machines always intrigued me, thinking about it (...) I hadn't thought of it, you know. And I hadn't thought that I liked machines quite as much, when I am slagging them off."* The approach supported participants to have a greater degree of control over the experiences and narratives they shared in the interview, and provided an opportunity for them to talk in great length about their expertise, skills, competencies

and agency; even if, at times, these had been constrained and challenged by technologies. In doing so, they implicitly challenged the perceived norm of older people being vulnerable and experiencing a state of decline in old age, which is often how they have been portrayed in research on ageing and technology [75]. The life course perspective allows us to step back from seeing older adults primarily through a lens of "vulnerability", and like Gatehouse et al.'s work with LGBT young people [33], allows us to challenge reductive understandings of technology design.

In order to incorporate the past into studies of technology and ageing, researchers must also acknowledge the role of specific techno-historical contexts in shaping perceptions and attitudes. We have suggested the life course perspective can provide a useful conceptual scaffolding for this endeavour, as already observed by other scholars [22, 30]. Foong has remarked that *"A comprehensive technology history for older adult users might be the HCI equivalent of the health history used in epidemiology"* [30]. Chesley and Johnson have observed that *"both technology and life course scholars have an interest in understanding the larger historical and social context that shapes technology adoption and different patterns of use when thinking about the social implications of technological innovation"* [22].

Building upon their arguments, we suggest the life course perspective can further contribute to HCI studies of ageing in three ways. First, by positioning ageing as a life-long process where the timing of events, our relationships with others, and context - socio-economic, historical and cultural - play a fundamental role in shaping outcomes in later life. Second, by reminding us that individual agency is exercised within the opportunities and constraints established by institutional structures. Lastly, by providing us with a set of core concepts that can help structure our inquiries into the past, such as transitions and trajectories, the latter linking individual lives to institutions.

Our research made use of these concepts by positioning technology as a fundamental component within the institutional configuration of postindustrial life courses, and by making an explicit attempt to unravel our participants' technology trajectories through life story interviews. Our findings demonstrate the life course perspective and the life story interview can help designers identify conflicts between personal values and those projected onto technological artifacts, as well as gather insights about how those value dissonances develop on the basis of expectations and notions built upon prior experiences of technology. This contributes to a richer understanding of attitudes towards technology in later life, and can uncover controversial aspects of technology that should be tackled through design.

By drawing attention to how the techno-historical context contributes to perceptions, notions and expectations of technology, the life course perspective also confronts us with the question of how our contemporary technology context - characterised by such things as ubiquitous computation and networking capabilities, bulk data collection, widespread surveillance, the deployment of algorithmic decision making and ever increasing energy consumption - will shape the understandings and attitudes towards technology of future cohorts of older adults.

6 CONCLUSION

In this paper we have demonstrated how turning our attention to the past can contribute to HCI studies of technology and ageing. Using life course perspectives as a guiding framework, and through life story interviews, we approached technology as a key component within the institutional structure of the postindustrial life course, and uncovered our participants' personal trajectories in relation to it. During our analysis of those trajectories, we identified dissonances between our participants' personal values and the values they projected onto digital technologies. Interpreted as a form of everyday resistance, these value dissonances can reveal controversial aspects of existing technologies obscured by familiarity or habit, opening the possibility to address them through design.

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