



Older People as Early Adopters and Their Unexpected and Innovative Use of New Technologies: Deviating from Technology Companies' Scripts

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Abstract. Technology companies, when considering the design of their products or services, tend to configure users by scripting appropriate user interactions with their technology. Older users are often seen as laggards who take no part in innovation processes. The scripts for technology use planned by technology companies rarely take older users into account. Hence the role of older adults in participating in innovation processes, challenging scripts and reconfiguring technologies has not been well researched. We present four cases in which the role of older adults in innovation processes is examined: as early adopters (case 1); in playing an active role in deviating from technology companies' scripts (cases 2 and 3); or in clarifying these scripts (case 4). Finally, we present our conclusions and implications for future innovative practices, focusing on the importance for technology companies not only to involve younger, but also older people when designing new technologies with underlying scripts that are useful in their everyday life.

Keywords: Older people · Early adopters · New technologies · Unexpected use · Innovative use · Technology companies · Scripts · Configuring users · Reconfiguring technologies · Adoption · Appropriation · Repossession

1 Introduction

In the innovation diffusion literature, older people, if considered at all, are typically positioned as laggards, i.e., old age is often associated with an increased propensity not, or only reluctantly, to adopt new technologies [1]. Despite the relative absence of empirical evidence supporting this viewpoint, widespread stereotypes would have it that older people cannot be early adopters of new technologies. This paper will present four counter-intuitive examples that challenge the assumption that older people are laggards

who are the last to follow technology companies' planned scripts, and only doing so long after new technologies have been adopted by young users. We agree with Pinch [2, p. 247] who argues that:

“Woolgar [3] has shown how designers actively” “configure” users, and Akrich [4] has argued that the appropriated user interaction with a technology is “scripted” into its design. Users in turn, can challenge such scripts and reconfigure technologies (Latour [5], Akrich [4]). (...) Historians have studied how users come up with (...) completely new uses for technologies. Douglas [6] drew attention to the role of amateurs operators in the history of radio, Fischer [7] and Martin [8] have shown how rural women first used the telephone for extended conversations rather than simply short business calls, and Kline and Pinch [9] documented the use of the automobile as a stationary source of power rural in the rural United States.”

As far as we know, the role of older adults in challenging scripts and reconfiguring technologies through unexpected and innovative uses has not been very well researched. For this reason, we present four cases showing that older people can and do play an active role in deviating from technology companies' scripts.

The first case presents the history of the e-bike [10, 11] and the involvement of older customers who were anything but laggards. Secondly, we present a case describing the strategic use of deliberate missed calls by older people in Barcelona (Catalonia). The third case presents the development of the “Are you okay today” app by an 83-year-old man as part of the innovative start-up-plus program created by the Dutch knowledge centre, Leyden Academy on Vitality and Ageing. The fourth case is about the experiences of a 75-year-old woman who took part in testing the use of Google speakers, another initiative of the Leyden Academy on Vitality and Ageing. This resulted in a how-to guide for other older users, enabling other older users to make use of this new technology in such a way that it fit their everyday life needs. This shows what can happen when older people are given a voice in innovation processes.

Finally, we will present our conclusions and implications for future innovative practices, focusing on the importance for technology companies to involve older people when designing new technologies with underlying scripts that are useful for their everyday life. In our opinion, beyond adoption, appropriation – which happens when users make a technology their own – becomes relevant as a source of innovation. Bar et al. [12] argue that “appropriation challenges the initial power structure embedded in a technology, fostering new practices and new technological implementations.” [12, p. 619]. The appropriation model they propose has three steps: “technology evolution [is] a three-stage cyclical process of adoption, appropriation, and repossession” [12, p. 624]. Users drive adoption – and further appropriation – and providers react by reclaiming the resulting innovations. Repossession modes include, on the one hand, learning from final users' practices to embed them into successive iterations of the product/service; and on the other hand, to block or suppress an innovation that technology companies and providers find too antagonistic. Under this perspective, the four cases discussed here illustrate how older people's everyday life needs may be taken into account for a more nuanced, richer evaluation of innovation processes.

2 Method

We generate insights into the unexpected and innovative use of new technologies by older people on the basis of three research projects that were initiated and conducted by the authors of this paper. We draw on these cases to reflect on older people as early adopters and their unexpected and innovative use of new technologies. For more details on the methods, we refer to Sect. 3.1 for case 1, Sect. 3.2 for case 2, and Sect. 3.3 for cases 3 and 4.

3 Cases

3.1 E-bike

In the literature on innovation diffusion – a notion famously introduced and elaborated by Rogers [1] – age is a contested topic. According to the theory of innovation diffusion, acceptance and use of a new technology is driven by social contagion – a notion that Rogers developed, having been heavily influenced by French sociologist Tarde [13] (see also [14]). This implies that *early adopters* – individuals who are particularly quick to embrace a new technology even before its usability and usefulness have been demonstrated – serve as important initiators of innovation diffusion. In the prolific literature on innovation diffusion, the defining characteristics of early adopters remain somewhat ambiguous. Uncertainty abounds regarding the extent to which these characteristics must be empirically determined per case (i.e., they are characteristics manifesting in specific human-machine relations), or whether they are generic traits of certain socio-demographic groups. In this latter view, which arguably is the most influential in industry discourses on innovation diffusion, early adopters are often said to be highly educated, venturesome, have a high exposure to diverse media channels, be socially well connected, and so forth [15]. Empirical studies that link age to different adopter characteristics are inconsistent [1]. It is therefore all the more interesting that studies that describe adopter categories in terms of generic traits of individuals generally associate older age with late adoption or with being a laggard [16, 17]. To the degree that innovation diffusion theory has found its way into marketing textbooks and popular business vernacular, this stance has contributed to the widespread and ageist assumption that older people are an adopter group of low interest for the diffusion and use of new technologies [10].

Against this background, the history of the electric bicycle, or simply e-bike, is an interesting one. In the Netherlands, sales of e-bikes outnumbered those of regular bikes in 2019 [18], and e-bikes are now used across all age groups, including, to a growing extent, secondary school students. E-bikes these days come in many varieties, but they are generally sleek and only distinguishable from normal bikes by a fairly inconspicuous battery underneath the luggage rack. They also come in more expensive and more sportive variants that carry more obvious signifiers of battery and motor assistance.

However, closer examination of the rise of the e-bike and the diffusion of this technology over the past 10–15 years reveals that this popularity was a later development. In the early 2000s, E-bikes tended to be clunky, with glaringly conspicuous electric assistance systems. They were quite obviously useful only to those requiring assistance and no longer able to ride a regular bike. Older people were among the first group of

adopters [11], which meant that during the 2000s, the dominant users of e-bikes were older people, with whom they became strongly associated. How then to explain why the diffusion of e-bike usage did not end with this age group, but instead spread to become popular among Dutch bicyclists of all ages? And what role did the older early adopters play in this process of innovation diffusion?

These are questions that the second co-author of the present paper addressed in a 2017 study, during which 17 qualitative interviews were conducted with nearly all Dutch manufacturers of e-bikes [10]. The study focussed particularly on the manufacturers' recollections of the diffusion history of e-bikes, and how they related features of certain e-bike designs to the use practices of various age groups throughout this history. From these recollections, it became apparent that manufacturers frequently related the early adoption of e-bikes to an imaginary of the fourth age [19]. In their stories of the early days of e-bikes, they coupled the clunkiness of e-bike designs to the vulnerabilities of old age. As one of our respondents explained about the first e-bike designs (original quotes in Dutch, translated to English by A.P.):

“When we began, it was meant as a successor to the Spartamet [a bike with a gasoline auxiliary engine]; this was thus a target group of individuals that wanted to continue riding a bicycle, but needed a little bit of assistance. Hence, it was the somewhat older target group. A fairly old target group. That's where the success of the electric bike began.” (R1)

But back then, it was anything but obvious that e-bike use would further diffuse among older and younger age groups. This became clear from the more ageist language used by other respondents in their description of the early adopters of e-bikes, as illustrated by the following quotes:

“(...) the first bikes that were electric were all for old geezers. Those that rode them were all old geezers. That's what it was associated with. [...] ‘And what will the neighbors think’ – that was the impression given by one of those things [*early e-bikes*].” (R2)

“In the beginning, the target group was disabled persons; one could not imagine a normal human being ...an able-bodied person riding an electrical bike – insane by definition.” (R3)

These recollections demonstrate that “fourth age” users – as some of the respondents explicitly called them – were not a preferred group of e-bike users. In particular, they were not deemed to be promising early adopters, because they would simply not have the contagion potential to initiate a broader uptake of e-bikes. On the contrary, many respondents noted that older adopters became the target group for the early e-bikes precisely because these early designs were not attractive to those not in dire need of assistance. Even for these e-bike manufacturers, it was difficult, at least initially, to recognize that older people could be innovative and potentially influential adopters of this new technology. Although older people were the first to adopt the use of e-bikes, it was difficult for the manufacturers to view them as *early adopters* and they consequently continued to refer to them as laggards.

In practice, however, these imagined fourth age users turned out to be something quite different. As our respondents frequently remarked, these early users of e-bikes indeed had a need for assistance, but they also – probably less surprisingly than our respondents were prepared to admit – had a keen interest in image and appearance, as well as in adding a little extra range to their existing bicycling practices. In reality, the imagined fourth age cyclists turned out to be solidly embedded in the cultural field of the third age [19]. One of our respondents succinctly described how he eventually recognized that older people, contrary to the stereotypes expressed above, formed a diverse group:

“Actually, those that consider themselves to still be a little bit young. That’s really nice, it’s not just the one type. Well, some bikes do actually look like, almost, revalidation exercise bikes, but that’s not what they want. (...) This 84-year-old man told us’ this morning I played tennis’ (...) wow, fantastic. So, in that respect, old people are all seen far too often as, well the stereotypical image, but there is an unbelievable diversity [*in this group*].” (R4)

Statements like these illustrated how early contact with older clients led to a shift in the way this specific target group was perceived by the manufacturers, evoking an imaginary of the third age as an explanation for the further diffusion of the e-bike. Instead of focusing solely on aged, enfeebled bodies, to whom clunky designs would not matter, e-bike manufacturers started to address old age in terms of more complicated and diverse configurations of evolving disabilities, economic prosperity, recreational practices and an interest in combining assistance with a sportive appearance:

“I would say, the people that are close to retirement. Who are entering the third phase, or whatever it is called (...). Those that still cycle in pairs. They are the baby boomers, right? The people who have just retired and who have money –they need to have that –, and who have time, because they want to enjoy. That’s a really nice group. All happy people.” (R4)

Hence, in the early days of the technology, contrary to what many had taken for granted, actual in-the-flesh older people indeed turned out to be inspiring early adopters, who enabled e-bike designs to evolve from conspicuous mobility assistive devices to assistive devices that were not obviously recognizable as such. The very visible and clumsy battery and motors of the first e-bikes became focal areas of development, as even these older users indicated they would prefer smaller batteries and motors, that did not turn e-bikes into signifiers of vulnerabilities and disabilities. In the recollections of the manufacturers, the cultural field of the third age turned out to be much more conducive to the diffusion of e-bikes than the imaginary of the fourth age. In that sense, and in the view of the e-bike manufacturers, older people thus metamorphosed from a distinctly unpromising group of laggards into an attractive early adopter market that became an important playing field for new e-bike designs.

What this case clearly demonstrates is the extent to which widely held beliefs about older people in relation to technology are still fraught with ageist stereotypes. In the case of the e-bike, these stereotypes turned out to be misleading; e-bike manufacturers, on encountering real-life older people, were quite surprised about the diversity of this group, which, over time, led them to question their own stereotypes. They encountered

a considerable number of unexpected use practices, among which an interest in image and appearance, the importance of recreational use, a keen interest in gadgetry (and the spending power to indulge this interest) and an enthusiasm for sheer speed and battery power. Over time, they grew to appreciate these unexpected use practices as a resource which could be leveraged for new e-bike designs catering to a complicated configuration of evolving vulnerabilities with recreational, sports and social practices.

3.2 The Dynamics of Deliberate Missed Calls in Barcelona

This case focuses on older individuals (aged 60 and over). The research project aimed at a qualitative exploration of the relationship between older individuals and mobile telephones and the way mobile phones were appropriated (or not) by these older users. This research project was led by the third co-author, who used a qualitative approach that involved conducting semi-structured interviews in Barcelona in the period between 2010 and 2011. The 53 participants included 33 women and 20 men aged between 60 and 93. Some 25 respondents were found to rely on missed calls, i.e., short signal calls that are not intended to be answered. Missed calls emerged as an innovative practice attached to the mobile phone in the early 2000s [20–23]. As summarized in the paper [24, p. 286] on which this section is based:

“Deliberate missed calls [DMC] constitute a communication practice per se that is linked to the economic rationale of maximizing communication while minimizing the related costs. A DMC is a message that goes in one direction; it might therefore involve a certain degree of uncertainty because there is no feedback from the receiver. In this sense, it is a more limited form of communication than a voice call or SMS. The full use and exact meaning of DMC communication is linked to the ability to screen incoming calls. In addition, a DMC can have several meanings, or no meaning at all, since it is just a ring call. For this reason, prior agreement as to what a sent message means becomes very important. Given that DMCs are not intended to be answered, they constitute a zero-cost form of communication [as no call is effectively set up].”

In the present case, it was explored how older individuals used missed calls, something not usually analyzed from the perspective of the older people themselves. A relevant finding [24, p. 293] was that:

“Seniors using DMC in the sample correspond to a diversity of profiles, from sophisticated users who utilize deliberate missed calls to make the most of communications through their mobile phones, to one (...) user who just follows basic instructions because she is almost illiterate and barely knows how to use the phone. These results are in line with the fact that DMC use is widespread among different social strata, as well as among different age groups and genders [25, 26] in societies where it is a significant practice, as in Catalonia. Most of all, when DMC responds to a previously agreed behavior, participant seniors enthusiastically explain how they use them. This attitude challenges the idea that older people are passive users of mobile phones who “tend to use the technology only when there is no alternative communication method” [27, p. 891].”

Of interest here is the fact that DMCs became part of some seniors' everyday communication practices. Most commonly, they used DMCs with close relatives, which tended to be either their spouse or their children and, although less often, the grandchildren. In some cases, they also relied on DMCs with peers— although that appeared to be less common.

Within the family or with friends, the most common use of DMCs was micro-coordination, or “the nuanced management of social interactions” [28, p. 70]:

“Yesterday, for example, my wife said: Send me a missed call and I'll hurry up if I haven't finished yet.” (Man, 69 years old)

“I make a lot of missed calls. If I arrange to meet a friend, when I leave the house, I give her a missed call.” (Woman, 66)

DMCs were also a way to transfer the cost of communication to the wealthier communicant. As before, the meaning of the call must be agreed upon in advance. In some cases, children would send DMCs to their parents to get a callback, as one 68-year-old woman reported. On other occasions, the children would assume the cost of the call:

“I send [my son] missed calls and he calls me back ... because it costs him nothing [as he has a flat rate] and (...) maybe otherwise I would have to pay. (Woman, 62)

[My son] says ‘Look, so you don't have to pay so much’, (...) send me a missed call.” (Woman, 76)

Also, participants with a flat-rate contract were happy to assume the cost of voice calls. One participant used a variation of a DMC to avoid instructing those who call her. To save her callers money, she showed “an innovative behavior that takes full advantage of her flat-rate subscription in a context in which most subscriptions are billed per minute of consumed airtime.” [24, p. 293]:

“[I pick up the phone and say] hang up; I'll call you back. [Because] they already know why I'm doing that.” (Woman, 66)

The study was conducted during a period when missed calls were a prevalent practice. Yet, at the time of this paper's writing, the popularity of DMCs had fallen in Barcelona, as mobile phone flat-rates had since become pervasive. The communication goals sought using DMCs could now be achieved via WhatsApp messages or voice calls, which are more precise and do not increase the final bill. In fact, one participant had already reported using WhatsApp with her daughter in 2011, although this was not a feasible method of communication with peers at the time. However, in low-income contexts and among adults who have pre-paid subscriptions, deliberate missed calls (DMC) remain a zero-cost form of communication that is (still) commonly used to keep the phone bill down (e.g., [22, 29, 30]), also among older individuals –see [31] for the case of Lima (Peru).

Bar et al. [12] argued that DMCs constitute an example of appropriation that challenges the initial scripts imagined by mobile phone operators. The struggle for control (over the costs of a service) led to the use of a zero-cost communication service in the form of deliberate missed calls. It is an unexpected and innovative use that reduces the

operators' benefits, as no voice call is set up. In contexts where voice calls are perceived as being too expensive, DMCs rely upon two main features. First, the caller ID identification, available on all mobile phones by default. Second, the fact that mobile phones, which are personal, portable and pedestrian [32], are perceived as a tool for micro-coordination. In terms of Bar and colleagues' theoretical framework [12], flat rates can be understood as mobile phone companies' response to DMCs –at least in part. The flat rate as a post-paid contract commits the consumer to permanent, monthly expenses that might be higher than a pre-paid subscription. However, a flat rate enables users to gain control over their costs in a way a pre-paid subscription does not. Most consumers, therefore, do switch to different, albeit more expensive plans that allow the use of mobile data in a safer way than pre-paid subscriptions.

Yet by looking at particular practices of older individuals – in this case, the deliberate use of missed calls to communicate, a practice that runs directly counter to the planned scripts set up by mobile phone operators –it is possible to understand the richness and diversity of digital practices at any age. Clearly, innovation adoption is not static in old age: DMCs were shown first to be used with relatives and later with peers, as well. Then, as usage-based charges increasingly gave way to flat rate plans, the practice was eventually abandoned.

All in all, designers should approach old age as another period of life during which innovation in digital practices (also) occurs. Such appropriations of products not only evolve, but are relevant to explore.

3.3 Stimulating Innovative Practices for Older People by the Leyden Academy on Vitality and Ageing

The Leyden Academy on Vitality and Ageing (<https://www.leydenacademy.nl/home-en/>) is a Dutch knowledge institution with a clear mission: to increase knowledge about ageing and vitality, and to make this knowledge accessible to policymakers, healthcare providers and the general public in order to improve the quality of life of older people. One of the programs developed by Leyden Academy was called Start-up Plus, and directed at senior entrepreneurs:

“Most start-up courses target and are tailored to young entrepreneurs. Given our increasing number of healthy life years, however, more and more seniors are considering a second career and wish to create start-ups, which is shown to be beneficial for wellbeing and health. With Start-up Plus, we will train them to start their own businesses in healthy living and active ageing. Participants in this free course do not require any background knowledge, but we will select participants on the basis of their motivation. In eight weeks, they will follow an adaptive, individual learning pathway and learn essentials about entrepreneurship. We will provide individual coaching through face to face and virtual meetings, as well as expert interviews. (...)” <https://www.leydenacademy.nl/start-up-plus-for-senior-entrepreneurs/>

As one of the participants in the Start-up Plus program for senior entrepreneurs, 83-year-old Han developed an app called “Are you okay today”. The first author of this

paper conducted an interview with him (December, 3, 2020) to find out more about how this came about. During that interview, Han explained that his son Thijs had told him that he wanted to keep an eye on him. Thijs didn't want his father, who lived alone, to run the risk of not being able to warn anybody, for example, if he should experience a fall. Han told his son that, although he understood his son's worries, he did not want to install a home camera surveillance system, nor was he prepared to wear a device with an alarm button. They discussed their concerns, and, as both had a technical background and had worked – or in the case of Thijs, worked - in technology, were able to come up with an innovative solution; one that guaranteed Thijs would be warned if something happened with his dad and that Han's life wouldn't be impacted by having to install a video monitoring system. The two brainstormed together and came up with the idea for the app. Han then field-tested a prototype of the “Are you okay today” app at 100 locations in the Netherlands for a period of three months. The app is linked to a smart meter (an electronic device that records information such as consumption of electric energy that electricity suppliers are currently installing in a growing number of Dutch households) in the home of the older person. The script of the smart meter, as planned by the energy supplier, is that the recorded information is communicated to the consumer, allowing her or him to gain insight into their energy consumption behavior, as well as to the electricity supplier, allowing the electricity supply to be monitored and facilitating the billing process. Clearly, Han has deviated - in an unexpected and innovative way - from the electricity supplier's script in reconfiguring this technology for a new use fully adapted to his needs, finding an unobtrusive way to alert a relative or a friend that an older person at home alone may be in need of help. Han explained how his app works:

“It is based on my electricity consumption. I developed a self-learning system that registers the electricity consumption pattern of my household's devices. After three weeks, the system has ‘learned’ the pattern of my electricity use. In the event of a deviation from this pattern, the system initiates a phone call: not to my son Thijs, which would be an intrusion of my privacy, but to me. If I fail to answer, then something is wrong and the system calls Thijs.”

A deviation in the average pattern of electricity consumption - Han developed an algorithm for this – will therefore trigger the smartphone app to call him and ask: “Are you OK today?”. Should the older person using the app fail to respond to the smartphone call, the warning system is activated and a relative or friend is then alerted through a phone call. Han is now looking for commercial partners to introduce his app to the market. He sees this as a promising unobtrusive technological alert device for older people and their relatives and friends that works by following a script that deviates from yet at the same time builds on the script originally planned by the electricity supplier.

Another example from the Leyden Academy on Vitality and Ageing is that of 75-year-old Mary, who, after participating in a Google speakers user test session, decided to develop a guide for other older users showing how to install the device and how to use it. Her aim was to enable them to take advantage of this new technology in such a way that it fit their daily life needs. The point here is that Mary did not wish to deviate from the Google speakers' scripts as planned by Google. On the contrary, as part of the older user group, she created a language that addressed a specific target group (older people) for

this new technology; a target group that is usually ignored by technology companies. In this way, she created visibility for older users of the technology and debunked the myth that older people are unable to learn how to use a new technology script independently:

“[I developed a little user guide] with tips and showing the order of steps to be taken. You need to explain how to install the device first, and what you need in order to be able to do this. And you need to give examples of the purposes you can use it for, and that you can use your voice.”

4 Conclusions and Implications for Future Innovative Practices

According to Pinch [2], designers tend to configure users [3] by scripting appropriate user interaction with a technology into the design of their products [4]. We agree with Pinch [2, p. 247] that “users, in turn, can challenge such scripts and reconfigure technologies [4, 5]”. In this paper, we have introduced examples of older people cast in the role of early adopters, rather than laggards, in product innovation (case 1: e-bike); older people as innovative mobile phone users (case 2: deliberate missed calls); innovative older individuals able to reconfigure technology by deviating from planned scripts (case 3: innovative unobtrusive App Are you OK today); or innovating through the development of a user guide for Google speakers, thus helping older people learn how to use a new technology script independently by showing them how to install the device and how to use it (case 4: a user guide for Google speakers developed by an older person for older persons).

The main conclusion is, therefore, that older individuals are able to learn and innovate when it comes to using new technologies. However, for older people, getting stakeholders - such as technology companies - to hear their voice is another challenge. Many stakeholders are unaware that older people have a voice – and quite often, the realization that, not only do they have a voice, but that they also wish to be heard never dawns at all.

A final point we would like to make for future innovative practices is the need to involve users (younger and older ones) at an early stage in the design process, to avoid having designers create products and services that are designed for a projected user [4] without regard for the reality of the actual users’ context. The pitfall of I-methodology, described by Akrich [33, p. x, 32] as the “reliance on personal experience, whereby the designer replaces his professional hat that by that of the layman”, should be avoided. Importantly, technology companies should adopt a co-design approach when developing new technologies, involving both younger and older users to ensure the underlying scripts fulfil the needs of all users in the future use of these new technologies. One way to do this would be through the organization of focus groups [34–37].

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