Cohort Differences in Internet Use Amongst Older Adults

Evidence from the English Longitudinal Study of Ageing (ELSA)

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While much has been written on the age-based digital divide, more understanding of the relative importance of factors affecting use of the internet is needed. This paper analyses nationally representative data from the English Longitudinal Study of Ageing (ELSA) to understand older adults' frequency of using the internet and reasons for not using it more. We examine the extent to which health, lifestyle, and sociodemographic correlate with the pronounced age gradient in not using the internet. We find that the reasons why people in the 80+ cohort did not use the internet more are not qualitatively different from the reasons people aged 50–64 or 65–79 did not use it more, but do differ between rare and regular users. We also find that of the myriad factors that are potentially relevant, only cognitive ability, educational attainment, and employment status were robustly associated with the age gradient in internet use.

CCS Concepts: • **Social and professional topics → Seniors**; • **Human-centered computing → Empirical studies in HCI**.

Additional Key Words and Phrases: Older adults, ageing, aging, ageism, HCI, quantitative analysis, digital divide

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1 INTRODUCTION

The longstanding focus on 'older adults' in HCI would suggest that individuals over a certain age start to have a different relationship with, or different challenges in using, technology. What exactly changes with age to affect technology use is not fully understood but is key to ensuring that, to the extent that older adults could benefit more from these technologies, effective interventions are devised. Nor is there enough information about at what age this gradient in use becomes perspicuous (in other words, when age really starts to matter to technology use), which could inform more critical engagement with the implications of utilising particular age groups in HCI research.

Typically, the field has defined 'older adults' as being chronologically older than age 65 [43], though there is some variability across studies. That chronology is used in this way implies a straightforward relationship between age and

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technology use, with those older than 65 presenting recognisably differently than the default, younger people. But are people in their 80s sufficiently similar to those in their 60s that HCI ought to consider them part of the same user group? And are people in their 60s so vastly different from people in their 50s that they be categorised as 'older' and the other 'younger'? Perhaps these days, when many ageing into the presumptive 'older adult' bracket have experience using the internet through their employment, 65 is not so old after all—at least in terms of the reasons HCI might be interested in ageing.

In this paper, we analyse longitudinal data from England to examine patterns and correlates of digital technology use among older adults. We answer the following research questions:

RQ1: How do internet use and reasons for not using it more differ between age cohorts (50–64yr, 65-80yr, 80+)?

RQ2: Which factors, if any, are associated with the age gradient[1] in not using the internet (health, lifestyle, sociodemographic)?

RQ3: What reasons do older adults give for not using the internet more (motivation, skills, access/accessibility barriers)?

The paper proceeds as follows. After situating it in related work §2, we present our analyses of the most recent data from the English Longitudinal Study of Ageing (ELSA) (§3). In §4, we discuss our interpretations of our findings, followed by limitations (§5) and proposed future work to answer remaining questions (§6). Our quantitative study enriches a largely qualitative CHI literature base on ageing and shows that:

(1) Older adults have reasonably high rates of internet use across all age bands, are generally content with how frequently they use the internet, and provide similar reasons for not using the internet as the general population. Overall, and consistent with [45, 58] and others, non-use seems to be a choice more than a function of structural barriers. This underscores the need for discourses on the age-based digital divide to recognise the role of privilege and agency in decisions to disengage from technologies in later life [43].

(2) Those over age 80 are more dissimilar from those aged 65–79 than those aged 65–79 are to those younger than 65. This finding is consistent with the rationale behind age categories used in gerontological literature (e.g. 'fourth age' or 'old-old' vs. 'third-age' or 'young-old') [2], but problematises the use of the chronological age 65+ as a way of defining who is or isn't an "older adult" in HCI [43]. Crucially, however, the difference does not appear to be fully explained by the acceleration of functional decline at age 80, as emphasised in the gerontology and geriatric medicine literature [2, 74].

(3) Apart from diminished cognitive performance, many other factors thought to explain the age-based digital divide do not. Though we find a variety of motivational and skills barriers to greater use of the internet, in support of arguments made by [23, 46, 50, 73] and others to eschew a deficit view of ageing, we find little evidence of there being true accessibility or usability barriers to use as people get older.

(4) Low educational attainment and not being in employed work have explanatory value in understanding the age-based digital divide. This underscores the need for HCI and Ageing research to more critically engage with lifecourse [73], and specifically, explore: (i) the complex ways retirement may affect internet use (cf. [24]); and (ii) generation/cohort effects [43], not only in terms of technology histories [63] but also in terms of changing norms in educational attainment.

[1]We use the phrase 'age gradient' to mean the negative correlation between age and technology use. We use the phrase 'age-based digital divide' to when to mean the presumptive inequality of this age gradient (i.e. a matter of social and technology policy).

Together, these findings have important implications for how we talk about old age in HCI and how we ought to address the age-based digital divide.

2 THE AGE-BASED DIGITAL DIVIDE

2.1 Terminology

Various terms have been used to describe digital inequality between younger and older people. We adopt 'age-based digital divide' [59] to describe these age-patterned differences in technology use over terms such as 'silver digital divide' (e.g. [80]) or 'grey divide' (e.g. [29]), which draw on stereotypical characteristics of older people's appearance. No term is without its limitations, however, and 'age-based digital divide' should not be interpreted as endorsing the idea that age alone predicts internet use [28]. There is also an important distinction between the *digital divide*, which connotes inequality of outcome in digital use, and *digital exclusion* or *digital poverty*, both of which focus on the inequitable sub-set of inequalities. And as aptly noted elsewhere [1, 25], even those who do not engage with digital technologies are still digital citizens and are both highly datafied and affected by the digital world.

2.2 Theorising this divide

Despite considerable research and policy interest in ageing and technology, the age-based digital divide does not appear to be going away. For at least two decades [16, 54, 70], the use of the internet (and other digital technologies) by older adults[2] has continued to increase alongside steadily increasing use by younger adults [60]. However, older adults' uptake and use is consistently lagging behind in relative terms [1]. This is concerning on a number of counts. Firstly, as a public policy issue given the hope that digital technologies will help reduce the rising healthcare needs (and costs) of an ageing society by increasing functional independence [20], e.g. providing assistance with daily living and reducing risk factors such as social isolation. Secondly, as a matter of social justice, if older adults cannot access information [78] and they are systematically excluded from public services and from civic participation due to increased digitalisation [19, 33, 68]. Thirdly, in terms of equitability, if they do not reap the many benefits that others are getting from using digital technologies [46].

An extensive body of literature within HCI, gerontology, public policy and beyond has explored factors that contribute to the age-based digital divide. One set of factors pertains to physiological changes that occur as part of the ageing process (if at different rates for different people depending on genetic and environmental factors [43]) which decrease functional abilities in ways that make online interactions more difficult to execute and make learning to use technology more challenging [20, 33]. These include issues of physical and cognitive impairment that become more common with age. Accessibility features [18, 38] and alternative interfaces (e.g. voice-based interaction) [12, 79] have been proposed for mitigating these potential barriers to use for older individuals. The emphasis on age-based deficit and decline has, however, faced extensive critique within HCI for presuming all older adults as disabled and for neglecting other salient factors in non-use [48].

There are also important cohort effects between younger and older and within the category of older adult [58, 63]. Many of the most reliable indicators of whether a person uses the internet (i.e., indices of deprivation) correspond with age but are not related to the ageing process *per se* [28]; and whereas younger people are more likely to either be digital natives or learned to use technologies through their employment, many older people, and more of the older-old,

[2]We draw from literature that defines 'older adults' using different chronological cut-offs. Here we look at internet use and reasons for not using it more for UK adults aged 50+, but segment findings by age bands 50–64, 65–79, and 80+; and later (§??), when we examine the beliefs about older adults, we define "older" respondants as those aged 50+ to mirror the ELSA dataset analysed in §3.

have never needed to learn to use these tools and may feel more comfortable and capable carrying on without them [66]. HCI efforts to address this barrier include design for novices [33] and provision of tailored training and support for those wanting to learn how to use digital technologies [8]. But many older adults have used digital technologies but later disengage [37], either because they develop impairments that make use more difficult, or because of changes to their social context and/or social needs [66]. So while some proportion of older adults face barriers to using the internet to the extent they would like to (a.k.a. involuntary digital exclusion [26]), others choose to limit or discontinue their engagement to best suit their needs. The challenge lies in determining whether an older person's lack of interest in digital technologies originates from insecurities around their IT skills [28] or cognitive capabilities [76], or from internalised beliefs about what people their age can do or should be interested in [57, 75], or from feeling that structural barriers are not worth the effort to overcome [59].

A recent paper by Knowles et al. [43] proposes a novel framework for understanding the relationship between age and the digital divide: that on the one hand, ageing can lead over time to a decumulation of resources needed for being able to access and use digital technologies; and on the other hand, can lead to the accumulation of certain privileges that enable individuals to disengage from them. This 'resource view' of ageing helps explain the heterogeneity of older adults, as people can progress along different dimensions of age at different rates, and also underscores how structural forces shape differential resource de/accumulation. Our paper builds on these insights by examining which of these resources (i.e. dimensions of age that are measured in the ELSA questionnaire) are consequential to the digital divide and how they relate to markers of social stratification (conveniently also measured in ELSA).

2.3 English/UK context

Our study is conducted in England, UK,[3] where the majority of people have internet access. According to the Pew Research Center, who conduct a Global Attitudes Survey including questions on internet use in 27 countries, a high percentage of UK adults use the internet (93%).[4] For comparison, this is lower than South Korea (99%) and the US (95%), the same as Germany and Italy, and strikingly higher than countries such as Nigeria (57%) and India (56%) [17]; though there are regional disparities within the UK, with Scotland having the highest proportion of adults offline [5, 40].[5] Internet use among the UK adult population has increased precipitously in the last 20 years or so (compared to 47% in 2002) [16],[6] with the older demographic showing the greatest increase in use of the internet (e.g. from 28% in 2010 to 58% in 2019 for those in the 50–74 age bracket [60]; elsewhere reported as increasing from 29% in 2013 to 54% in 2020 amongst people aged 75+ [27]). Age has been shown to be a significant correlate of non-use [4, 6, 17, 40], with 2.1 million UK adults are offline [5].[7] The vast majority of those offline (86%) say they do not use the internet out of personal choice [3], though interestingly, *84% of adults 60+ who are offline say nothing could motivate them go online*, compared with 63% of the general population [28].

As much as 10% of the UK population say they do not use the internet more because they do not have access to an internet connected device [5], though again there are pronounced differences in access to the internet by age. Amongst

[3]England is one of the four nations comprising the UK. Where England-specific statistics and research are available, we cite these; however, while acknowledging that the UK and England are not synonymous, we cite broader research from the UK as well when it can provide further contextualising information.
[4]Statistics vary somewhat across different research bodies. For example, the Office for National Statistics reports 92% internet use by UK adults [62], while Statista finds 97.8% use the internet including all ages [70].
[5]Latest available from Lloyds Bank. The Digital Consumer Index reports do not always convey the same information, but wherever possible, we report the latest data available.
[6]According to Lloyds Bank, internet use by UK adults "in the last three months" is as high as 96% as of 2023, though reached as much as 99% in 2022, up from 95% in 2021 and 91% in 2000 [5].
[7]The UK government defines being "offline" as not using the internet in the last three months [5].

the general population, 7% of households do not have access to the internet, whereas only 75% of people aged 65+ have access at home [62]. There are a number of UK charities that help tackle access issues, most notably the Good Things Foundation,[8] who have a National Device Bank of retired corporate IT they can redistribute and a National Databank that provides free mobile SIM cards to people who need them. It is difficult to know the extent to which those who still lack internet connected devices are unaware of these charities, experience issues in accessing their support, or are resistant to going online.

There is considerable data regarding the gap in digital skills between younger and older UK adults, as this is tracked annually through Lloyds Bank's Consumer Digital Index report. While people in older age brackets have shown the most rapid increase in digital capability (e.g. those aged 75+ with Foundation Level skills increasing from 31% in 2022 to 53% by 2024 [6]), two-thirds of the ultra-low digital engagement segment is individuals aged 70+ [5], and there is a pronounced drop-off in "essential digital skills for life" (according to the UK government's definition) from 65–74 to 75+ [4]. More than half of individuals with "zero basic digital skills" are the older-old [40]. The UK has invested significantly in digital skills training [32], now available for older adults through a variety of local authorities and charity organisations (e.g. AgeUK and University of the Third Age) [66], and has recently launched an essential digital skills framework to support organisations and employers in adult training [31] as well as providing a formal qualification in essential digital skills which is free to take [61]. But, as with the access charities, uptake of these training opportunities requires motivation to develop digital skills.

There is also some data suggestive of an age gradient in trusting the internet. While difficulties recognising untrustworthy content online are widespread (11% of the population), those over the age of 75 are least skilled at identifying fake news and untrustworthy vendors (only 70% being capable) [6]. That said, ability to ascertain trustworthy content begins to drop off at a comparatively young age, with only 86% of UK adults aged 35+ reporting confidence compared to 95% of 18–34-year-olds [6]. It is difficult to know whether these findings reflect over-confidence of younger people or actual differences in ability. It is also not clear whether this translates to differences in trust in the internet, as trust in the internet interacts with those with lower information literacy can have higher trust in online information [81]. Further, even if older adults were to report lower trust in the internet, it may be that citing distrust is a convenient way of accounting for not using the internet more, rather than it being a factor in decisions to not use the internet [44, 45].

"Physical impairment" is also strongly correlated with digital skills gaps, according to Lloyds Bank [6], with 91% of people in the UK without any impairment vs. 76% with an impairment achieving Foundation Level. These figures are improving year-on-year, increasing from 68% of those with an impairment in 2022 [6]. Their data is further broken down into type of impairment: 81% of those with mental health impairment, 72% of those with learning or memory impairment, 71% of those with sensory (vision and hearing) impairment, and 69% of those with physical impairments achieving Foundation Level. Having multiple impairments also lowers attainment (70% with multiple vs. 83% with a single impairment achieving Foundation Level). What isn't clear from the Lloyds data is the relationship between age and impairments that matter to attainment, or for that matter, actual usage of the internet.

Clearly there is an extant evidence base regarding UK internet use with several findings which are suggestive of an age-based digital divide. Our analysis of the ELSA dataset offers another window onto this phenomenon, as it allows deeper exploration of the health and lifestyle factors that correlate with internet use amongst older adults. Further, from the evidence above, it is not clear whether or to what extent older adults are not using the internet more due to inequalities (e.g. in ability to use or access to internet connected devices) vs. these inequalities reflecting enactment of

[8] https://www.goodthingsfoundation.org/

personal preference and agency (i.e. different levels of motivation to use the internet). ELSA provides opportunity for analysing potential variation in motivation alongside these structural factors to understand their relative importance.

3 ELSA METHOD AND RESULTS

We analysed data from Wave 10 of ELSA, which is a nationally representative survey of men and women aged 50 and older living in the community[9] in England [72]. The study started in 2002/03, with 12,099 participants ranging in age from 50 to over 90 years, and assessments typically take place every 2 years through a combination of Computer-Assisted Personal Interviews (CAPI) carried out face-to-face in people's homes[10], coupled with paper-based self-completion questionnaires. New respondents are periodically added to maintain the full age range. Details regarding attrition and refreshment samples are available in the technical reports issued with each wave.[11] The study is multidisciplinary, involving the collection of sociodemographic, economic, psychological, social, biological, and genetic data. Wave 10 was carried out following the Covid-19 pandemic, with data collection started in late 2021 and continuing until early 2023; most individuals were assessed in 2022. These analyses from Wave 10 involve n=6,373 participants (n=3,757 women and n=2,798 men) ranging in age from 50 to over 100 (mean 68.35, sd 9.46 years) who completed a module concerning internet use. Questions about internet use are present in all waves, though these have evolved over time, with Wave 6 introducing questions about frequency, and Wave 10 being the first to ask about reasons for not using the internet more. Waves 1–10 of the ELSA were approved through the National Research Ethics Service. Informed consent was obtained from all participants involved in the study.

The primary analyses involved logistic regression, assessing the odds of internet use in the 65–79 and 80+ age groups, with the 50–64 year group as the reference category. The amount of missing data was small (<5%), so a complete case analysis was carried out. The ELSA data are deposited with the UK Data Service (https://ukdataservice.ac.uk/), and can be accessed by researchers throughout the world. Despite the availability of this data, ours is the first study to conduct these analyses of correlations between various factors and rates of internet use. Neither we nor anyone else has published this analysis elsewhere.

Positionality statement. This research was conducted as part of a funded research project [project title and funder anonymised for review], of which all authors are researcher co-investigators. This project had explicit aims of advancing theorisation on the age-based digital divide and promoting digital equity [more specific language redacted to preserve anonymity for re-review]. Naturally, this informed the research questions for this study; but neither our funding agency nor academic institutions exerted any pressure regarding acceptable findings (e.g. with respect to a political agenda). The authors have worked extensively with the population and the dataset, which is publicly available. Our team is comprised of individuals below and above age 65, which prompted fruitful discussion about the meaningfulness of established age categories. All are UK citizens, either from birth or naturalised, so our analyses reflect a Western, and specifically British, cultural perspective on older age and technology. While this is arguably beneficial for interpreting our findings within the English context, we are not necessarily able to perceive how this culture shaped our study and findings (apart from being cognizant of common associations of age 65 with the major life stage transition to retirement as a legacy of former UK employment practices). We do, however, recognise that it will have done, and welcome others to reflect on and empirically test the extent to which our findings apply to other cultural contexts—particularly

[9] i.e. not in assisted living/institutional care.
[10] Participants were visited by a trained interviewer who used their computers to record responses. Participants themselves did not use computers directly; as such, CAPI would not have introduced selection-bias favouring responses from individuals capable of using computers.
[11] https://www.elsa-project.ac.uk/study-documentation

those with vastly different levels of and histories of technologisation, cultural associations with old age, and societal in/equality.

3.1 Rates of internet use

These analyses are based on a classification of age into three groups: 50–64 yr, 65–79 yr, and 80 and older. We might have chosen to test different age ranges (and of course, others can, given the public availability of the ELSA data). Adopting 60+ as our definition of an 'older adult' and 75+ as our oldest category would have enabled more direct comparison with the policy literature we cite (e.g., [6, 65], but would have aligned less well with the CHI literature into which we offer our contribution (cf. [43]). Importantly, our groupings also align with the gerontological literature which finds that people 80+ ('fourth age', 'old old') are qualitatively more different from 65–79 ('third age', 'young old') than 65–79 are from mid-life (<65) [2]. Our study design supports empirical testing of this premise as it relates to internet use, allowing us to comment on the usefulness of age 65+ as a chronological definition for 'older adults' in HCI [43]. We start with a lower bound of age 50 due to the availability of data in ELSA. The 80+ group allows us to explore whether it is the increased 'frailty' [2] (i.e. functional decline) characteristic of this group that appears most material to internet low-/non-use, or perhaps something else.

The basic profile of internet use is shown in Table 1. Levels decreased with age, but even among respondents aged 80 and older, around half (49.2%) were using the internet daily. There was also a pronounced age gradient in never using the internet, ranging from only 1.7% of people aged less than 65 to 32.3% of the 80+ group.

Frequency of use	50–64 yr	65–79 yr	80+ yr	Total
Never	1.7%	7.5%	32.3%	8.7%
Seldom	0.6%	1.4%	2.0%	1.2%
Monthly or more	3.7%	9.4%	16.4%	8.2%
Daily	94.1%	81.8%	49.2%	81.9%
Rare use (never + seldom)	2.3%	8.9%	34.3%	9.9%
Regular use (daily + monthly or more)	97.7%	91.1%	65.7%	90.1%

Table 1. Full analytic sample: Internet use by age group.

Because the 'seldom' and 'monthly or more' groups are small, we recoded the data into two categories: regular use (daily and monthly or more) and rare use (seldom or never). (Note: Hereafter, "rarely" means "never or seldom", and "rare users" means the set of "never" + "seldom" users.) These categories are shown in the last two rows. Overall, 90.1% fell into the regular use and 9.9% into the rare category.

3.2 Factors potentially affecting the age gradient in internet use

We tested a number of demographic, social, mobility and health factors that might account for the age gradient in internet use. Data were analysed using logistic regression, with use (regular vs. rare) as the dependent variable. Mean adjusted percentages of the proportion of participants in each age group using the internet are presented, together with adjusted odds ratios (with 95% confidence intervals). We also estimated the proportion of the age gradient correlating with each factor using the method described by Lin et al [51].

The following factors that might be associated with the age gradient were tested:

- Sex. On entry to ELSA, participants were asked to report their "sex" as "man" or "woman". We use the term sex here because this is how the question is worded in the ELSA survey, but we highlight that both sex and gender are socially constructed, and the actual construct being measured here might best be understood as self-reported gender identity.
- Socioeconomic resources. These were assessed using wealth, which is a robust indicator of socioeconomic resources at older ages [53]. It was calculated by summing of multiple sources of household wealth including wealth from property, possessions, housing, liquid assets, cash, savings, investments, artwork, and jewellery, net of debt and exclusive of pension wealth. Wealth was analysed as a binary variable divided at the median. Wealth ranged from -£163,000 to £13.8 million, with the average wealth in the lower and higher category being £162,000 and £941,000.
- Education was analysed as a binary variable, comparing individuals educated up to O level[12] (including those with no qualifications) with those with secondary school or higher education. In this sample, only 57.5% were educated above O level, which is typical for an older sample in England.
- Employment. We compared people in paid employment (33.4%) with the remainder.
- Marital status. The sample was divided into those who were married/partnered (66.8%) in one category, and those who were single, divorced, separated or widowed in a second category.
- Mobility and physical impairment. Problems of mobility and difficulty in completing activities of daily living (ADL) become increasingly common as people get older. We therefore tested whether having such issues was linked with reduced use of the internet as hypothesised in the HCI literature an popular discourse. Participants were questioned about 10 aspects of mobility (e.g. difficulty pushing or pulling large objects, difficulty reaching or extending arms above shoulder level, difficult picking up a 5p coin). Around half (49.8%) of respondents reported no mobility impairment.
- Long-term health conditions. We assessed the presence of six major long-term health conditions that become increasingly common at older ages, namely coronary heart disease, diabetes, cancer, chronic lung disease, stroke, and Parkinson's disease. 35.6% of participants had physician diagnoses for one or more of these conditions.
- Cognitive ability. There are decreases with age on average in memory, attention, and other cognitive abilities. Lower cognitive ability might account for age-related changes in use of the internet. We analysed two aspects of cognitive function—memory and verbal fluency—creating a standardised score from aggregating three objective tests. We classified individuals with scores in the lowest quartile as having poor cognitive function.

The results of these analyses are summarised in Table 5 in the Appendix, and represented in Figure 2. It should be noted that all these factors were related to internet use: internet use was less common among women than men, less wealthy and educated participants, people who were not in paid work, were not married, had mobility impairment and long-term health conditions, and who had poorer cognitive function. The issue addressed in these analyses is whether addition of these factors reduced the gradient.

The statistics underlying these associations are shown in Table 6 in the Appendix (see Figure 3 for a visual overview). Table 5 shows the percentage of regular users of the internet was 97.7% in the 50–64yr age category, 91.9% in the 65–79 yr category, and 65.7% in the 80+ yr category. If a particular factor is important for reducing the gradient the age gradient, then the age category percentages would shift closer to one another, and the percentage of the age difference reduction would be large. The inclusion of several of these explanatory factors does not account for much of the age

[12]This is a considered a basic education, roughly equivalent to a US high school diploma.

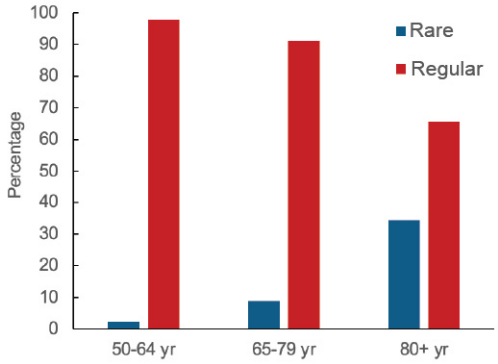

Fig. 1. Internet use by age group. Rare vs. Regular users.

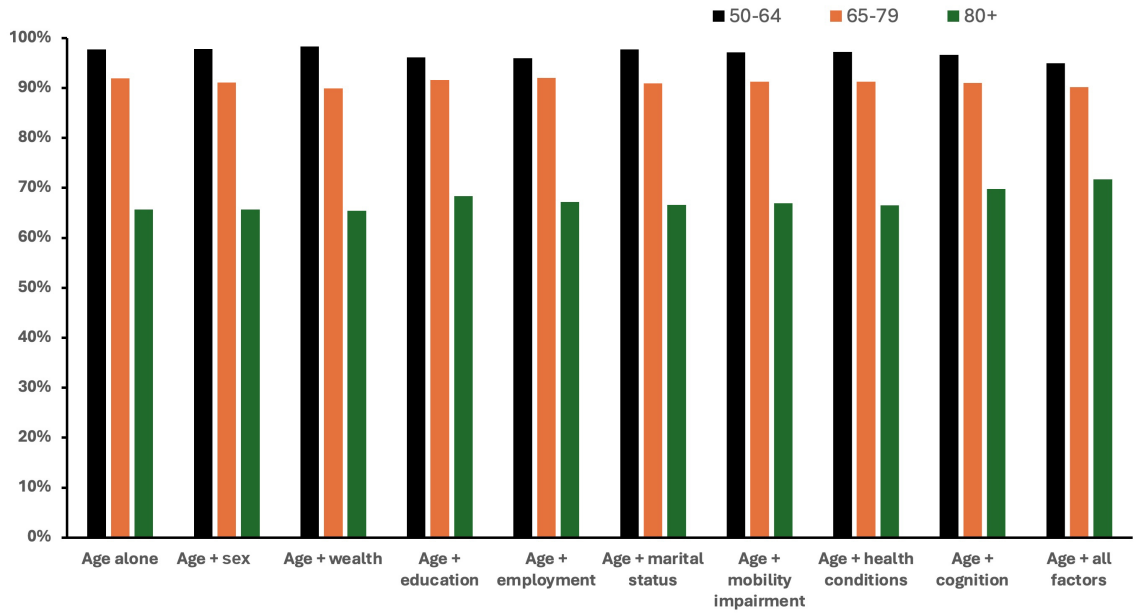

Fig. 2. Full analytic sample: Percentage of regular internet users by age category, and accounting for sociodemographic characteristics. Detailed statistics in Table 5.

difference in use. But three factors had a large effect, namely poor cognitive ability, less education, and not being in paid employment. These factors individually accounted for 5.5%–7.8% of the age gradient. When all factors were entered into the analysis at the same time, they accounted for 16.3% of the age gradient in internet use. What these results suggest is that sociodemographic factors and cognitive ability are associated with a significant reduction in the amount of the difference in internet use of people at older categories compared with the 50–64 yr group.

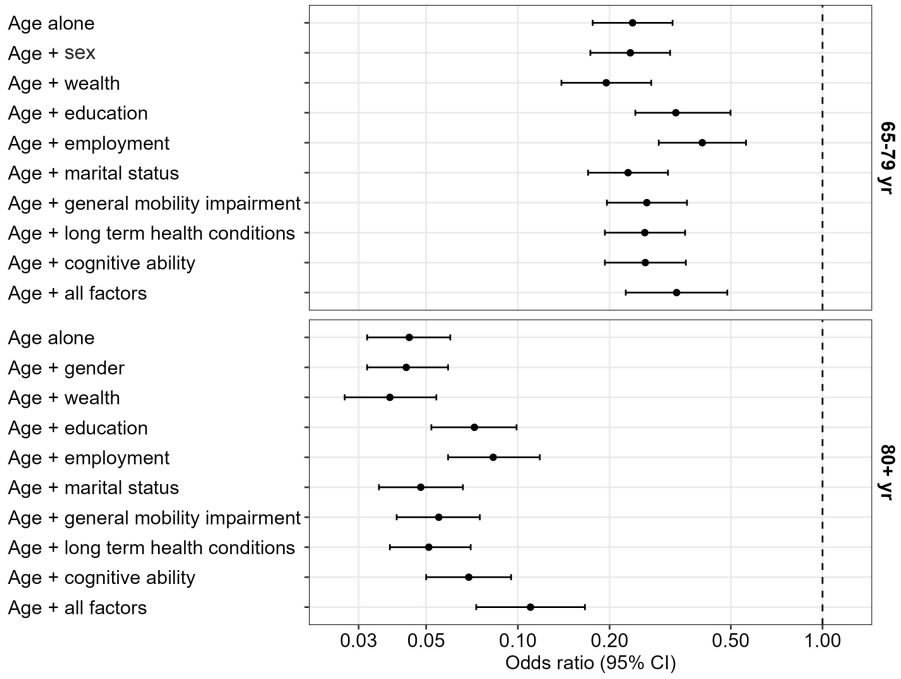

Fig. 3. Full analytic sample: Forest plot showing logistic regression results for regular internet use (compared to rare use) by age alone, followed by models for various sociodemographic correlates, physical health and impairments, and cognitive ability. Odds ratios (OR) and 95% confidence intervals for age, with 50–64yr category as the reference group. Detailed statistics in Table 6.

3.3 Other issues potentially affecting the age gradient in internet use

Data on multiple health, social and economic issues are collected on every wave of ELSA. This meant that in addition to the major categories of factors that could potentially correlate with the age gradient in internet use, we were able to examine some more specific factors, namely:

- Manual dexterity. The analyses in Table 5 and 6 included measures of a broad set of mobility problems. We tested two specific issues that could reduce internet use: manual dexterity (ability to pick up a small coin), and arm mobility (ability to reach or extend arms above shoulder level). These issues could reduce ability to use keyboards or keypads.
- Sensory impairment. Problems with sight and hearing become more frequent with age. Difficulty seeing screens or keyboards, or problems with hearing mobile phones or internet sounds could limit use. We therefore assessed sensory deficits, analysing the impact of having poor sight and poor hearing (even with appropriate aids). A total of 12.8% reported their sight was poor (even with spectacles) and 20.8% that their hearing was poor.
- Close relationships. The number of close relationships decreases with age, and older people with fewer relationships may be less likely to use the internet. Participants indicated the number of people with whom they had close relationships including partner, children, other relatives, and friends. We defined individuals who reported five or fewer close relationships (34.2%) as having few close relationships.

- Social isolation. A related factor is social isolation. More isolated older people may be less likely to use the internet. ELSA uses a well established measure of social isolation including the amount of contact that people have with children (if they have any), other relatives and friends, and level of involvement in organisations, groups or clubs.
- Depression. Depression is associated with a reduction in many activities, and could contribute to the age gradient in internet use. Depressive symptoms are assessed in ELSA using a short form of the CESD (Center for Epidemiologic Depression scale), comparing individuals with significant depressive symptoms (12.6%) and the remainder.
- Loneliness is another potentially relevant factor. People who feel lonely may be less likely to use the internet regularly because they may feel that they have little reason to do so. Loneliness is measured in ELSA through a well-established questionnaire (the short-form UCLA loneliness scale), and 25.4% of respondents rated themselves as lonely some or all of the time.
- Self-rated cognitive ability. It is possible that in addition to objective measures of cognitive function, older people who believe that their mental function is poor may lack confidence in using the internet. We asked participants to rate their cognitive ability as excellent, very good, good, fair, or poor. Individuals who classified themselves as having only fair or poor cognitive function (13.7%) were compared with the remainder.

The results of these analyses are shown in Table 7 in the Appendix and represented in Figure 4. As with the factors included in the previous analysis, it should be emphasised that all these issues are associated with internet use: internet use is less likely among individuals with manual dexterity problems, problems with arm mobility, poor hearing and sight, depression, loneliness, and poorer self-rated cognition. But they do not account for the age gradient in internet to a great extent. One explanation for this is that many of these factors are not common in this population sample. So although, for example, manual dexterity is important in itself, it is only experienced by 5% of respondents, and does not therefore go far in reducing the age gradient in the older population at large. Another possibility is that people who are motivated to use the internet (an issue to which we turn next) actively invest in methods for addressing these potential barriers to use (such as aids), which may moderate the effect of these factors on internet use.

The supporting statistics are shown in Table 8 in the Appendix (see Figure 5 for a visual overview).

3.4 Reasons older people have for not using the internet more

The findings shown in Figures 2–5 and detailed in Tables 5–8 indicate that although some factors—education, paid employment, and cognitive function—are important in understanding age differences in internet use, much of the age gradient remains unexplained. More insight might be gained by asking participants why they did not use the internet more. We therefore analysed responses to questions asked in ELSA about several possible reasons for not using the internet more, including issues that have been identified in research across the full age spectrum, together with specific age-related factors such as poor vision and health problems.

Responses are summarised in Table 2, listed according to the frequency with which they were endorsed. People could select more than one reason, so percentages do not add up to 100%. These analyses are adjusted statistically for sex and education. The most common reason overall was that people did not see any reason to use the internet more. Next most frequent reasons for not using the internet more were poor IT skills, and lack of trust. Equipment and access issues were not commonly reported. The least common reasons given were problems with vision or other health issues. Even among respondents aged 80 and older, fewer than 5% endorsed vision and health issues limited their digital access.

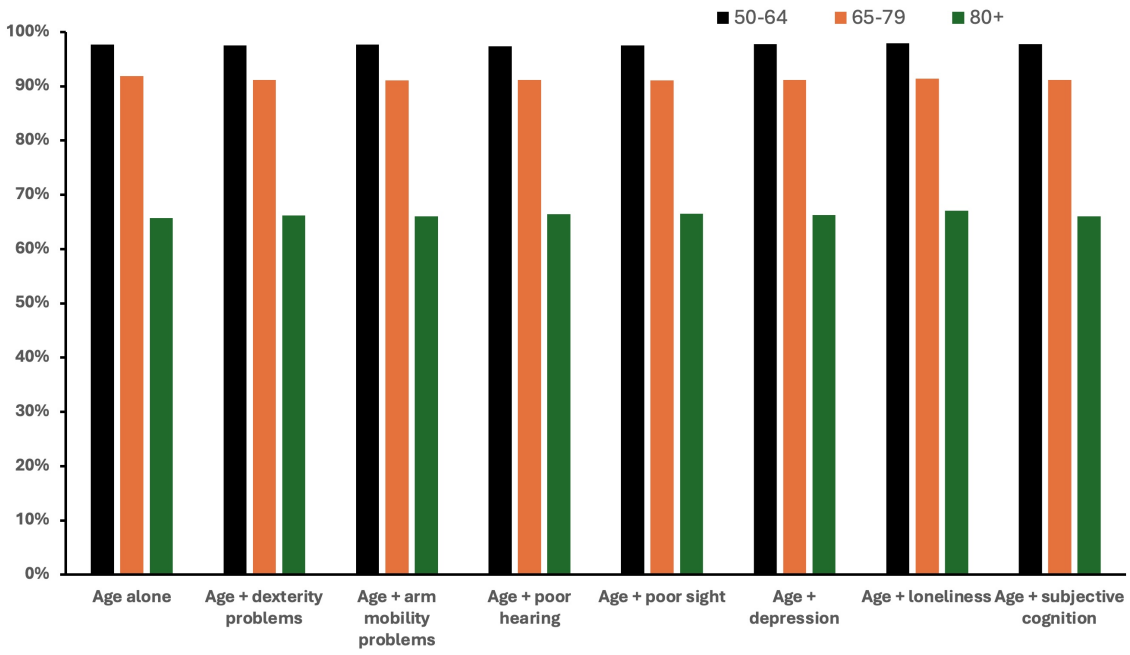

Fig. 4. Full analytic sample: Percentage of regular internet users by age category, and accounting for physical impairments, depression, loneliness, and subjective cognition. Detailed statistics in Table 7.

Reasons	50–64 yr	65–79 yr	80+ yr	Total
I have no reason to use it more	21.2%	27.9%	33.1%	26.2%
My IT skills are not good enough	13.5%	25.3%	43.0%	23.4%
I don't trust the internet	12.4%	21.6%	23.8%	18.6%
It takes too much time	3.7%	5.3%	9.7%	5.3%
I don't have access to good enough equipment	1.6%	2.1%	5.1%	2.3%
I don't have good enough access to broadband	1.9%	2.1%	3.6%	2.2%
My vision is not good enough	0.7%	1.1%	4.9%	1.5%
My health problems (not including vision) stop me	0.9%	0.9%	2.9%	1.1%

Table 2. Full analytic sample: Reasons why participants do not use the internet more.

However, these figures are from the complete ELSA sample, including those who do and do not use the internet regularly. In order to understand whether these factors are relevant to the age differences in access, we need to analyse these factors in two different groups of individuals: those who do vs. do not regularly use the internet.

3.4.1 Rare users of the internet. The reasons given by non-users are summarised in Table 3. It can be seen that poor internet skills and trust issues are the most commonly endorsed reasons for not using the internet. But it is notable that these reasons are not given more frequently by the older people in the sample. For example, 42.4% of non-users aged 80+ say that their IT skills are not good enough, but so too do 45.1% of participants in the 65–79 yr age group, and 48.6% in the 50-64 yr group. In fact, none of the reasons are endorsed with greater frequency in the 65-79 yr or 80+ group compared with the younger respondents. In the case of lack of trust in the internet, this is mentioned much more

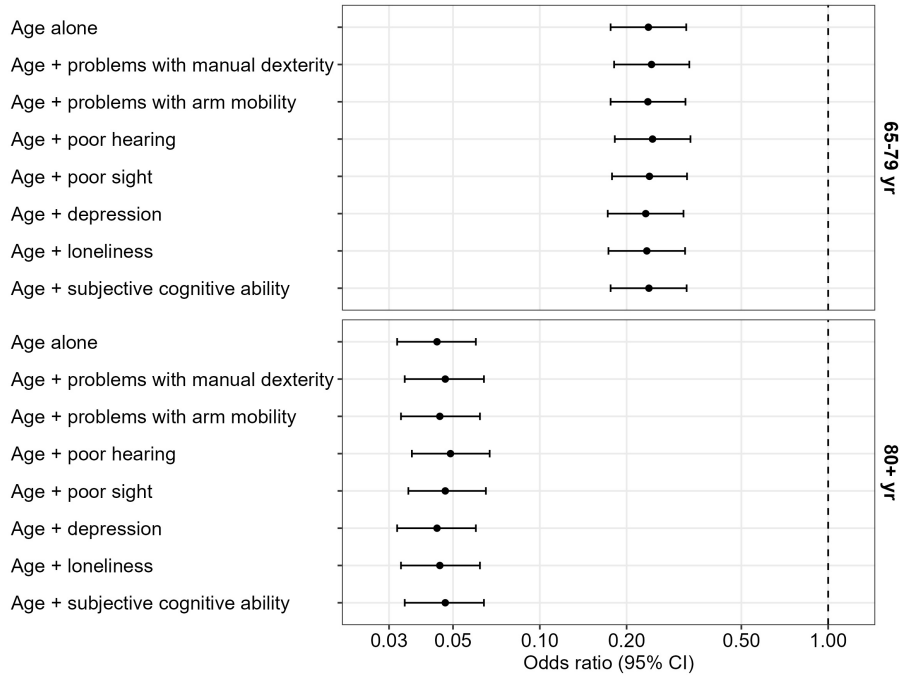

Fig. 5. Full analytic sample: Forest plot showing logistic regression results for regular internet use and age accounting for physical impairments, depression, loneliness, and subjective cognition. Odds ratios (OR) and 95% confidence intervals for age, with 50–64yr category as the reference group. Detailed statistics in Table 8.

frequently in youngest group (40.1%) than in the 65–79 and 80+ groups (25.7% and 21.5%). It appears that these issues are not the reasons why there is an age gradient in digital activity in this study.

Reasons	**50–64 yr**	**65–79 yr**	**80+ yr**
I have no reason to use it more	20.2% (8.2–32.2)	24.9% (19.8–30.0)	24.8% (19.7–29.8)
My IT skills are not good enough	48.6% (34.8–63.2)	45.1% (39.2–51.0)	42.4% (36.6–48.2)
I don't trust the internet	40.1% (28.1–52.1)	25.7% (20.6–30.9)	21.5% (16.4–26.6)
It takes too much time	12.3% (4.1–20.5)	8.2% (4.7–11.7)	10.5% (7.0–13.9)
I don't have access to good enough equipment	12.3% (4.4–20.1)	7.6% (4.2–10.9)	9.0% (5.7–12.3)
I don't have good enough access to broadband	10.1% (3.3–16.8)	5.8% (2.9–8.7)	6.1% (3.2–8.9)
My vision is not good enough	6.1% (1.0–12.1)	2.8% (3.0–5.4)	6.8% (3.0–5.4)
My health problems (not including vision) stop me	10.6% (4.5–16.6)	3.7% (1.1–6.3)	5.5% (2.9–8.1)

Table 3. Sub-sample of participants in the rare user category: Reasons why they do not use the internet more. Percentages adjusted for sex and education with 95% CIs.

3.4.2 Regular users of the internet. These reasons may not be important in understanding why digital access decreases with age. But they may be crucial for understanding why older people who are digitally connected do not use the internet more. This is evident in Table 4 which summarises the responses of people who are regular users of the internet. Here, we see very pronounced age differences in the relevance of these factors. For example, 43.1% of people aged 80

and over say that their IT skills limit their use of the internet, compared with only 12.6% of individuals aged 50–64 years. Over one third of the 80+ group say that they have no reason to use it more, compared with 21.2% in the youngest category. There are also marked age differences for trust and for the notion that using the internet takes too much time.

Reasons	50–64 yr	65–79 yr	80+ yr
I have no reason to use it more	21.2% (19.3–23.1)	28.3% (26.7–29.9)	37.7% (33.9–41.5)
My IT skills are not good enough	12.6% (10.9–14.3)	23.6% (22.1–25.0)	43.1% (39.7–46.5)
I don't trust the internet	11.7% (10.0–13.3)	21.3% (19.9–22.7)	24.9% (21.7–28.2)
It takes too much time	3.3% (2.4–4.2)	5.0% (4.2–5.8)	9.4% (7.5–11.3)
I don't have access to good enough equipment	1.33% (0.8–1.9)	1.6% (1.1–2.1)	3.0% (1.9–4.1)
I don't have good enough access to broadband	1.8% (1.2–2.4)	1.7% (1.2–2.2)	2.3% (1.1–3.5)
My vision is not good enough	0.5% (0.1–1.0)	0.9% (0.5–1.3)	3.9% (3.0–4.8)
My health problems (not including vision) stop me	0.5% (0.2–0.9)	0.6% (0.3–0.9)	1.6% (0.9–2.3)

Table 4. Sub-sample of participants in the regular user category: Reasons why they do not use the internet more. Percentages adjusted for sex and education with 95% CIs.

3.5 Conclusions so far

These ELSA analyses show marked age differences in digital activity, from 97.7% in the 50–64 yr group to 91.1% among those aged 65–79, and 65.7% in people aged 80 and older. Still, a sizeable proportion of people in their 80s and 90s are digitally active. Moreover, the reasons why people in the 80+ cohort did not use the internet more are not qualitatively different from the reasons people aged 50–64 or 65–79 did not use it more.

It appears that various factors are relevant to whether older people are digitally active or not, and to how much regular users engage with internet activities. The main factors associated with the age gradient in being digitally active are higher cognitive ability, greater educational attainment, and being in paid employment. Other demographic and social factors (wealth, sex, marital status, social isolation) and health and mobility issues are related to internet use but do not appear to account for age differences. Nor is the age gradient in digital activity linked to factors such as limited IT skills, lack of trust, or having poor connectivity. However, amongst regular users of the internet, several of these factors are associated with why people in the older categories are not online for a greater amount of time; these include lack of trust, poor IT skills, and not having good reasons to use the internet more.

It is important in the understanding of internet use among older people to distinguish between i) whether or not people are digitally active at all and ii) how much those people who are active use the internet. The factors associated with these two issues are different.

4 DISCUSSION

4.1 Understanding differences in usage rates

Our analyses confirm an age-based digital divide, as evidenced in declining frequency of use of the internet as age increases. Differences between our three cohorts demonstrate the utility of cohort segmentation within HCI studies on ageing (cf. [63]), even with heterogeneity within any cohort. There were particularly pronounced differences between those above and below 80 yr—certainly more so than those above and below 65 yr—which is consistent with findings from Hargittai, Piper and Morris' [34] study of autonomy of use. This raises a question of the usefulness of defining older adults as 65+, as standard in HCI [43]; but at least suggests a need of more research exploring how those 80+

interact with computers, despite the noted challenges of recruiting within this cohort [58]. It also may also signal an opportunity to conduct age-period-cohort analyses to better understand how the technological implications of being 'older' are changing, and whether 'old age' (at least in terms of what concerns HCI) is shifting older. Indeed, the gaps between the 50–64 and 65–79 groups were quite small, compared to the much larger gap between these groups and the 80+ group, and the age gradient was only negligibly reduced by accounting for factors typically used to explain age-based declines in technology use. Taken together, these findings are suggestive of something beyond these factors that is driving the age gradient. We speculate this may represent a cohort effect, wherein it is not ageing as a process but rather age at introduction of technology and uptake among one's cohort (peer group) that shapes technology use in older adulthood (cf. [63]). In other words, encountering the internet for the first time in one's 20's, for example, and seeing its widespread uptake among peers may produce a fundamentally different experience of and view towards the internet than experiencing it for the first time in one's 40's and seeing it only used intermittently and for specific, work-related functions.

Daily use of the internet was found to be dramatically higher than UK figures from two decades ago [54] and higher than figures reported by the Office for National Statistics (ONS) in 2020 [65]. Whereas ONS found that 54% of UK adults 75+ used the internet within the last 3 months, we found (albeit looking at England only and splitting our age brackets differently) that 65.6% of those 80+ used the internet at least monthly and 91.2% of 65–79-year-olds used the internet at least monthly. This could be an indication that the pandemic itself necessitated greater engagement; however, this is not supported by the ELSA data itself, which showed no increase in daily internet use between the wave directly preceding the pandemic and the wave collected June/July 2020 [47]. It is possible, then, that the disparity is due either to regional differences within the UK, or differences in interpretations of 'the internet' and thus different prompting within the ELSA and ONS surveys. Actual use of internet might have been under-reported in both datasets if the respondent didn't understand the tools they use to be 'the internet' (though, indeed, there may not be consensus within HCI on what counts as 'the internet'). People of all age groups are prone to misunderstanding what 'the internet' means [66, p. 27] and are frequently unaware that they are using the internet (e.g. thinking of WhatsApp as the same as phone texting, thinking of streaming as the same as watching TV) [28], which may mean that use is indeed higher than Table 1 suggests, and possibly higher still if low cognitive performance contributes to this confusion.

4.2 Implications for policy interventions to address the age-based digital divide

Our analysis also enables us to comment on the kinds of interventions that might effect greater use of the internet by older adults. Commonly understood barriers to use of digital technology[13] include: "a lack of **motivation** or perceived need for them; a lack of **trust** in digital technologies and the internet (for example, fear of fraud or identity theft); a lack of support with learning digital **skills**; and lack of **access** to the required devices and internet connectivity" [61, emphasis added for clarity]. To what extent are these barriers endorsed by older adults in the ELSA dataset?

Amongst rare users—i.e. those ostensibly experiencing "digital poverty and/or "digital poverty" and/or "digital exclusion" [1]—lack of **access** was an infrequent reason. In fact, lack of access is a much more common reason for internet non-use amongst the general population than it is for the older adults in ELSA [37]. Provision of broadband/data and internet connected devices should be available for older adults who do face access issues in being able to use the internet more, as with any other age group experiencing digital exclusion; but these interventions would not in themselves mitigate the age-based digital divide. In short, and consistent with [36], the 'first-level digital divide' [9]

[13]While our analysis focuses specifically on internet use, there is very significant overlap in "digital technologies" and internet connected technologies; and the policy literature we cite will often report on these together, i.e. "digital technologies and the internet" [61].

between those with and without access to the internet is not especially salient to the phenomenon of the age-based digital divide.

Lack of IT **skills**, on the other hand, is the most common reason for not using the internet more (or at all). Therefore, interventions to promote IT skills would seem promising for increasing internet use for a greater proportion of older adults not using the internet—even if this factor would appear not to pertain to age or ageing specifically (i.e. it does not explain the age gradient in our analyses, so the age-based digital divide is also not simply a version of the 'second-level digital divide' [9, 35]). It is interesting, though, that the reason *My IT skills are not good enough* was only cited by 23.4% of the participants surveyed through the ELSA (higher for rare than regular users), given that only 68% of UK adults 75+ have what are considered "Essential Digital Skills for Life" and 51% achieve Foundation Level digital skills [5]. This is especially surprising given older adults' lower digital confidence [5] (see also: [76]), which if anything, should mean they are likely to have an overly negative view of their own IT skills, rather than this seemingly more positive view. This raises a question about the different needs of people who have low skills but label them high (overconfident), high skills but label them low (underconfident), and those who accurately perceive low skills. Presumably the latter two groups would be most likely to take up various upskilling efforts, while the first group might be most vulnerable to scams and other online harms, but this deserves empirical study.

Perhaps the disparity regarding low IT skills is explained by having asked about why they do not use the internet *more*, which undoubtedly interacts with what the policy literature often terms lack of **motivation**. It is striking that while other polls have found that 14% of UK adults who are offline completely attribute this to lack of "interest" [5], older adult rare users participating in ELSA (again, in England only) are much more likely to state that they have no reason to use it more (50+=20.2%–24.8%, not differing greatly by cohort). This could indicate a lack of perceived benefit in using the internet by older adults, signifying a 'third-level digital divide' in beneficial outcomes of internet use [9, 77] (see also: [46]). It could, on the other hand, demonstrate a tendency toward voluntary disengagement from technology in later life—perhaps a reprioritisation in how one spends one's time, or growing disconnect between one's own values and that represented in technology [7]. At the very least, these findings should prompt reflection on the normative implications of any framing that presumes older adults are not using the internet *enough*, as opposed to younger people using it too much [52].

Our results show that many older adults report a lack of **trust** in the internet (18.6% of the total sample) as a reason for not using the internet more, but that this, too, is not a phenomenon of age in itself. In the case of those who rarely use the internet, not trusting was cited nearly twice as often for 50–64yr than 80+yr, though the pattern reverses for regular users. Other studies that have shown a robust age gradient in trust (albeit in data practices) [22, 69] have not differentiated between rare and regular users (i.e. those with more or less knowledge). This underscores the complexity of trust: that it involves a constellation of factors [71], and that distilling it down to a single survey question may lead to oversimplification of its relationship to age. As a case in point, Kennedy et al. found in reviewing multiple studies of trust in data and data technologies that "There are inconsistencies around how levels of trust vary by age, with young people being estimated as both the most and least trusting, depending on the measure being used" [42]. Clearly more work is needed to disentangle multiple trust factors to determine which, if any, explain the age gradient in using the internet and which do not. One that would seem especially important to explore is how trust in the internet interacts with concerns about cognitive ability and/or internalised negative stereotypes about older adults' technological competence [15, 43, 64]—whether "I don't trust the internet" was sometimes selected to express "I don't trust *myself* with the internet."

What we can't say at this point is whether self-assessed lack of IT skills is more often independent of or co-occurring with having no reason to use the internet more—in other words, whether lack of skills is a true barrier to realising a desired use of the internet versus compounding low motivation (if there is an expected learning curve with little pay-off for this investment). The same can be said of the impact of low trust; and of not having access to good enough devices. There is reason to suspect, however, that these are all interconnected [58], i.e. lack of a reason to use the internet reduces interest in developing IT skills and purchasing expensive devices [28]. We note in support of this interpretation that older adults are demonstrably capable of learning to use IT when a clear benefit or genuine need arises [13, 30, 44]. We propose, therefore, that addressing IT skills gaps may not unlock internet use for digitally excluded older adults, so much as partially disinhibiting interest in using the internet. We stress, however, that having no reason to use the internet more was strongly endorsed by both rare and regular uses of the internet, so researchers and policymakers should be careful not to assume that inequality of outcome (in terms of frequency of internet use) is experienced by older adults as an inequity. In short, they may not be looking for any assistance with getting online more.

4.3 Implications for HCI: separating ageing and accessibility

Our results also indicate that physical impairments pose a more significant barrier to internet use for younger people (50–64yr) than older. This is surprising given that ageing generally increases the chances of having multiple impairments, which Lloyds' analyses [6] found to correlate with lower internet use.

There are at least two interpretations of our results. The first is that having impairments may motivate greater use of the internet in cases where the internet enables a person to overcome the impairment (e.g. streaming services reducing a person's need to physically travel, e-readers and audio books allowing those with impaired vision to consume books). Perhaps the types of physical impairments that become more likely with advanced age pose less of an accessibility challenge than ones that people are more likely to experience earlier in life or from birth. Or perhaps if physical health declines slowly enough (as with ageing, as opposed to, e.g., serious injury), people adjust by turning to the internet in various ways.

The other interpretation, the one we think better fits the data, is that acquiring a physical impairment is less consequential to internet use if interest in using it is already waning. So while Mostaghel & Oghazi's [56] find that health problems are a leading reason why older people withdraw from technology they once used, disengagement may have less to do with the impairment making internet use infeasible than these health problems catalysing more profound changes in priorities and/or practices. This suggests that care should be taken to tease apart whether and how non-use and disengagement are differently motivated.

Clearly further study is needed to understand the relationship between age, impairment, and frequency of internet use. For now, our analyses (i) provide strong empirical support for the proposition that old age is not disabling *per se* [46], and (ii) underscore the need for HCI to move beyond focusing on age-related decline [73] to embrace understandings of more agentic forms of technology non-use [59].

4.4 Other factors and their implications

But what to do with the finding of low educational attainment and not being in employed work being salient to the *age-based* digital divide? The latter, we think, should inspire more HCI research into the complex ways retirement may affect internet use (cf. [24]). We note that employment status may have nothing to do with age, or it can be linked with whether a person is retired, in which case it relates to the age dimension Life Stage and the measure 'stage in life transition' [43]. But are we simply seeing an effect of many more older adults no longer in employment, or is there

something in particular about retirement that matters particularly to internet use? And if retirement is special somehow, is it changes in finances, the end of on-the-job training, the removal of a financial reason to stay on top of one's tech skills, or something about changes in social networks or daily routines that matters to disengagement in retired life? We also note that being in the position to retire can be a marker of social class privilege, so exploring age at retirement may be an important direction for future research.

As for the importance of low educational attainment, however, this may indicate a cumulative effect, i.e. that "Ageing provides time for…the inequalities found to be risk factors for digital exclusion at any age to amplify to significance" [43]. This is further supported by related findings that higher education and higher socioeconomic status correlate with better internet skills and greater autonomy of use, but that when controlling for these factors age differences disappear [36]. In other words, what might be playing out is a growing divide between those accumulating or decumulating certain key resources over time, with some reaching older adulthood significantly disadvantaged in terms of their ability to use the internet. If this is the case, it suggests that the way to mitigate the age-based digital divide is to intervene earlier, with dedicated programmes to support the development of technology skills amongst those with low levels of education, as well as lower socioeconomic status.

Our findings could also be seen as highlighting important, but largely neglected, generation/cohort effects [43]—in particular, it would seem, how changing norms in educational attainment contribute to the phenomenon of the age-based digital divide. More generally, these analyses underscore the need for HCI and Ageing research to more critically engage with lifecourse [73].

5 LIMITATIONS

Our study has several strengths. We use nationally representative data with a wealth of well-validated measures to capture the sociodemographic, physical, and mental characteristics of older adults in England. We provide empirical tests for several often hypothesised factors driving older adults' non-/use of technology. Nonetheless, like all observational studies, our study has several limitations.

First, while the ELSA data are longitudinal, our analysis is restricted to Wave 10 only due to variation in the availability of specific variables of interest (such as the internet use module) across rounds. We therefore highlight that our findings are correlational, not causal. For instance, it is possible that people experiencing depression use the internet less, but also possible that some content on the internet could prompt or exacerbate depression, leading to withdrawal from activities, including those online. Without a longitudinal examination of such factors, we cannot make any causal claims.

Second, ELSA samples older adults living in the community; barriers to internet use may be different for adults living in assisted living, nursing, or other institutional settings. In particular, such individuals may have selected into institutional settings due to the kinds of physical and cognitive challenges that might also be expected to present a barrier to internet use. The results we presented here may differ substantially were the study repeated among older adults in institutional care facilities.

Third, as noted in preceding sections, there may be important variation in how people understand the ELSA questions themselves (e.g. what counts as 'using the internet'). Moreover, frequency of internet use as a four category scale is inherently subjective. What one person may categorise as frequent use, another may categorise as rare. It is not improbable that users who, for example, used the internet regularly for work or to connect with family and friends living far away would give different responses on these questions as compared to people who did not have these experiences for what would be categorised by an outside observer as the *same actual use*.

6 FUTURE WORK

Surveys such as ELSA provide robust population-based evidence about internet use among large samples of older men and women. The results summarised here come from more than 6,000 individuals who are broadly representative of the older population of England. Because the data were collected with face-to-face interviews, the study includes people with limited or no access to the internet as well as regular users. However, the measures used in the survey are short and summary in nature, and do not provide a nuanced understanding of the factors underpinning internet use at the individual level. Complementary in depth qualitative assessments are therefore very valuable in this context; as are complementary surveys which allow respondents to select sub-reasons for not using the internet more (e.g. whether they don't trust the internet because of fears about fraud or identity theft [55], concerns about privacy [10, 14], or concerns about their own ability to assess the trustworthiness of information [6]).

ELSA participants were asked about their own frequency of use and reasons for not using it more. This presents an interesting opportunity for a complementary survey to empirically test the tendency of older adults to distance themselves from "other older adults" [64], e.g. if the predictions about use and reasons of "older adults" by people aged 50+ diverge greatly from those given by older adults in ELSA. Further comparison with predictions of younger adults would be one way of empirically testing the theory that younger adults, in particular, do not understand the abilities and needs of older adults [63].

There may be other factors not captured in ELSA that are more useful for understanding the enduring predictiveness of age in digital exclusion [29, 40]. Clearly further research is warranted regarding the influence of other dimensions of ageing on internet use, which may include, e.g., age identity [41], psychological age (e.g. emotional maturity, wisdom) [7, 45], social age [39] and structural ageism [23, 49, 67], structural pressures [59] and cumulative disadvantage [21]. Moreover, the ELSA measures are focused on frequency of use and broad reasons for not using the internet. However, it is possible that many more frequent internet users share concerns about e.g. IT skills and equipment, but persist despite these concerns because of a strong pull. For example, some frequent users may worry about IT skills, but use the internet frequently because their family lives remotely and they have no other means of regular communication. Understanding not only reasons for not using the internet, but also reasons for using it frequently, could provide further insights into the gradient in internet use.

While our study provides insights into which dimensions of age seem to matter most to non-use, it does not show how resources accumulate or decumulate over time for any given individual or groups of individuals of a similar social gradient or category [43]. In other words, we do not know the life histories of the individuals in the ELSA data and how their particular histories of using technology over time have shaped their current internet use behaviours. Longitudinal models which track technology use in different contexts (e.g. at home, at work) and opportunities for building skills and confidence with technology from a much earlier stage in the lifecourse could help to identify how earlier experiences shape current (non-)use.

Finally, our analyses focused on internet use because this is what ELSA asked about. But as AI becomes increasingly pervasive within digital tools (even internet search), and new AI solutions are not only entering the home but are being marketed to older adults, it is worth doing similar studies of older adults' use of AI and reasons for not using it more. We suspect the relationship to our findings about internet use will not be straightforward, the internet being familiar and fairly uncontroversial by comparison. The findings from our study suggest that older adults who have positive attitudes towards internet use are more likely to be accepting, recognising the perceived benefits of using AI. Moreover, older adults who have already expressed scepticism towards the internet may be less likely to see the value of using AI.

It is certainly possible, however, that there is a much stronger age gradient in use of AI; but equally, if older adults are finding AI useful or exciting in ways that the internet itself is not, this may create greater interest in using AI through later life. An initial study in the US [11], conducted in 2025 and polling adults over the age of 50, has shown a complex picture is emerging, where some are happy to use AI for a variety of activities (e.g. talking to Alexa, finding out about health information) while others are wary and don't trust it. However, as the study polled only those over 50, it is not clear how and whether those in their 50s have different perceptions and experiences than those who are in their, 60s, or 70s, or 80s and above.

7 CONCLUSION

We explored factors that might explain why there is an age gradient in digital activity among older people through analysis of data collected from 6,373 participants in the English Longitudinal Study of Ageing. We found that regular internet activity decreased with age from 97.7% in respondents aged 50–64 to 91.1% in the 65–79 range, and 65.7% in those aged 80 and older. Given that 65–79-year-olds were much more similar to 50–64-year-olds than those that are 80+, this suggests that HCI may be perpetuating a false distinction between people above and below 65 and that a more useful chronological definition of 'older adult' for HCI may (now) be 80+. A more complex series of analyses could yield a more precise age at which this gradient appears to dramatically steepen to inform a more specific chronological definition of 'older adults' (say, 78+); though we caution that this might lead to further reliance on the poor proxy of chronology above other relevant dimensions/measures of age [43] and exacerbate the tendency to homogenise people on the basis of socially constructed categories [23, 49, 50, 63].

Our study empirically refutes the common assumption in HCI that functional decline is the primary reason for technology non-use among older adults, and instead highlights cognitive ability, employment status, and education as more influential factors. While there is a drop off in use of the internet as people age, this is not necessarily due to factors typically associated with the physical processes of ageing. Those experiencing cognitive impairment—which can happen at any age but is more common later in life—do use the internet less; but similarly important for understanding the age-based digital divide are lower education (as age increases, rates of educational attainment goes down) and not being in paid employment (likelihood of retirement increases sharply after age 65 in the UK, though this is no longer the default retirement age). Amongst regular users of the internet, issues such as IT skills, trust, and not having reasons to use the internet more, were relevant to the age gradient. This findings suggest that it is important to the understanding of internet use among older people to distinguish between whether or not people are digitally active at all, and how much those people who are active use the internet. The factors associated with these two issues are different.

Reasons given for not using the internet more indicate a lack of interest in using the internet beyond current rates. It is important to provide assistance to individuals facing barriers to using the internet and wanting to use it more; but this does not appear to be the case for the vast majority of older adults, even those who are not using the internet at all. Our findings indicate that, for the most part, non-use is an expression of personal preference in older age—in which case HCI research on ageing ought to be exploring how technology design can support this choice.

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REFERENCES

[1] Kira Allmann. 2022. UK digital poverty evidence review 2022. *London: Digital Poverty Alliance* (2022).

[2] Paul B Baltes and Jacqui Smith. 2003. New frontiers in the future of aging: From successful aging of the young old to the dilemmas of the fourth age. *Gerontology* 49, 2 (2003), 123–135.

[3] Lloyds Bank. 2022. 2022 Digital Consumer Index. https://www.lloydsbank.com/assets/media/pdfs/banking_with_us/whats-happening/221103-lloyds-consumer-digital-index-2022-report.pdf.

[4] Lloyds Bank. 2022. Essential Digital Skills data tables. https://www.lloydsbank.com/banking-with-us/whats-happening/consumer-digital-index/essential-digital-skills.html.

[5] Lloyds Bank. 2023. 2023 Consumer Digital Index. https://www.lloydsbank.com/assets/media/pdfs/banking_with_us/whats-happening/231122-lloyds-consumer-digital-index-2023-report.pdf.

[6] Lloyds Bank. 2024. 2024 Consumer Digital Index. https://www.lloydsbank.com/assets/media/pdfs/banking_with_us/whats-happening/lb-consumer-digital-index-2024-report.pdf.

[7] Belén Barros Pena, Rachel E Clarke, Lars Erik Holmquist, and John Vines. 2021. Circumspect Users: Older Adults as Critical Adopters and Resistors of Technology. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 84, 14 pages. https://doi.org/10.1145/3411764.3445128

[8] Togtokhtur Batbold, Alessandro Soro, and Ronald Schroeter. 2024. Mentorable Interfaces for Automated Vehicles: A New Paradigm for Designing Learnable Technology for Older Adults. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (Honolulu, Hawaii, USA) *(CHI '24)*. Association for Computing Machinery, New York, NY, USA, Article 463, 15 pages. https://doi.org/10.1145/3613904.3642390

[9] Annika Bergström. 2023. Internet perceptions among older adults in Sweden. *Frontiers in Human Dynamics* 5 (2023), 1250008.

[10] Grant Blank, William H Dutton, and Julia Lefkowitz. 2019. Perceived threats to privacy online: The internet in britain, the oxford internet survey, 2019. (2019).

[11] Robin N Brewer. 2025. How Older Adults Use and Think About AI. https://www.healthyagingpoll.org/reports-more/report/how-older-adults-use-and-think-about-ai.

[12] Robin N. Brewer, Leah Findlater, Joseph 'Jofish' Kaye, Walter Lasecki, Cosmin Munteanu, and Astrid Weber. 2018. Accessible Voice Interfaces. In *Companion of the 2018 ACM Conference on Computer Supported Cooperative Work and Social Computing* (Jersey City, NJ, USA) *(CSCW '18 Companion)*. Association for Computing Machinery, New York, NY, USA, 441–446. https://doi.org/10.1145/3272973.3273006

[13] Tim Broady, Amy Chan, and Peter Caputi. 2010. Comparison of older and younger adults' attitudes towards and abilities with computers: Implications for training and learning. *British Journal of Educational Technology* 41, 3 (2010), 473–485.

[14] Kelly E Caine, Arthur D Fisk, and Wendy A Rogers. 2006. Benefits and privacy concerns of a home equipped with a visual sensing system: A perspective from older adults. In *Proceedings of the human factors and ergonomics society annual meeting*, Vol. 50. SAGE Publications Sage CA: Los Angeles, CA, 180–184.

[15] Clara Caldeira, Novia Nurain, and Kay Connelly. 2022. "I hope I never need one": Unpacking Stigma in Aging in Place Technology. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, Louisiana, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 264, 12 pages. https://doi.org/10.1145/3491102.3517586

[16] Pew Research Center. 2022. 3. Internet, smartphone and social media use. https://www.pewresearch.org/global/2022/12/06/internet-smartphone-and-social-media-use-in-advanced-economies-2022/.

[17] Pew Research Center. 2024. Internet, Broadband Fact Sheet. https://www.pewresearch.org/internet/fact-sheet/internet-broadband/.

[18] Sara J Czaja. 2006. Technology and older adults: designing for accessibility and usability. In *Proceedings of the 8th International ACM SIGACCESS Conference on Computers and Accessibility*. 1–1.

[19] Sara J Czaja. 2017. The potential role of technology in supporting older adults. *Public Policy & Aging Report* 27, 2 (2017), 44–48.

[20] Sara J Czaja, Neil Charness, Arthur D Fisk, Christopher Hertzog, Sankaran N Nair, Wendy A Rogers, and Joseph Sharit. 2006. Factors predicting the use of technology: findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). *Psychology and aging* 21, 2 (2006), 333.

[21] Dale Dannefer. 2003. Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 58, 6 (2003), S327–S337.

[22] Doteveryone. 2018. People, power and technology: The 2018 digital attitudes report. https://www.understanding.doteveryone.org.uk.

[23] Jeannette Durick, Toni Robertson, Margot Brereton, Frank Vetere, and Bjorn Nansen. 2013. Dispelling ageing myths in technology design. In *Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration* (Adelaide, Australia) *(OzCHI '13)*. Association for Computing Machinery, New York, NY, USA, 467–476. https://doi.org/10.1145/2541016.2541040

[24] Abigail Durrant, David Kirk, Diego Trujillo Pisanty, Wendy Moncur, Kathryn Orzech, Tom Schofield, Chris Elsden, David Chatting, and Andrew Monk. 2017. Transitions in Digital Personhood: Online Activity in Early Retirement. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. Association for Computing Machinery, New York, NY, USA, 6398–6411. https://doi.org/10.1145/3025453.3025913

[25] Virginia E Eubanks. 2007. Trapped in the digital divide: The distributive paradigm in community informatics. *The Journal of Community Informatics* 3, 2 (2007).

[26] Rebecca Eynon and Ellen Helsper. 2011. Adults learning online: Digital choice and/or digital exclusion? *New media & society* 13, 4 (2011), 534–551.

[27] Office for National Statistics. 2021. Internet users, UK: 2020. https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/bulletins/internetusers/2020.

[28] Tom French, Lauren Quinn, and Simeon Yates. 2019. Digital Motivation: Exploring the reasons people are offline. https://storage.googleapis.com/scvo-cms/sites/default/files/digital_motivations_final_0.pdf.

[29] Thomas N Friemel. 2016. The digital divide has grown old: Determinants of a digital divide among seniors. *New media & society* 18, 2 (2016), 313–331.

[30] Lorna Gibson, Paula Forbes, and Vicki Hanson. 2010. What can the 'ash cloud' tell us about older adults' technology adoption. In *Proceedings of the 12th International ACM SIGACCESS Conference on Computers and Accessibility* (Orlando, Florida, USA) *(ASSETS '10)*. Association for Computing Machinery, New York, NY, USA, 301–302. https://doi.org/10.1145/1878803.1878881

[31] UK Government. 2018. Guidance: Essential digital skills framework. https://www.gov.uk/government/publications/essential-digital-skills-framework.

[32] UK Government. 2023. 2. Digital skills and inclusion - giving everyone access to the digital skills they need. https://www.gov.uk/government/publications/uk-digital-strategy/2-digital-skills-and-inclusion-giving-everyone-access-to-the-digital-skills-they-need.

[33] Vicki L Hanson. 2010. Influencing technology adoption by older adults. *Interacting with computers* 22, 6 (2010), 502–509.

[34] Eszter Hargittai. 2001. Second-level digital divide: Mapping differences in people's online skills. *arXiv preprint cs/0109068* (2001).

[35] Eszter Hargittai. 2002. Second-Level Digital Divide: Differences in People's Online Skills. *First Monday* 7, 4 (Apr. 2002). https://doi.org/10.5210/fm.v7i4.942

[36] Eszter Hargittai, Anne Marie Piper, and Meredith Ringel Morris. 2019. From internet access to internet skills: digital inequality among older adults. *Universal access in the information society* 18, 4 (2019), 881–890.

[37] Ellen J Helsper and Bianca C Reisdorf. 2013. A quantitative examination of explanations for reasons for internet nonuse. *Cyberpsychology, behavior, and social networking* 16, 2 (2013), 94–99.

[38] Michael Heron, Vicki L Hanson, and Ian W Ricketts. 2013. Accessibility support for older adults with the ACCESS framework. *International Journal of Human-Computer Interaction* 29, 11 (2013), 702–716.

[39] Nancy R Hooyman and H Asuman Kiyak. 2008. *Social gerontology: A multidisciplinary perspective*. Pearson Education.

[40] Communications House of Lords and Digital Committee. 2023. Digital Exclusion. https://publications.parliament.uk/pa/ld5803/ldselect/ldcomm/219/219.pdf.

[41] R. Kastenbaum, V. Derbin, P. Sabatini, and S. Artt. 1972. The Ages of Me: Toward Personal and Interpersonal Definitions of Functional Aging. *Aging and Human Development* 3, 2 (1972), 197–211. https://doi.org/10.2190/TUJR-WTXK-866Q-8QU7

[42] Helen Kennedy, Susan Oman, Mark Taylor, Jo Bates, and Robin Steedman. 2021. Public understanding and perceptions of data practices: A review of existing research. (2021).

[43] Bran Knowles, Jasmine Fledderjohann, Aneesha Singh, Richard Harper, Julia McDowell, Judith Tsouvalis, Alice Ashcroft, Yvonne Rogers, Ewan Soubutts, Andrew Steptoe, et al. 2025. Not just a number: a multidimensional approach to ageing in HCI. *Interacting with Computers* (2025), iwaf050.

[44] Bran Knowles and Vicki L Hanson. 2018. Older adults' deployment of 'distrust'. *ACM Transactions on Computer-Human Interaction (TOCHI)* 25, 4 (2018), 1–25.

[45] Bran Knowles and Vicki L Hanson. 2018. The wisdom of older technology (non) users. *Commun. ACM* 61, 3 (2018), 72–77.

[46] Bran Knowles, Vicki L Hanson, Yvonne Rogers, Anne Marie Piper, Jenny Waycott, Nigel Davies, Aloha Hufana Ambe, Robin N Brewer, Debaleena Chattopadhyay, Marianne Dee, et al. 2021. The harm in conflating aging with accessibility. *Commun. ACM* 64, 7 (2021), 66–71.

[47] Claryn SJ Kung and Andrew Steptoe. 2023. Changes in Internet use patterns among older adults in England from before to after the outbreak of the COVID-19 pandemic. *Scientific Reports* 13, 1 (2023), 3932.

[48] Amanda Lazar, Robin N Brewer, Bran Knowles, et al. 2025. HCI and Older Adults: The Critical Turn and What Comes Next. *Foundations and Trends® in Human-Computer Interaction* 19, 2 (2025), 112–212.

[49] Amanda Lazar, Mark Diaz, Robin Brewer, Chelsea Kim, and Anne Marie Piper. 2017. Going Gray, Failure to Hire, and the Ick Factor: Analyzing How Older Bloggers Talk about Ageism. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing* (Portland, Oregon, USA) *(CSCW '17)*. Association for Computing Machinery, New York, NY, USA, 655–668. https://doi.org/10.1145/2998181.2998275

[50] Ann Light, Sonja Pedell, Toni Robertson, Jenny Waycott, Jeanette Bell, Jeannette Durick, and Tuck Wah Leong. 2016. What's Special About Aging. *Interactions* 23, 2 (feb 2016), 66–69. https://doi.org/10.1145/2886011

[51] DY Lin, TR Fleming, and V De Gruttola. 1997. Estimating the proportion of treatment effect explained by a surrogate marker. *Statistics in medicine* 16, 13 (1997), 1515–1527.

[52] Ilse Mariën and Jernej A. Prodnik. 2014. Digital inclusion and user (dis) empowerment: A critical perspective. *info* 16, 6 (2014), 35–47.

[53] Michael Marmot, James Banks, Richard Blundell, Carli Lessof, and James Nazroo. 2003. Health, wealth and lifestyles of the older population in England. *London: Institute of Fiscal Studies* (2003).

[54] Peter Millward. 2003. The'grey digital divide': Perception, exclusion and barriers of access to the Internet for older people. *First monday* (2003).

[55] Tracy L Mitzner, Julie B Boron, Cara Bailey Fausset, Anne E Adams, Neil Charness, Sara J Czaja, Katinka Dijkstra, Arthur D Fisk, Wendy A Rogers, and Joseph Sharit. 2010. Older adults talk technology: Technology usage and attitudes. *Computers in human behavior* 26, 6 (2010), 1710–1721.

[56] Rana Mostaghel and Pejvak Oghazi. 2017. Elderly and technology tools: a fuzzyset qualitative comparative analysis. *Quality & quantity* 51, 5 (2017), 1969–1982.

[57] Bárbara Barbosa Neves and Fausto Amaro. 2012. Too old for technology? How the elderly of Lisbon use and perceive ICT. *The journal of community informatics* 8, 1 (2012).

[58] Barbara Barbosa Neves, Rachel L. Franz, Cosmin Munteanu, Ronald Baecker, and Mags Ngo. 2015. "My Hand Doesn't Listen to Me!": Adoption and Evaluation of a Communication Technology for the 'Oldest Old'. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (Seoul, Republic of Korea) *(CHI '15)*. Association for Computing Machinery, New York, NY, USA, 1593–1602. https://doi.org/10.1145/2702123.2702430

[59] Barbara Barbosa Neves, Jenny Waycott, and Sue Malta. 2018. Old and afraid of new communication technologies? Reconceptualising and contesting the 'age-based digital divide'. *Journal of Sociology* 54, 2 (2018), 236–248.

[60] OECD. 2020. Digital Transformation in the Age of COVID-19: Building Resilience and Bridging Divides. https://img.lalr.co/cms/2020/11/27173400/digital-economy-outlook-covid.pdf.

[61] Parliamentary Office of Science and Technology. 2021. Developing essential digital skills. *POSTNOTE* 643 (2021), 1–6.

[62] Ofcom. 2023. Adults' Media Use and Attitudes report 2023. https://www.ofcom.org.uk/siteassets/resources/documents/research-and-data/media-literacy-research/adults/adults-media-use-and-attitudes-2023/adults-media-use-and-attitudes-report-2023.pdf.

[63] Helen Petrie. 2023. Talking 'bout My Generation … or Not? The Digital Technology Life Experiences of Older People. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI EA '23)*. Association for Computing Machinery, New York, NY, USA, Article 420, 9 pages. https://doi.org/10.1145/3544549.3582742

[64] Alisha Pradhan, Ben Jelen, Katie A. Siek, Joel Chan, and Amanda Lazar. 2020. Understanding Older Adults' Participation in Design Workshops. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, Hawaii, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–15. https://doi.org/10.1145/3313831.3376299

[65] Cecil Prescott. 2021. Internet users, UK: 2020. *Internet use in the UK* (2021).

[66] James Richardson. 2019. I am connected: New approaches to supporting people in later life online. The Centre for Ageing Better and Good Things Foundation, https://www.housinglin.org.uk/_assets/Resources/Housing/OtherOrganisation/I-am-connected-new-approaches-to-supporting-people-in-later-life-get-online-research-report.pdf.

[67] Andrea Rosales and Mireia Fernández-Ardèvol. 2019. Structural ageism in big data approaches. *Nordicom Review* 40, s1 (2019), 51–64.

[68] Neil Selwyn. 2004. The information aged: A qualitative study of older adults' use of information and communications technology. *Journal of Aging studies* 18, 4 (2004), 369–384.

[69] Royal Statistical Society. 2014. Royal Statistical Society research on trust in data and attitudes toward data use / data sharing. https://www.statslife.org.uk/images/pdf/rss-data-trust-data-sharing-attitudes-research-note.pdf.

[70] Statista. 2024. Share of individuals using the internet in the United Kingdom (UK) from 2002 to 2024. https://www.statista.com/statistics/1124328/internet-penetration-uk/.

[71] Robin Steedman, Helen Kennedy, and Rhianne Jones. 2020. Complex ecologies of trust in data practices and data-driven systems. *Information, Communication & Society* 23, 6 (2020), 817–832.

[72] Andrew Steptoe, Elizabeth Breeze, James Banks, and James Nazroo. 2013. Cohort profile: the English longitudinal study of ageing. *International journal of epidemiology* 42, 6 (2013), 1640–1648.

[73] John Vines, Gary Pritchard, Peter Wright, Patrick Olivier, and Katie Brittain. 2015. An Age-Old Problem: Examining the Discourses of Ageing in HCI and Strategies for Future Research. *ACM Trans. Comput.-Hum. Interact.* 22, 1, Article 2 (feb 2015), 27 pages. https://doi.org/10.1145/2696867

[74] Ioannis Vrettos, Fotios Anagnostopoulos, Panagiota Voukelatou, Andreas Kyvetos, Despoina Theotoka, and Dimitris Niakas. 2024. Does old age comprise distinct subphases? Evidence from an analysis of the relationship between age and activities of daily living, comorbidities, and geriatric syndromes. *Annals of geriatric medicine and research* 28, 1 (2024), 65.

[75] Kerryellen G Vroman, Sajay Arthanat, and Catherine Lysack. 2015. "Who over 65 is online?" Older adults' dispositions toward information communication technology. *Computers in Human Behavior* 43 (2015), 156–166.

[76] Jenny Waycott, Frank Vetere, Sonja Pedell, Amee Morgans, Elizabeth Ozanne, and Lars Kulik. 2016. Not for me: Older adults choosing not to participate in a social isolation intervention. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. 745–757.

[77] Kwok-Kee Wei, Hock-Hai Teo, Hock Chuan Chan, and Bernard CY Tan. 2011. Conceptualizing and testing a social cognitive model of the digital divide. *Information Systems Research* 22, 1 (2011), 170–187.

[78] Hyunwoo Yoon, Yuri Jang, Seoyoun Kim, Alycia Speasmaker, and Ilsung Nam. 2021. Trends in internet use among older adults in the United States, 2011–2016. *Journal of Applied Gerontology* 40, 5 (2021), 466–470.

[79] Ja Eun Yu and Debaleena Chattopadhyay. 2020. Supporting Older Adults in Locating Mobile Interface Features with Voice Input. In *Proceedings of the 22nd International ACM SIGACCESS Conference on Computers and Accessibility* (Virtual Event, Greece) *(ASSETS '20)*. Association for Computing Machinery, New York, NY, USA, Article 97, 4 pages. https://doi.org/10.1145/3373625.3418044

[80] CHI ZHANG, Jiayu Hou, and Hengyuan Zhang. 2025. Bridging the Silver–Digital Divide: How Digital Literacy Shapes Diverse Healthcare Utilisation among China's Older Adults—A Cross-Sectional Study in Seven Chinese Cities. *Frontiers in Public Health* 13 (2025), 1577231.

[81] Yixuan Zhang, Joseph D Gaggiano, Nutchanon Yongsatianchot, Nurul M Suhaimi, Miso Kim, Yifan Sun, Jacqueline Griffin, and Andrea G Parker. 2023. What do we mean when we talk about trust in social media? A systematic review. In *Proceedings of the 2023 CHI conference on human factors*

in computing systems. 1–22.

8 APPENDIX

Factor	50–64 yr % regular use	65–79 yr % regular use	80+ yr % regular use	Age gradient explained %
Age alone	97.7%	91.9%	65.7%	
Age + sex	97.8%	91.1%	65.7%	0%
Age + wealth	98.3%	96.9%	65.4%	0%
Age + education	96.9%	91.6%	68.4%	5.9%
Age + employment	96.0%	92.0%	67.6%	5.5%
Age + marital status	97.7%	91.9%	66.6%	1.8%
Age + general mobility impairment	97.1%	91.3%	66.9%	2.9%
Age + long term health conditions	97.2%	91.3%	66.5%	1.8%
Age + cognitive ability	96.6%	91.0%	69.8%	7.8%
Age + all factors	95.0%	90.2%	71.7%	16.3%

Table 5. Full analytic sample: Factors associated with the age gradient in internet use. Percentages adjusted for each of the factors listed.

Factor	50–64 yr Reference group	65–79 yr OR (95%CI)	80+ yr OR (95%CI)
Age alone	1	0.238 (0.176–0.322)	0.044 (0.032–0.060)
Age + sex	1	0.234 (0.173–0.316)	0.043 (0.032–0.059)
Age + wealth	1	0.195 (0.139–0.274)	0.038 (0.027–0.054)
Age + education	1	0.330 (0.243–0.499)	0.072 (0.052–0.099)
Age + employment	1	0.403 (0.290–0.561)	0.083 (0.059–0.118)
Age + marital status	1	0.230 (0.170–0.311)	0.048 (0.035–0.066)
Age + general mobility impairment	1	0.265 (0.196–0.359)	0.055 (0.040–0.075)
Age + long term health conditions	1	0.261 (0.193–0.354)	0.051 (0.038–0.070)
Age + cognitive ability	1	0.262 (0.193–0.356)	0.069 (0.050–0.095)
Age + all factors	1	0.332 (0.226– 0.487)	0.110 (0.073–0.166)

Table 6. Full analytic sample: Logistic regression results for for regular internet use (compared to rare use) by age alone, followed by models for various sociodemographic correlates.

Factor	50–64 yr % regular use	65–79 yr % regular use	80+ yr % regular use	Age gradient explained %
Age alone	97.7%	91.9%	65.7%	
Age + problems with manual dexterity	97.5%	91.2%	66.2%	1%
Age + problems with arm mobility	97.7%	91.1%	66.0%	0.4%
Age + poor hearing	97.4%	91.2%	66.4%	1.5%
Age + poor sight	97.5%	91.1%	66.5%	1.2%
Age + few close relationships	97.7%	91.1%	65.7%	0%
Age + social isolation	97.7%	88.5%	59.6%	0%
Age + depression	97.8%	91.2%	66.3%	0%
Age + loneliness	97.9%	91.4%	67.1%	0.5%
Age + subjective cognitive ability	97.8%	91.2%	66.0%	1%

Table 7. Full analytic sample: Other factors potentially associated with the age gradient in internet use. Percentages adjusted for each of the factors listed.

Factor	50–64 yr Reference group	65–79 yr OR (95%CI	80+ yr OR (95%CI
Age alone	1	0.238 (0.176–0.322)	0.044 (0.032–0.060)
Age + problems with manual dexterity	1	0.244 (0.181–0.330)	0.047 (0.034–0.064)
Age + problems with arm mobility	1	0.237 (0.176–0.320)	0.045 (0.033–0.062)
Age + poor hearing	1	0.246 (0.182–0.333)	0.049 (0.036–0.067)
Age + poor sight	1	0.240 (0.178–0.324)	0.047 (0.035–0.065)
Age + few close relationships	1	0.237 (0.175–0.320)	0.044 (0.032–0.060)
Age + social isolation	1	0.190 (0.129–0.279)	0.036 (0.024–0.054)
Age + depression	1	0.233 (0.172–0.315)	0.044 (0.032–0.060)
Age + loneliness	1	0.235 (0.173–0.319)	0.045 (0.033–0.062)
Age + subjective cognitive ability	1	0.239 (0.176–0.323)	0.047 (0.034-0.064)

Table 8. Full analytic sample: Other factors potentially associated with the age gradient in internet use. Statistical findings: Odds ratios (OR) and 95% confidence intervals for age, with 50-64yr category as the reference group.