An Age-Old Problem: Examining the Discourses of Ageing in HCI and Strategies for Future Research

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Ageing has become a significant area of interest in Human-Computer Interaction (HCI) in recent years. In this article we provide a critical analysis of 30 years of ageing research published across the ACM Special Interest Group on Computer-Human Interaction (SIGCHI) community. Discourse analysis of the content of 644 archival papers highlights how ageing is typically framed as a "problem" that can be managed by technology. We highlight how ageing is typically defined through an emphasis on the economic and societal impact of health and care needs of older people, concerns around socialisation as people age, and declines in abilities and associated reductions in performance when using technology. We draw from research within the fields of social and critical gerontology to highlight how these discourses in SIGCHI literature represent common stereotypes around old age that have also prevailed in the wider literature in gerontology. We conclude by proposing strategies for future research at the intersection of ageing and HCI.

Categories and Subject Descriptors: K.4.m [**Computers and Society**]: Miscellaneous

General Terms: Design, Human Factors

Additional Key Words and Phrases: Ageing, older people, social gerontology, critical reflection, discourse analysis

1. INTRODUCTION

It is well established that the World's population is ageing at its fastest rate since records began [World Health Organisation 2011]. As may be expected, ageing has subsequently become an important topic across many academic disciplines. Over the last decade funding organisations have issued frequent calls for projects to investigate the social, economic, and health concerns arising from a population that is getting older (e.g., EPSRC [2012] and the National Science Foundation in the United States [2011]). As ageing has emerged as a field of enquiry new disciplines have formed such as social gerontology [Holstein and Minkler 2007] and the cognitive neuroscience of ageing [Cabeza et al. 2005] where the investigation of human ageing is the primary phenomena of interest. There is a general agreement that ageing is a multifaceted

phenomenon, requiring a holistic response across both academic disciplines and society as a whole. Echoing this concern, over the last decade there has been a substantial growth in research papers and articles published at Human-Computer Interaction (HCI) venues that investigate the relationship between technologies and growing old. As of the end of 2012, 162 papers have been published in ACM SIGCHI venues that treat the relationship between ageing and technology as a primary concern since the inaugural CHI conference in 1982—80% of these were published since 2007.

HCI is an intrinsically human-centred discipline, and much of its legitimacy as a research enterprise comes from a focus on "the user" and the various challenges, problems, and concerns they face in their daily lives [Cooper and Bowers 1995]. Woolgar [1991] and Sharrock and Anderson [1994] have highlighted the myriad of ways that interdisciplinary HCI teams frame users (both envisaged and real) in response to insights about their needs, the capabilities of a technology, and wider organisational and infrastructural influences. As such, the act of designing a new technology is also an act of "configuring" the intended users [Woolgar 1991], constraining the ways they can interact with and appropriate a system, and vis-à-vis the notion of whom the user is and our knowledge about them acts as a way of bounding and constraining the space of design opportunities [Redström 2006]. As such, while defining the user of a new technology can be beneficial in characterising its use cases, it has been long argued that this comes with the danger that heterogeneous and multifaceted human beings are reductively portrayed only in relation to the systems they use and how they are allowed to use them [Bannon 1991].

In this article, inspired by these prior arguments, we ask whether the ways that ageing is framed, articulated, and understood as a research challenge in the field of HCI is restricting the way we design technology for older members of our society. In particular, we offer a critical analysis of how ageing is discussed within research publications across the ACM SIGCHI community. We address four broad research questions: (1) How prevalent is age-related research in HCI? (2) How are older people framed in research published at SIGCHI venues? (3) How does this shape how HCI designs technology for older people? (4) How could we research and design technology for ageing in the future?

Based upon discourse analysis of 644 ACM SIGCHI papers published over the last three decades, we argue that in HCI "older users" are often portrayed as people with a set of specific characteristics: they have a range of health concerns, they experience physical and cognitive decline, they are slow at performing with technology, and experience social isolation and a loss of independence. We "reconfigure the user" [Mackay et al. 2006] by drawing on arguments within the field of social gerontology in order to open up the conceptual space for exploring a more holistic view on what it means to age over the life course. In doing so, we do not aim to prescribe a new approach to designing new technologies for later life, but rather explore the ways that design can draw upon multiple disciplinary perspectives in the exploration of the "problem" of human ageing, and as a critically reflective exercise in rethinking the "older user" so as to open up new design spaces or opportunities for technology, system, and service innovation.

Our aim with this article is not to argue that past HCI research is inherently wrong or poor quality—indeed, we will highlight how the discourses of ageing in HCI are mostly a result of prevailing societal and cultural attitudes. Furthermore, the discourses expressed in research publications are typically responsive to the aims of the funding bodies and governmental agencies that have commissioned the research, which both explicitly and implicitly influence what is researched, how it is researched, and what problems it seeks to address. As with analogous debates within sustainable HCI (e.g., Brynjarsdottir et al. [2012] and Purpura et al. [2011]) we discuss the consequences this

has for interaction design for ageing and the impact this may have on those living with technologies in later life.

The remainder of the article is separated into five interrelated sections. First, to open our article we briefly introduce the history of gerontology and the emergence of social and critical gerontology as fields of research. As the most encompassing fields of studying human ageing over the last century, gerontology and its social and critical subfields provide useful insight for understanding some challenges HCI faces as ageing becomes an increasingly important topic of study. In particular, we highlight how the broader field of gerontology has been critiqued by scholars in critical gerontology for propagating negative societal attitudes towards older people. Second, we move on to detail our method for collecting and analysing age-related literature across the HCI community. Here, we discuss the prevalence of ageing as a topic of research across the SIGCHI community over the last 30 years, highlighting its growth in popularity as a topic of research and the publication venues where this growth has been particularly prominent. Third, we report on our discourse analysis of 644 articles and papers that represent 30 years of SIGCHI literature related to ageing. We identify four dominant discourses related to ageing that underpin the vast majority of work published within the SIGCHI community. Our key argument in this article is that the HCI research community has tended to render ageing as a "problem" that can be managed by technologies. In doing so, it focuses on the deterioration of cognitive and physical abilities, health-related problems and associated risks, and the shrinking of social opportunities and networks resulting in loneliness and social isolation. Finally, we conclude by articulating a future research agenda for ageing research in HCI. In this, we reconfigure the older technology user as an active agent, belonging to a diverse cohort rich in experience, who should have more active involvement in establishing the HCI research agenda.

2. A BRIEF HISTORY OF GERONTOLOGY AND ITS CRITIQUES

While ageing has only relatively recently come to prominence in HCI as a significant research topic, the study of human ageing more broadly can be traced to the medieval period. Gerontology (Greek for "study of old man") as a term was coined in the early 1900s but it was not until the 1940s that it started to become an organised discipline, with the *Gerontological Society of America* being founded in 1945 and the first issue of *The Journal of Gerontology* being published in 1946. While from the start the formalised field of gerontology was highly multidisciplinary,[1] over the mid to late 20th century, four core areas of study emerged: *chronological ageing,* which focused on identifying correlations between changes to human behaviour, psyche, physiology, and sociality and a person's chronological age; *biological ageing*, which typically referred to the study of physical changes occurring to the human body as a result of decline in cell replication as the human body ages; *psychological ageing*, which included studying changes to senses, perception, and cognition as people age; and finally *social ageing*, which is the study of how an individuals' relationships and roles change in relation to friends, family, and organisations [Hooyman and Kiyak 2008].

Social gerontology emerged as a subfield in the 1960s. It encompasses a variety of disciplines and theoretical ideas that share a common concern with the impact of social and cultural conditions on growing old. This includes the study of societal attitudes towards ageing and how these influence the way "needs" are defined and responded to, both at an interpersonal level but also structurally, through policy and service provision [Powell 2006]. One shared value across this diverse discipline is that social

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[1]As highlighted by the first issue of *The Journal of Gerontology*, which published articles from biology, medicine, social work, and literary analysis of the works of Shakespeare.

gerontologists view the ageing process from a "lifecourse" perspective [Dannefer and Phillipson 2010]. That is, in order to understand the experience of ageing, we need to understand it in the context of a person's entire life span and the cultural context within which they have lived. As such, social constructionist approaches and the concept of the "social construction of old age" have been put forward to offer useful ways of understanding how ageing is framed and societal attitudes to ageing are reinforced [Fenge 2001].

Social gerontology also emerged as a critical reaction to the broader field of gerontology. Scholars aligned with social gerontology have argued that the study of ageing within gerontology has been undertaken through a "biomedical lens" [Katz 1996] and that ageing has often been portrayed as a pathological problem tied to discourses of decline and dependency [Phillipson 1998]. As a result, gerontological literature throughout the 20th century portrayed older people as a "social problem" due to the economic costs associated with maintaining their "broken bodies" [Macintyre 1977]. Katz [1996] has argued that this dominant way of framing older people is a result of a "medical model of ageing" that became prevalent during the formative years of the field of gerontology. These perspectives subsequently promoted the rise of a further subfield of study referred to as critical gerontology. Critical gerontologists like Phillipson and Walker [1986, p. 280], argued for "a more value committed approach" where researchers are committed "not just to understand the social construction of ageing but to change it." Minkler [1996] highlights how critical gerontology is based around two sets of related principles. First, critical gerontologists examine the ways old age has been socially constructed as a problem for society resulting from inequalities in the distribution of "power, income, and property" [1996, p. 470]. Second, researchers in this subfield follow a primarily humanist tradition, which explicitly opposes negative portrayals and stereotypes of old age and instead explores "what makes a good life in old age, and how society can support multiple alternative visions of a good old age" [Holstein and Minkler 2007]. Between both these traditions a shared value is the empowerment of older people—through motivating action in the redistribution of wealth or to support them in transcending socially constructed norms of what it means to "grow old."

The emergence of social and then critical gerontology is significant here as it highlights the ways in which negative societal assumptions about ageing—which are often highly economically and politically motivated—permeate the research community and become reified further through study findings and in publications. The arguments made by critical gerontologists therefore provide a useful starting point for considering whether the recent growth in age-related HCI research is similarly problematic in how it reifies negative portrayals of what it means to be old in contemporary society. Later in the article, we return to the critical gerontological literature in order to reflect on the findings from our analysis of SIGCHI literature on ageing. In doing so, we aim to highlight how ageing is depicted and framed by the HCI community, not to criticise but to allow us to reflect on how the work of the community is embedded within wider societal understandings of ageing. We will also return to specific concepts from critical approaches to gerontology with a view to shedding light on alternative visions of how older people could be framed and conceptualised within HCI.

3. THE PREVALENCE OF AGEING AS A RESEARCH CONCERN ACROSS SIGCHI

In order to explore the prevalence of ageing as a research concern in HCI, we (1) undertook a systematic search of the ACM Digital Library in developing a corpus of papers that would act as the "data" for our study; and (2) established the emphasis placed on ageing within this collection of papers.

3.1. Systematic Search and Data Gathering

We conducted a systematic search [Gray 1997] of ACM SIGCHI literature in order to identify how prevalent ageing is as a research concern in HCI. An initial set of 10 key search terms were devised by the authors: "ageing," "aging," "older people," "older adults," "seniors," "elderly," "later life," "age-related," "retiree," and "retired." Following initial searches and examination of the results, we expanded the search term list to also include "elders," "geriatric," "life course," "grandparent," "grandmother," and "grandfather."

Using these search terms we performed an "all fields" (title, abstract, keywords, and body text) search on 22 March 2013 on the ACM Digital Library. We restricted the search to ACM SIGCHI sponsored conferences and journals (as of the date of the search).[2] We did not restrict our search by publication date and so our earliest result dated back to the CHI 1986 proceedings. This resulted in an initial corpus of 1017 publications. A significant number of the results were discarded because search terms had been used with a different meaning (i.e., the term "seniors" used in an education context). These results were removed, which included all results from the CHIMIT conference. This resulted in 644 results in total. For brevity, the results for the most recent 6 full years of search results (2007–2012) are summarised per venue in Table I. A full list of all identified papers can be found in the online appendices accompanying this article.

We restricted our search to ACM SIGCHI sponsored venues because of SIGCHI's perceived status as the premier society for HCI researchers and professionals. Bounding our data collection to these venues provided a useful means with which to restrict our search (although this still resulted in 644 articles to analyse) while also covering a broad range of perspectives that embodies the heterogeneity of HCI as an interdisciplinary enterprise. We acknowledge that restricting our data collection activity in this way adds the potential for biases in our findings. For example, our search excludes a range of journals and conference series that are considered high impact, have high readerships, and may offer publications that have complimentary or contrasting ways of framing ageing to those published across SIGCHI sponsored venues. Also, we have not included results from ASSETS in our analysis. This decision was made in order to focus our investigation on the ways in which ageing is framed in the broader HCI literature rather than in the more specialised area of computing and accessibility that the ASSETS and SIGACCESS communities have tended to focus on. However, we appreciate that in restricting our search and analysis in this way our findings only represent those papers in our corpus (i.e., papers that are published in SIGCHI venues that have been peer-reviewed by members of that research community and likely written with this readership in mind) and thus only represents a subset of wider HCI discourse on ageing. In Section 3.2 we do, however, examine the prevalence of ageing as a topic at SIGCHI venues compared to ASSETS.

3.2. The Prevalence of Ageing as a Primary or Secondary Research Concern across SIGCHI

First, we investigated the prevalence of ageing as a subject and domain of study within SIGCHI literature. To understand the emphasis placed on ageing within these 644

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[2]The SIGCHI proceedings and journals searched were *Human Factors in Computing Systems* (CHI), *Designing Interactive Systems* (DIS), *Computer Supported Cooperative Work* (CSCW), *Ubiquitous Computing* (UbiComp), *User Interface and Technology* (UIST), *Human-Computer Interaction with Mobile Devices and Service* (MobileHCI), *Tangible, Embedded and Embodied Interaction* (TEI), *Multimodal Interaction* (ICMI), *Group Work* (GROUP), *Computers and Information Systems* (ICIS), *Computer-Human Interaction for Management of Information Technology* (CHIMIT), *Creativity and Cognition* (C&C), *Interactive Tabletops and Surfaces* (ITS), *Engineering Interactive Computing Systems* (EICS), *Recommender Systems* (RecSys), and *Transactions on Computer-Human Interaction* (TOCHI).

Table I. Numbers and Percent of Papers That Relate to Ageing at SIGCHI Publication Venues between 2007 and 2012 (in Parentheses for Papers where Ageing is a Secondary or Referential Issue)

Conf.	2007	2008	2009	2010	2011	2012	Total
CHI	5 (7)	2 (14)	7 (24)	12 (29)	16 (29)	11 (21)	53 (124)
	2.8% (3.9%)	0.9% (6.4%)	2.5% (8.7%)	4% (9.6%)	3.9% (7%)	3% (5.7%)	3% (7%)
UbiComp	n/a	2 (11)	2 (9)	2 (8)	4 (8)	5 (24)	15 (60)
		4.8% (26.2%)	6.5% (35.5%)	5% (20%)	8% (16%)	8.6% (41.4%)	6.8% (27.1%)
DIS	n/a	3 (7)	n/a	3 (13)	n/a	7 (8)	13 (28)
		5.7% (13.5%)		5.3% (22.8%)		7.8% (8.8%)	6.5% (14%)
CSCW	n/a	1 (8)	n/a	4 (4)	3 (9)	5 (11)	13 (32)
		1.2% (9.3%)		6.9% (6.9%)	5.2% (15.5%)	3.0% (6.7%)	3.8% (5.5%)
UIST	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (2)	0 (2)
	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (3.2%)	0 (8%)
TEI	0 (2)	0 (1)	0 (4)	1 (5)	1 (5)	2 (4)	4 (21)
	0 (4%)	0 (2.2%)	0 (5.7%)	1.9% (9.25%)	1.5% (7.7%)	4.8% (9.6%)	1.2% (6.4%)
TOCHI	0 (2)	1 (4)	1 (5)	1 (3)	0 (4)	0 (3)	3 (21)
	0 (13.3%)	5.6% (16%)	4.8% (23.8%)	5.6% (16.7%)	0 (17.4%)	0 (9.4)	0 (16.5%)
RecSys	0 (1)	0 (1)	0 (1)	0 (0)	0 (2)	0 (1)	0 (6)
	0 (6.25%)	0 (2.6%)	0 (1.25%)	0 (0)	0 (9%)	0 (4.2%)	0 (2.9%)
EICS	n/a	n/a	0 (0)	1 (1)	1 (0)	1 (3)	3 (4)
	n/a	n/a	0 (0)	3.1% (3.1%)	3.1 (0)	3.3% (14.3%)	3.3% (4.4%)
ITS	n/a	n/a	0 (1)	0 (1)	0 (0)	1 (1)	1 (3)
			0 (3.4%)	0 (3.1%)	0 (0)	3.3% (3.3%)	1% (3%)
C&C	0 (2)	n/a	3 (3)	n/a	1 (0)	n/a	4 (5)
	0 (8.3%)		8.8% (8.8%)		3.1% (0)		4.4% (5.5%)
ICIC	n/a	n/a	n/a	1 (2)	n/a	1 (0)	2 (2)
				5.5% (11.1%)		7.7% (0)	6.5% (6.5%)
GROUP	0 (3)	n/a	1 (4)	2 (2)	n/a	0 (3)	3 (12)
	0 (7.9%)		2.5% (10%)	5.6% (5.6%)		8.6%	2% (8%)
ICMI	0 (0)	0 (2)	0 (1)	1 (1)	1 (4)	1 (6)	3 (14)
	0 (0)	0 (4.5%)	0 (2.4%)	3.4% (3.4%)	2.1% (8.5%)	1.6% (9.8%)	1.2% (5.6%)
MobileHCI	3 (3)	1 (7)	0 (6)	0 (7)	1 (5)	2 (11)	7 (39)
	6.8% (6.8%)	1.5% (10.8%)	0 (15.7)	0 (15.2%)	2.1% (10.5%)	3.7% (20.3%)	2.3% (12.9%)
ASSETS	4 (13)	5 (17)	3 (15)	4 (20)	2 (15)	5 (8)	23 (88)
	15% (48%)	17% (59%)	11% (58%)	14% (71%)	7% (55%)	20% (32%)	14% (54%)

Years when a conference was not held are signified by the use of "n/a."

results, we separated the publications into three categories: (i) *primary papers*, which mentioned any of the search terms in titles, keywords, abstracts, or in the opening motivation for the paper (in its introduction); (ii) *secondary papers*, which mentioned the keywords in the main body of the text but the primary focus of the study was on unrelated phenomena; and (iii) *reference papers*, which cited papers that were explicitly age related but did not discuss these explicitly in the text. This resulted in the identification of 162 primary, 354 secondary, and 128 reference papers.

In order to ascertain what trends in relation to ageing research are occurring in the SIGCHI community, we examined a subset of the results from our initial searches for the period between 2007 and 2012. By way of contrast, in Table II we also include search results from the *ACM ASSETS* conference. *ASSETS*, which is the major conference of the ACM special interest group in accessible computing, has for some years been considered the premier venue for publishing work on people with disabilities and older adults. Unsurprisingly, considering its specialised focus, *ASSETS* has a higher percentage of publications related to ageing compared to any of the SIGCHI venues—with 23 published papers between 2007 and 2012 having been primarily motivated by issues related to ageing equalling 14% of all publications at ASSETS during this period. However, *CHI* has published the most papers related to ageing with 53 publications treating it as a primary concern during this time (although this is only 3% of all *CHI* publications).

In terms of the percentage of overall publications across an individual SIGCHI publication series, *UbiComp* was by far the largest publication venue in our search results with just under 27% of submissions being of relevance to, or referencing, age-related topics. Indeed, *UbiComp* 2012 presented the largest percentage of overall submissions in any single SIGCHI proceedings, with 41.4% of its submissions relating to ageing in some way. After *UbiComp*, *TOCHI* (16.5%), D*esigning Interactive Systems* (DIS, 12.7%), and *MobileHCI* (12.9%) were the publication venues with the largest proportions of age-related papers in the search results. At the other end of the scale, the *Symposium on User Interface and Software Technology* (UIST) and the *Conference Series on Recommender Systems* (RecSys) had no papers that were primarily motivated by issues related to ageing, albeit a small number of papers in each mentioned age-related concerns or cited related material.

A chronological view of this data highlights how, in general, the number of papers related to ageing being published in SIGCHI venues is increasing. For example, in 2007 five *CHI* papers were primarily focused on issues related to ageing, compared to 11 in 2012; for *CSCW*, one paper was primarily related to ageing in 2007 compared to six in 2012. However, this progressive trend is primarily the result of an increase in the total number of papers published in these venues each year. So, for example, while there has been an increase in the number of papers published at *CHI* on ageing in the 6-year period we examined, the proportion of such papers was relatively stable at between 2.8% and 4% (with the exception of 2008).

4. DISCOURSES OF AGEING ACROSS SIGCHI

While the previous searches provided a starting point for identifying the prevalence and degree to which ageing is a research concern for the SIGCHI community, an indepth analysis of data is required to gain a richer understanding of how the experience of ageing has been framed.

4.1. Discourse Analysis Method

To examine the previous question, we performed discourse analysis [Tonkiss 2012] on the 644 papers that were identified in our initial search. Discourse Analysis (DA) as a term covers a range of theoretical approaches and techniques for reading and analysing texts, conversations, and documents. While there are a great many ways of undertaking DA, in general the approach is committed to examining "how language is used in certain contexts," as language is not intrinsically neutral and both reflects and shapes social phenomena and power relationships [Rapley 2007]. In the context of this article, we were specifically interested in forms of communication that support knowledge production within the field under study (its publications) and how these express relationships with other knowledge producing fields, their epistemologies, and
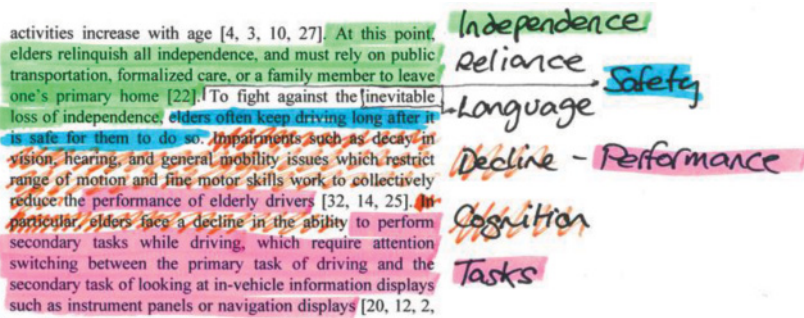
Fig. 1.   Example of multiple coding for the same data excerpt. The use of different colours signifies code associations with overarching themes. Example comes from scan of coding annotations of Kim et al. [2011].

politics. As such, we took inspiration from uses of DA in the health sciences and public policy, where it is used extensively to examine the "academic 'talk' and 'writing' about a subject, so as to reveal how 'knowledges are organized, carried, and reproduced in particular ways and through particular institutional practices" [Jupp 2006, p. 74]. Approaching DA in this manner aligns our analysis with the tradition of social constructionism, which Burr [1995] notes requires taking a critical stance towards "taken for granted" knowledge and understanding.

Although DA is an established approach to undertaking qualitative research, there is no prescribed method of analysing data [Jupp 2006]. DA typically begins with the researcher reading through the data and identifying implicit and explicit discourses. Jupp [2006] identifies a number of questions a researcher may ask of a text as it is being read, including the following:

—What traces of other texts are evident?
—How consistent, contradictory, or coherent is the text?
—How are people, objects (including technologies), and ideas categorised?
—Who and what are considered as normal, natural, and common sense?
—Who are the assumed readers of the text?
—What are the likely social effects of the text?
—What alternative readings may be made by different social groups?

Following Jupp [2006], our analysis began by authors 1, 2, and 5 dividing the papers amongst themselves and reading the texts with the previous questions in mind, with each researcher annotating data with single word codes that were openly generated on a sentence-by-sentence basis (as illustrated in Figure 1). Consecutive sentences that share the same meaning were taken as a single unit and shared the same code. This provided a balance between capturing the detail of a particular sentence, while ensuring it is still read in context. One feature of DA is that it is impossible to summarise all extracts of text with single codes. Therefore, on occasion, multiple codes were used to summarise the same textual data. An example of this is presented in Figure 1, where the codes of health and independence were entwined with one another but have significantly different meanings. Another issue with summarising data of this kind is that many of the papers in the secondary and reference category only discussed ageing either once or twice. In these cases, we only coded the relevant textual data, as illustrated in the highlighted text in Figure 2. During the coding process, the researchers met frequently to compare the codes generated and to scrutinise any discrepancies within the coding so as to develop a consensus. These discussions focused on clustering codes together, relating these clusters to the dominant discourses based
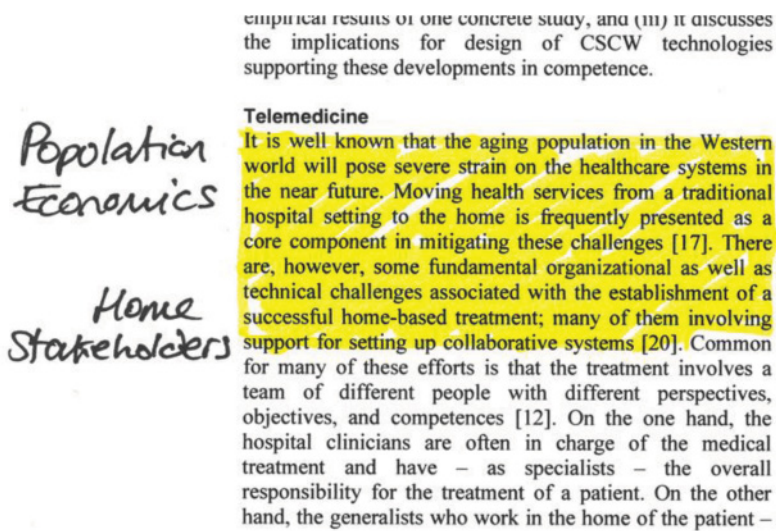
Fig. 2. Example of coding from a secondary paper, where the yellow highlighted data was included and coded in the analysis. Example comes from scan of coding annotations of Larsen and Bardram [2008].

on the papers cited, the political drivers that are both implied and made explicit, and the contradictions and assumptions embedded in the texts. Finally, all of the codes were then clustered into four overarching areas of investigation that we present in the following as discourses: *discourse of health economics*, *discourse of sociality*, *discourse of homogeneity*, and *discourse of deficits*.

In the following sections, we describe these discourses by discussing the underlying codes and provide examples using direct quotations and references to the analysed texts. We use chosen examples that best illustrate aspects of each discourse but have also aimed to draw on a variety of papers within each discourse to highlight how the underlying themes came from multiple sources. For purposes of clarity, we reference only papers belonging to our collected data corpus—in Section 5 of the article we will reflect on the issues we have identified by drawing on wider literature within HCI and the fields of social and critical gerontology.

4.2. Discourse of Health Economics: Technology as Reducing the Risks of Growing Old

A prominent discourse throughout our analysis was the relation between ageing, medical ailments, and the impact this may have on healthcare provision. In these portrayals, the worldwide ageing population is portrayed as an economic and social problem that will likely have a negative impact on us all. In highlighting this challenge, HCI is portrayed as a source of potential solutions, by developing and studying technologies that may reduce the cost of medical and health care and allow people to live independently for longer:

> *"As the world's old-age population continues to rise, the hope is that such technological advancements can defray expensive health care costs while maintaining the dignity of citizens who can continue to manage their own care in their homes and communities."* [Palen and Aaløkke 2006, p. 79]

> *"Caring for all of these seniors as they age will be a critical problem that has garnered significant research attention both within the CHI community and more broadly."* [Birnhotz and Jones-Rounds 2010, p. 143]

"As we age, we experience an increase in health care issues that require ongoing medical attention." [Piper et al. 2010, p. 907]

In examples such as these, the dominant portrayal of older age becomes attached to the emergence of multiple ailments and conditions that need careful management. Along with the broad suggestion that as people age the number of ailments increases, papers also relate the rapidly ageing population to a subsequent growth in the incidence of dementias (e.g., Dahl and Holbø [2012] and Lindsay et al. [2012]) and Parkinson's (e.g., McNaney et al. [2011]):

"In the wake of the ageing of the world population, we can expect to see an increase in the prevalence of dementia, making dementia one of the most pressing issues in long-term care." [Dahl and Holbø 2012, p. 572]

When related to health, ailments, and conditions, societal ageing is framed as an uncontrollable issue (*"continues to rise," "most pressing"*) that will have a significant impact upon existing healthcare provision both in terms of financial cost (*"defray expensive healthcare costs"*) and its efficacy (*"maintain the dignity of citizens"*). As such, technology presents one way to help control these problems by reducing costs and enabling new healthcare practices. Examples include technologies that allow carers to remotely monitor medication intake [Ballegaard et al. 2008], technologies for older people to reflect upon their own medication use [Lee and Dey 2011], rehabilitative systems for people who have suffered strokes [Gerling et al. 2012], and reminder systems to support correct medication intake [McGee-Lennon et al. 2011]. There are also examples of the design of healthcare technologies to alleviate the concerns of family members [Mynatt et al. 2001; Rowan and Mynatt 2005]. Other papers studied the efficacy of health-related information learning for older people, either at home [Gerling et al. 2012] or after treatment in a hospital [Bickmore et al. 2009].

All of the preceding are examples of papers for which the development or evaluation of healthcare technologies related to ageing is the primary research topic. There was a greater abundance of papers that referred in passing to the importance of healthcare technologies in later life. For example, Larsen and Bardram discuss how worldwide population ageing *"will pose severe strain on the healthcare systems in the near future"* [Larsen and Bardram 2008, p. 554], and use this to motivate for their research into telemedicine and ageing-in-place. Birnholtz and Jones-Rounds [2010] examine the privacy needs of older people in the context of remote monitoring and communication technologies, and note that seniors are at risk of *"possible illness or a range of other emergency situations such as freak injuries or accidents"* [Birnholtz and Jones-Rounds 2010, p. 144]. Others highlighted examples of technological solutions that support health-related practices between family members, such as Sellen et al. who in their paper on design methods, use an example of a daughter using her *"computer to check on the well-being of her mother living across the country"* [Sellen et al. 2009, p. 636]. The sense that older people are implicitly facing increased health risks is also referred to in some of the terminology used to describe study participants, such as *"healthy older adult"* [Ziefle et al. 2007].

As we begin to see here, one way of characterising the focus on health is a concern for mitigating the perceived "risks" of growing old and designing safety measures that alleviate these risks. For example, work centred around remote monitoring technologies and ambient living systems are often designed to preempt or prevent accidents. There is an implied fear of older people living alone, posing potential injury and accident risks to themselves. Risk is also an issue when it comes to forgetting to take medication, where older people are portrayed as poorly adhering to and complying with medical advice. These risks are very much viewed as something negative and to be avoided, and

within the SIGCHI literature there is a dominant view that technology can alleviate these risks and avoid the associated negative consequences.

4.3. Discourse of Socialisation: Social Isolation, Routines, and Expected Roles

The second discourse relates to the socialisation of older adults—how they engage in leisure pursuits with others, how they communicate with people through technology, and how they are threatened by social isolation as they grow older.

First, there is a concern that as people age there is a greater risk of becoming socially isolated—particularly if they live alone or have moved into residential care facilities. For example, Birnholtz and Jones-Rounds [2010] cite social psychology and gerontological literature on the relationship between loneliness, depression, and well-being, and highlight the increased risk of experiencing loneliness that older people living in care facilities are faced by. The appearance of loneliness is sometimes not expected by the researchers. In their long-term engagement with a residential home, Gaver et al. [2011] explain how, while there was great diversity and social complexity among residents, many appeared *"passive and sedentary"* [p. 1758] and it was *"difficult to escape the impression that many of the residents were often bored and lonely"* [p. 1759]. The resulting system created for these residents was the Photostroller, which was designed to promote interaction and engagement among the residents and also provide a greater sense of connection with the world *"beyond the care home"* for those wishing to use it on their own [p. 1760]. In a similar vein, Muller et al. [2012] noted a lack of enthusiasm from care home residents to engage directly with new technologies but great pleasure in meeting new people during a series of "Internet days" organised by the researchers. In their work in a care home context, Piper et al. [2013] introduced a new photo-based system with the intention of supporting social interactions between visitors and their older participants. In other papers, robots [von der Pütten et al. 2011] and electronic pets [Friedman et al. 2003] are portrayed as offering opportunities for social interaction in care homes where others cannot be present.

In examples such as these, a lack of social interaction is associated with a sense of social isolation, which is typically explained in terms of the transition from one's own home to a care home and a consequent decrease in interaction with friends and family members (as in Muller et al. [2012]). Other papers, however, also highlight the potential that those "ageing-in-place" (i.e., living for as long as possible in one's own home) are also at risk of increased social isolation, as they *"face constraints on mobility and other physical activity, and may face situations where interactions with others are difficult"* [Benjamin et al. 2012, p. 800].

The second manner in which aspects of socialisation are expressed is in work studying family communication and roles. The search terms "grandparents," "grandmother," and "grandfather" were referred to in 12% of our corpus. The majority of these are fleeting mentions. For example, passing comments are made by younger participants in studies about their family relations—as, for instance, in the work of Odom et al. [2012] on technology heirlooms or in the work of Petrelli et al. [2008] on physical mementos handed down by older family members. Where grandparents take a more active role in studies there is an emphasis on designing technology to support social practices between young and old family members. Ambient awareness (e.g., Rowan and Mynatt [2005], Mynatt et al. [2001], and Judge and Neustaedter [2010]), social media (e.g., [Brush et al. 2008]), and video conferencing (e.g., Kirk et al. [2010] and Inkpen et al. [2013]) technologies are studied with a view to understanding how they might mediate and enhance communication between young and old. Work in this area is often motivated by a desire from grandparents for greater closeness and connectedness with their geographically distant grandchildren, a concern typically shared by their adult children. Some studies focus on the role video-mediated communication plays in

supporting complex remote "face-to-face" interactions and conversation between older and young family members (e.g., Ames et al. [2010] and Kirk et al. [2010]). In other examples, grandparents are portrayed in a somewhat more passive role—either as *"receivers"* of information [Judge and Neustaedter 2010] or *"remote observers"* [Inkpen et al. 2013]. Hutchinson et al. [2003] portray older family members as more active users in their deployment of a *"message probe"* system, wherein the grandparents used the system as a means for sending messages to their grandchildren. In this case, the grandchildren were actually portrayed as less engaged with the prototype, much to the *"disappointment"* of their grandparents [2003, p. 21]. An important point here is that grandparents are not typically framed as the primary users of the technologies under study—the emphasis is primarily on family practice. However, it is notable how the majority of studies are focused on the familial home (i.e., that of the grandchild and their parents) and not on the home of the grandparent. This is emphasised by the imagery within these papers, where we mostly see grandchildren interacting with a video link of their remote grandparent appearing on screen (e.g., Inkpen et al. [2013] and Raffle et al. [2010]).

Third, contrasting with the preceding portrayals of older people as being at risk of social isolation or disconnection from their family, there was a small number of papers that emphasise the social activity and autonomy of older people. These papers tended to be returned under searches for "retired" or "retiree," and typically take the form of minor discussions related to subsets of study participants. Voida et al. [2009, 2010] gave examples of how their older participants prompted social gatherings around console game playing activities with younger family members or peers. Other examples included studies of self-forming interest groups where retirees met with others to engage in hobbyist activities such as knitting [Rosner and Ryokai 2008] or collecting practices [Pierce and Paulos 2011; Kankainen and Lehtinen 2011]. There were also instances of older people being portrayed as active contributors to online communities. Zaphiris and Sarwar [2006] highlighted how a group of older people were more frequent users of a social networking news sharing website than a group of teenagers. Furthermore, a number of papers examining digital platforms for intergenerational communication emphasised the social and mental capital that older generations hold. For instance, Olsson et al. [2008] view the *"elderly"* as having a *"wide range of memories to share"* with other generations. Rice et al. echo this view, highlighting the potential for young people and older people to meet with one another and share their own different expertise and learn from one another. Similarly, Vines et al. [2012b] explain how their research on the financial practices of *"eighty-somethings"* frequently led to the sharing of knowledge and the offering of advice between the younger researchers and older participants.

In summary, a discourse of socialisation is represented throughout the studied texts. The vast majority of these works portray the social lives of older people as radically reducing as they age (due to reduced physical mobility or because of a disconnection with friends, family, or peers) or as a more remote (but still fundamental) member of familial life. Technology here is framed as a way of connecting people—offering new ways of communicating over distance or having a sense of awareness that others are with you. In a smaller number of cases, older people are also framed as more socially proactive and autonomous—as individuals engaged in using social media and engaging in regular social activities with others—and technology is framed as an existing presence within social routines.

4.4. Discourse of Homogeneity: Population Diversity and Generalisations

Our third discourse is that of homogeneity, by which we refer to the presentation of older people as a homogenous group. This appeared in the analysed publications in one of two ways.

First, homogeneity is strongly apparent where comparisons were made between older and younger users. A great many studies were based upon controlled comparative evaluations of technologies that studied age-related differences in technology use and accessibility. For example, Apted et al. [2006] evaluated the usability of their tabletop photo-sharing application with a group of younger and older users, noting: *"Testing with* [the] *elderly particularly highlighted problems with our two-handed gesture, which our young participants had no trouble with"* [Apted et al. 2006, p. 790]. In a similar vein, Ma and Cook [2009] compared the benefits of using different means of visually communicating verbs to younger and older participants. Ziefle et al. [2007] studied the performances of a group of younger and older people when attempting to access content on small screen devices. The ambition in examples such as these is to identify broad categorisations in relation to aspects of technology use and performance that occur with age and identify ways that interfaces could be more appropriately designed to account for age-related differences.

Second, homogeneity is also present in the ways older participants are discussed in the method, findings, and discussion sections of publications. It was notable how relatively few papers explored the heterogeneity of our ageing population, although some discussed gender differences (e.g., Ogozalek [1994]). Participants are described as "retirees" or "grandparents," but there is infrequent detail about what they have retired from or about the participants' lives beyond, say, their grandparenting role. There were also few instances where the socioeconomic and cultural contexts of participant's were discussed—as such, while we might expect great heterogeneity among those older people taking part in studies, in the vast majority of cases it was difficult to establish this based on an analysis of publications.

It is important to note, however, that there were exceptions in the analysis where the heterogeneity and diversity of people who happen to be of similar ages was detailed. We noted earlier that Gaver et al. carefully explained how heterogeneous the care home residents were in their work developing *The Photostroller*. In their related work on the design of *The Prayer Companion*, they explain how most *"design for older people* [...] *has the tendency to direct attention to a single dimension of comparison among people who may otherwise have little in common"* [2010, p. 2064]. Gaver et al. carefully portray the individual differences between the Nuns who lived with the Prayer Companion in their commune. They conclude by arguing that *"designing for specific groups of older people"* may be a way in which HCI can move beyond stereotypes [Gaver et al. 2010, p. 2064]. Coming from a different perspective, but still expressing heterogeneity, Ziefle et al. [2007] note that *"ageing itself represents a highly complex process. Not all users age in the same way, and the onset of aging processes as well as the consequences show considerable differences across humans"* [pp. 307–308]. Sears and Hanson [2011] make a case that in studies of system accessibility, participants are rarely *"representative"* of the populations that may have to live with and use the technology under evaluation— raising specific issues with a lack of representative sampling of older age groups in research and a lack of depth in reporting the experiences and skillsets of those taking part in research. Jensen et al. [2012] provide a detailed account of framing "ageing" in their work on indigenous knowledge in Namibia. In this account, the idea of old age is not linked to chronological age, in the way it is in the majority of papers analysed. Rather, it is linked to a person's knowledge and community identity, affording these "elders" a privileged position within their community:

"10 were classified as youth, with an average age of 21.6 (st. dev. 8.3) and 11 were elders, with an average age of 47.5 (st. dev. 8.1). The classification is made by the community and is not solely based on age, but rather the possession of knowledge and respect. Also, there is a high uncertainty associated with the reported ages, as many of the villagers do not know their exact age." [Jensen et al. 2012, p. 197]

While such examples exist, wherein "older people" and "ageing" are framed more sensitively by researchers, they appear infrequently in the literature we analysed.

4.5. Discourse of Deficits: Technology and Older People's Declining Abilities

While the previous three sections detail relatively discrete discourses that we identified from our analysis, there is a further discourse that underlies each of these—a discourse of deficits. Looking back at our first theme, this is particularly evident in the ways that SIGCHI publications draw on the economic challenges associated with the health concerns of older people, but issues around deficits also features prominently in the discourses of sociality and homogeneity. In the deficit discourse of ageing, there is a focus on the relationship between growing old, changes in cognitive and physical capability, and the impact this has on interaction—both with others and with technologies. The role of HCI in a deficit discourse of ageing is invoked in two ways in the papers we analysed.

First, it is emphasised that there is a need to understand the deficits that come with age in order to design interfaces, systems, and services that are inclusive, usable, and easy for older people to learn and use. Papers in this space tend to direct readers towards the objective reality of physical change as people age, such as diminished eyesight or restrictions in physical movement. In other instances, there were examples where authors specifically focused on the cognitive limitations of older people. Here, texts would cite studies in cognitive psychology that examine changes in cognitive processes such as working memory, fluid intelligence, episodic memory, attention, and sensory processing to make claims about the challenges older people face in completing complex tasks:

> *"Unlike younger adult users, there are physiological factors due to the normal aging process affecting older adult use of the Web. The normal aging process, including vision, cognition, and physical impairments, has an impact on Web usability when designers are not senior-friendly."* [Becker 2004, p. 388]

> *"It is known as people age, their cognitive, perceptual, and motor capabilities decline, with negative effects on their ability to perform many tasks."* [Worden et al. 1997, p. 266]

> *"We hypothesized that the attentional demands of input devices are intricately linked to whether the device matches the input requirements of the on-screen task. Further, matching task and device should be more important for attentionally reduced groups, such as older adults."* [Collins McLaughlin et al. 2009, p. 1].

The decline in capability that comes with age is portrayed as having a significant impact on the performance of older people using digital technologies. In the earliest paper in our corpus, Ogozalek and Van Praag [1986] compared the performance of younger and older people in using keyboard and voice-based input devices. This study focused on a tightly defined set of cognitive and perceptual skills in relation to the performance of a specific task. References to cognitive and memory changes and the resulting difficulties that older people have in using technologies still appear in more recent publications based on controlled usability studies (e.g., Worden et al. [1997]; Ziefle et al. [2007]; Chin and Fu [2012]).

A second way that a deficit discourse is expressed across the literature is through highlighting the way in which functional changes such as those detailed previously affect people's performance with digital technology. Referencing back to the prior section on the discourse of homogeneity, it was quite typical to see comparisons of the performance of older people with people in younger age groups (e.g., Worden et al.

[1997]; Hollinworth and Hwang [2011]; Collins McLaughlin et al. [2009]). For example, in their study of car dashboard displays Kim et al. [2011] examined how different instrument designs affected younger and older drivers' attention and concentration when driving. Similarly, Chin and Fu [2012] compared the speed differences between young and old people in information search tasks. A further example is Collins McLaughlin et al. [2009] where young and older participants were compared in terms of attentional demands that different input devices put onto people. These types of studies typically report that older people are slower at learning and using digital technologies compared to younger groups, and that technology could be redesigned in ways that better suit their capabilities:

> *"Older adult performance suffered more than younger adult performance due to the attentional demands of the input device itself, pulling attentional resources from the task and thus hampering performance."* [Collins McLaughlin et al. 2009, p. 12]

> *"[O]lder computer users position the cursor much more slowly than younger computer users and have great difficulty making correct movements to small targets. However, the time required to move the cursor to a small target was cut by over 50% when using a fully augmented pointing system as compared to the system used on most computer systems."* [Worden et al. 1997, p. 271]

> *'There was a significant main effect of age group on the selection time [. . .] where the older group took more than twice as long to select the target for the mouse shaking and sonar conditions as the younger group."* [Hollinworth and Hwang 2011, p. 865]

In much of the data that embodies the deficit discourse of ageing, researchers talk of how older people are *"slower"* at completing tasks, have *"very obvious"* signs of difficulty mastering certain tasks [Ziefle et al. 2007, p. 313], and are less accurate than younger people [Worden et al. 1997, p. 266]. Furthermore, familiarity with technology is also a potential deficit for older people—particularly as technology becomes an increasingly important feature of everyday life. Piper et al. explain that *"as medical practices begin to adopt digital patient record systems, communication of health care issues may be further complicated for older adults who are intimidated or overwhelmed by technology"* [Piper et al. 2010, p. 907]. Similarly, older people are framed as *"anxious and confused"* when introduced to computers or the Internet for the first time [Dickenson et al. 2007].

  While less explicit, a discourse around performance deficits also appears within qualitative work studying family relationships and rituals. In some cases the adult children and grandchildren of older participants would refer to the difficulties their older family members have with using technologies. For example, Kirk et al. [2010] highlighted how older family members engaged with the *Family Archive* prototype deployed in the family home when they visited. The authors explain how in one case the family members *"proudly showed us some old print photos that Grandad had been scanning into the device of himself and his wife"* [Kirk et al. 2010, p. 266] but followed this with

> *"the family was keen to repeatedly berate the grandad for a reported misuse of the system in which he'd managed to accidentally delete some scanned pictures of which the rest of the family had been particularly fond. They were making it clear to the grandad that he shouldn't use the device unsupervised (and we noticed this during interactions in our presence when he would indirectly ask his daughter for permission to hit some buttons on the interface)."* [ibid., pp. 266–267]

Kirk et al. go on to reflect on how their system highlighted tensions among the family about who should or should not be allowed access to certain aspects of the system. In some respects this was as a result of a desire for curatorial control—but in others it was down to the perceived *"competence"* [ibid., p. 267] of those interacting with the technology by other family members. This example was among a number that highlights how the perceived deficits of older people in relation to cognitive and physical capabilities and performance with technology are reflective of popular attitudes that were articulated by participants in studies. Light [2011] highlights how on occasions these attitudes around lacking technical competence can be expressed by older participants themselves—but also provides examples of how facilitation and workshop techniques can be used to support an articulation of agency surrounding technology use in the future [Light 2011].

Within the publications we analysed, there are a wide range of ways that researchers have responded to the identification of deficits around physical and cognitive function and performance. One approach has been to adapt everyday technologies so as to be more sensitive to the needs of older users: As exemplified by Worden et al. [1997] who developed a set of new interface components that assisted older participants in using a mouse, and in the tabletop application "SharePic" by Apted et al. [2006], which used metaphors of *"physical interactions that occur with printed photographs"* as a way of removing the abstractness of new interaction concepts [ibid., p. 783]. Another approach is to embody new technologies within interaction concepts that older people would be familiar with: for example, Piper et al. [2013] and Vines et al. [2012b] developed systems that explicitly harnessed their participants' lifelong familiarity with pen-and-paper–based technologies. Contrasting with this, others framed technology as a form of prosthetic that fills in the deficits that appear to come with ageing—for instance, by providing situated support systems to aid those who forget appointments and have difficulty in remembering when to take medication [McGee-Lennon et al. 2011], or using lifelogging technologies to support those with more severe memory impairments [Lee and Dey 2008].

5. AN AGEING RESEARCH AGENDA FOR HCI

In the previous section we presented the four dominant discourses related to ageing within the SIGCHI literature. We also highlighted some contradictory framings associated with each discourse that occur less prevalently within the same corpus. In this section we reflect upon these dominant discourses of ageing in HCI by highlighting how they mirror discourses found within the wider gerontological literature, which has been heavily critiqued by scholars in social and critical gerontology. In the following we will draw on some of these critiques and complimentary arguments in the wider HCI literature to highlight how the emphasis of these discourses might be somewhat limiting our understanding of how older people might experience, live with, use and actively shape and design technologies both now and in the future. We thus use these discussions to inspire a new research agenda for future HCI research that takes the diversity of lived experience in later life into account.

5.1. Avoiding the Biomedicalisation of Older People in HCI

The *discourse of health economics* highlighted how there was a great emphasis on issues to do with the health, medical, and, by association, care concerns of older people. Examining the literature in social and critical gerontology provides some insight on the possible reasons why this research topic is particularly prevalent across the SIGCHI community. As noted earlier, one of the motivations for the emergence of social gerontology as a distinct subfield from gerontology was a reaction to the biomedicalisation of the broader field:

"The construction of aging as a medical problem focuses on the diseases of the elderly—their etiology, treatment, and management—from the perspective of the practice of medicine as defined by practitioners. This means that the medical phenomena—with its emphasis on clinical phenomena—takes precedence over, and in many cases defines, the basic biological, social, and behavioural processes and problems of aging." [Estes and Binney 1989, p. 587]

Estes and Binney highlight a series of funding decisions within U.S. research councils in the mid-20th century as a significant turning point in the overt focus on biomedical issues of ageing in gerontology. This led to a reduction of funding made accessible to the psychological, behavioural sciences and humanities—and indeed, those projects in these fields that were funded often explored ageing in close alignment with identified clinical issues. They argue that these decisions have had ramifications beyond just the focus of research—that biomedicalisation has subsequently meant public sector workers working with older adults are trained to specifically attend to health- and medical-related risks, and that this attitude has also prevailed in the public sphere as well:

"Equating old age with illness has encouraged society to think about aging as pathological or abnormal. The undesirability of conditions labelled as a sickness or illness transfer to those who have those conditions, shaping the attitudes of the persons themselves, and those of others toward them." [ibid., p. 587]

Estes and Binney highlight how a side effect of people contending with self-impressions of increased fragility and decreased health as they age has been the rise of a health industry, which in many respects HCI is implicated in "the solutions to the problems of aging appear resolvable by the purchase and consumption of more and more high-cost medical services and technology" [p. 594]. The provision of these opportunities is also offset by mass-media and public discourse that "blames older people for the largely 'social' problems of demographic ageing [. . .]. Older people find themselves blamed for the health care crisis (and indirectly, for larger economic crises of state)" [ibid., p. 594].

We argue that many of the criticisms levelled at gerontology by Estes and Binney, as well as others within critical gerontology, are relevant to the discussion of the dominant discourses of ageing in HCI. Unsurprisingly, much of the research in HCI represents projects funded by large national and continental funding agencies—many of whom, like the National Science Foundation (NSF) that Estes and Binney critique, have proceeded to align with a predominantly biomedical model of the ageing human. As a result, study design and thus technology designs become responsive to the clinical diagnoses and health-related challenges that older people face. This also means that the dominant body of knowledge of ageing that HCI researchers draw upon is also biomedically framed creating a circularity through which the framing of ageing is narrowed. Therefore, our first agenda point is

1. Critically reflect on where the underlying motivation for studying ageing comes from, and challenge any taken for granted assumptions and predominantly negative societal attitudes of ageing.

As a starting point, we, as the HCI research community, should reflect on and be critical about where the motivations for researching ageing come from. As noted, while there has been an increased imperative from funding bodies across the world to study ageing (e.g., EPSRC [2012]) this is typically awarded from medical, engineering, or technology-funding bodies that have a significant stake in shaping the direction that research takes. For example, medical research councils might only fund proposals that fit a very tight remit in terms of the inclusion criteria of participants and have

an explicitly biomedical focus. While there is possibly very little that individual HCI researchers can do to impact upon the remit of the funding bodies it is imperative that we critically engage with how this influences our understanding of what it means to be old and how it is framed in our own research. Bond et al. highlight how, while issues such as health and wellness are clearly important, it is "disappointing that the joys and triumphs of old age are not promoted" [Bond et al. 1993, p.2]. In this sense, by being reflective in this manner it alerts us to being careful that as a community we do not only study these areas to the exclusion of others.

5.2. Embracing Diversity Across the Life Course and the Lived Experience of Old Age

In the *discourse of homogeneity*, we explained how the HCI community (as represented in the SIGCHI literature) can sometimes present older people as a homogenous group. This was conveyed in the ways in which "older people" feature in comparative studies with "younger people," and in how chronological age was associated with certain capabilities, skills, and attributes in relation to technology. As a result, it is implied that certain points in older age can be associated with specific sets of skills and attitudes to technology. This is by no means to suggest that attempting to capture commonalties among older people is flawed—nor that understanding why these needs are different to those of younger people who may typically be seen as the dominant user group of new technologies is wrong. However, social gerontology literature warns us that making generalised claims about groups of people based on their age is that it "legitimates the use of chronological age to mark out classes of people who are systematically denied resources and opportunities that others enjoy" [Bytheway and Johnson 1990]. Bytheway [1995] elaborates this further to highlight how the use of chronological age as a way of bounding a group around skills and abilities is illustrative of wider societal attitudes towards older people and is an implied ageism. This is not to argue that HCI is proactively ageist—however, that in classifying an age group based around certain skills and abilities there is a danger of "reinforcing a fear and denigration of the ageing process, and stereotyping presumptions regarding competence and the need for protection." [Bytheway 1995, p. 14].

As such, while it may sometimes be useful to make generalised statements about groups when attempting to derive design requirements and design new systems, we might also ask if there are alternative ways of representing older people in our communities' publications that better captures the diversity that comes with old age. Since the 1950s, social gerontologists have moved towards life-span perspectives on human development. Erikson [1950] highlighted how in order to "understand people in late life it is necessary to see them in the context of their whole life history with the problems both successfully and unsuccessfully resolved from earlier periods in life" [Bondet al. 1993, p. 30]. This also means acknowledging the reciprocal nature of influences between a person and their lived environment—including the ways in which family, friends, one's local community, the media, and different generations influence and shape personal development and attitudes. While this has many implications on ageing research, the most relevant to our discourse is that

> *"it suggests that the situations of older individuals will vary according to their histories. The courses of development of different people are likely to diverge the longer they live, and the more experiences they absorb. Rather than growing more alike as we age, we therefore become more unique."* [Bondet al. 1993, p. 30]

More recent critical approaches in gerontology have taken this further to stress that peoples' lives become increasingly varied and diverse as they age, and are tightly related to gender, class, and ethnicity. Thus, attempting to define clear stages of

development against chronological age is flawed due to the diverse and dynamic qualities of ageing. These approaches emphasise a "life course" rather than lifecycle perspective, which contends that in order to understand growing old it is necessary to view it through the trajectory of an individual's entire life and the myriad of micro and macro influences (throughout an individual's life) that impact upon their current lived experience. As such, our second agenda point is

> 2. *Critically engage with the context of ageing across an individual's life course and reflect upon how their personal histories impact upon technology use now and in the future.*

We argue that viewing the abilities, needs, and desires of older people from a life course perspective is useful to HCI research in two ways. First, it confronts us with the dangers inherent in attempting to correlate chronological age with specific abilities and competences. For example, our analysis highlighted how the ways in which older people are represented in HCI can easily lead to all people of a certain age being considered hesitant drivers [Kim et al. 2011], as being unfamiliar with technology [Muller et al. 2012], or experiencing multiple physical disabilities [Sears and Hanson 2011]. Again, this is not to argue that these claims are always untrue—but rather that we must be careful not to claim that these are issues for all people above certain ages. Thus, taking a life course perspective we argue would be beneficial for HCI in promoting greater reflection upon the context that research is performed in, including the geographical locations where research is conducted (and how this influences findings), how participants are recruited (i.e., through existing "participant panels" or from community groups), and the cultural and historical factors that influence peoples' lives and subsequently the insights of research. As such, our call for a life course approach is equally a call for deepened documentation of just "who" is involved in our research, being explicit about the constraints we place on diversity in terms of the individuals who participate in our research (i.e., who we define as users, subjects, or participants) and by association those that are excluded.

Second, a life course approach offers insights for the ways in which we may engage with older people as participants in research and HCI design processes in the first instance. Rather than attempting to develop technologies that respond to generalised insights about the skills and capabilities of a specific cohort, we might consider deepened engagements with individuals and design in response to their personal histories and life course. Such an approach echoes the biographical approaches of Blythe et al. [2002] to qualitatively inquiring into the role technology plays in peoples' lives, or the longitudinal engagement of Wallace et al. [2013] with a wife and husband that emphasised their personal narratives, which were responded to through the creation of personalised artefacts and technologies. This also evokes Dix's [Dix 2010] notion of designing for a long tail, which emphasises the benefits of designing in response to small groups (or even individuals) in order to emphasise more positive experiences of technology. As such, as with these prior arguments, taking the life course seriously as both a way of understanding people and as a means for generating innovative new designs would help researchers in recognising diversity, and thus move away from a tendency to homogenize the experience of ageing and the assumptions that frailty in later life is "universal, natural, and inevitable" [Powell 2012, p.15].

5.3. Revisiting the Deficits and "Successes" of Older People in HCI

In the *discourse of deficits*, we highlighted how throughout the discourses of health economics, sociality, and homogeneity there was a recurring focus—sometimes explicit, but often implied—on the deficits and declines of ageing. In terms of socialisation

this was evidenced in the myriad of ways that SIGCHI publications express concerns about the reduced opportunities for socialising as we age, and the role of technology in ameliorating this disconnection. In reference to homogeneity, the deficits discourse came into play in how older people were compared and contrasted with people in younger age groups. In health economics we saw how ageing relates to a decline in biological processes and the medical conditions and human behaviours that result.

That older people—and indeed, "users" in general—are often framed as experiencing some form of deficit that can be met with technology has been observed by prior work in the HCI community. Carroll et al. [2012] highlight how "deficit-driven design" might lead to a focus on developing technology to "mitigate unpleasant experiences and risks"—citing growing old alone and being isolated from one's family as one such deficit that technology might alleviate. Similarly, more recently (and outside of our period of data collection) Rogers et al. [2014] expressed concerns around the overt focus on the "downside of aging" in HCI. In both of these cases, the authors approach ageing as a positive resource that can be harnessed—for example, by emphasising the key role older people play in communities already (as in Carroll et al. [2012]) or through offering ideas around innovative uses of technology (as in Rogers et al. [2014]). Here, we would like to develop these recent considerations further by revisiting the social gerontology literature.

Insight into the challenges associated with this prevailing deficits discourse can be found by looking at one of the core concepts of early gerontology—"successful ageing." Rowe and Kahn [1997] define successful ageing as "low probability of disease and disease-related disability, high cognitive and physical functional capacity, and active engagement with life" [p. 433]. The notion of successful ageing was itself a response to the overt focus on negative stereotypes of old age within gerontology. However, the idea has been heavily critiqued for the way it ignores an individual's ambitions and definitions of "success." The critical gerontological literature has highlighted the potential contrasts between scientific representations of "successful ageing" compared to lay definitions of success in later life—for example, in the latter success may not be deemed upon a lack of disease, physiological functionality, and being active but rather more on a sense of social worth and bonds (as noted by Rowe and Kahn [1997]). Furthermore, it has also been highlighted how the manner in which "success" is conceptualised in gerontology is loaded with the assumption that everyone has the social, economic, and material capital to achieve this level of success. Holstein and Minkler [2007] highlight how one's ability to be "successfully old" or not is bounded by material wealth, the types of groceries accessible in a neighbourhood, whether it is safe to leave your house or not, and the cooking facilities in your home—among many other factors. As such, the "successful ageing" model thus fails to account for particular life trajectories and environmental realities, and is predicated on reductionist aims for a very large idea—that of success" [ibid., p. 16]. This leads to our third point for our research agenda:

3. By engaging with older adults prior to the design process, embrace alternative measures and attributes of "success" in later life.

With this point, we build upon a small body of work included in the analysed corpus that emphasised collaborative and participatory approaches to designing technologies with older people (rather than, say, primarily with carers or medical professionals) (e.g., Lindsay et al. [2012], Light [2011], and Vines et al. [2012a, 2012b]). However, we wish to emphasise here that this goes beyond inviting older people to be participants in a design process and contribute to the creation of new technologies, but also to use participatory processes as a means to challenge personal and societal assumptions (as

noted by Light [2011]). This would involve providing older people a voice throughout the design and research process, and include establishing measures of success that are meaningful to those individuals engaged in the research. We would assume that engaging older people in this way would lead to the generation of a wide range of "criteria" for technologies that support measures of success in later life that are highly contextual and heterogeneous. For example, we might see that success comes not just from an individual being medically healthy or able, but might also be measured in terms of feelings of societal worth; romantic and marital relationships; a sense of giving back to a community; financial stability; being depended upon by others; spending time in the local pub with other "regulars"; spirituality; feelings of stability or being able to adapt to changes in life; a sense of learning new ideas in retirement; the perceived success of one's friends or family, such as sons, daughters, and grandchildren; or just being able to take time out of each day to do what you enjoy doing most, even if that just includes watching a favourite TV show each and every evening. These are just a small number of potential measures of success that might emerge if defined and driven by older people themselves—indeed, as Martinson and Berridge [2014] highlight, the number of potential ways of articulating success is "dizzying" and highly dependent on personal motivations, desires, and social and cultural context. As such, what we call for here is for researchers to engage in developing criteria of "success" as a way of generating research questions and to inform the design process and, subsequently, provide lenses to evaluate the subsequent "success" of these interventions in practice. By taking this participatory approach to defining research questions as well as designing new systems, we thus also derive a fourth and final agenda point:

   4. *Support a HCI research agenda that is shaped by older people*.

This is to say, that as well as critically reflecting upon how ageing research is influenced at a funding level (as per agenda point 1), we should also engage with how older people themselves might actively direct, shape, and contribute to HCI research. In stating this we do not mean invite older individuals to participate in a design process, or be invited to contribute their experiences to a set of research questions already established. We might instead consider this approach more analogous to "lead user" processes—albeit the focus is on working with specific individuals and lead advocates who help define research questions and challenges that are of interest to their own and their peers needs and concerns. This requires reconceptualising the ways research is structured, designed, and even funded in the first instance. It would align research in HCI more along the lines of participatory research and co-inquiry approaches that are more common in the social sciences and the community development literature (e.g., Bergold and Thomas [2012]). In the UK, there has been a recent growth in awareness of the importance of community-university research partnerships as a way of developing meaningful research questions and also ensuring the sustainability and relevance of research findings (be these oriented towards technology and design or otherwise) [Banks et al. 2013]. We might consider the ways in which partnerships between older age advocacy organisations and their members might provide a useful starting point for these types of activities where older people help develop research questions for HCI researchers to investigate, rather than just be used as a supply of participants to take part in already defined studies. Indeed, organisations such as the University of the Third Age are already piloting competitions where older people develop ideas for research into ageing to be conducted with researchers from their local universities [U3A 2012]. While this highlights again the potential of ageing and older people as a resource of ideas, creativity, and insights (as per Rogers et al. [2014]; Carroll et al.

[2012]) it also highlights opportunities for older people to question, challenge, and change the dominant narratives of ageing in research and societal as a whole.

6. CONCLUSION

In this article we have presented DA of 644 archived SIGCHI publications related to ageing. The aim of this article has been to identify the dominant discourses surrounding ageing invoked by publications at SIGCHI venues. While we have been critical of the overt focus on decline, deterioration, loneliness, separation, health, and the construction of older people as a homogeneous group, we have done so with the aim of opening up new perspectives on what it might mean to age in modern societies. As such, we see our work as complementary and developing further recent critiques and commentaries on the dominance of deficit-driven (e.g., Carroll et al. [2012]) and assistive (e.g., Rogers et al. [2014]) approaches to developing technology for older people in HCI. As with these recent arguments, we investigated the problems of these dominant discourses with a view to directing the HCI community towards new research and design opportunities. Our research agenda has been developed to open up new ways of thinking about how we as a community might go about challenging and changing what could be viewed as negative stereotypes of ageing that prevail in society and permeate the SIGCHI literature. We have provided four specific challenges and suggestions for how future research might go about this, not with the view of giving precise directions for design but with the intention of changing the basis with which we develop research questions and involve older people in research in the first place.

We have focused entirely on ageing as a research concern in HCI. But the challenges we have described are by no means limited to just the study of older people using technology. First, we must remember that ageing is not a phase of life but a process that happens across the entire life course. Second, the types of social constructions and power relations we have attended to here potentially affect all manner of human-centred topics within HCI—such as exploring further the social construction of disability [Mankoff et al. 2010], or the construction of knowledge and power dynamics in domains such as ICT4D [Dourish and Mainwaring 2012] and sustainability [Brynjarsdottir et al. 2012]. We have shown that ageing is an important research area for HCI, evidenced in the growing popularity of the subject within the papers presented at leading conferences. Clearly it is no longer a specialist subject of a few key researchers but an issue that broadly permeates the literature. We have contended that with this increased permeation there has come a tendency to draw upon discourses of ageing that implicitly frame older people in a negative light. We have further suggested that HCI can learn from disciplines that are committed to challenging discrimination and engage in critically reflective practices, and this learning would enable us to open up new design opportunities.

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