12-1-2018

Designing for Older Adults: Overcoming Barriers to a Supportive, Safe, and Healthy Retirement

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Keywords

Older adults, digital marginalization, technology, gerontology, FinTech, cyber-safety, robo-advisor

Disciplines

Health Economics

Comments

The published version of this working paper may be found in the 2019 publication: *The Disruptive Impact of FinTech on Retirement Systems.*

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December 2018

PRC WP2018-17
Pension Research Council Working Paper
Pension Research Council
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Older adults[1] are often considered to be technologically less savvy than the average population (Grimes et al. 2010), which is due to several factors: declining tech savviness as seniors retire from the workforce, or social isolation which reduces the available peer support that can provide assistance and encouragement in adoption online technologies. This can affect several aspects of their security and well-being, such as increased risks of exposure to financial loss (e.g., through scams) (Garg 2011; CFAC 2014).

At the same time, numerous seniors are or feel socially isolated (Nicholson 2012). These two issues may be in fact co-dependent: our own research (Munteanu et al. 2015) has revealed that seniors[2] rely on their social network for support with Internet-related problems and that they avoid many online activities as a consequence of their lack of digital confidence or concerns with exposure to risks (e.g., fraud).

Older adults tend to acquire most of their digital knowledge from family (Boothroyd 2014). However, socially-isolated seniors may have limited contact with family or friends that can provide such knowledge, so instead they rely on mass-media for information, often presented in alarming terms (Boothroyd 2014). This lack of support limits opportunities that would allow them to learn about online practices (e.g., safety), which in turn may deter older adults from participating in online activities such as shopping or banking. This puts older adults at a disadvantage, as the Internet can provide them with relevant resources (Czaja et al. 2009), and more importantly, access to means that can aid in reducing the social and digital isolation (Czaja and Lee 2007) from which this issue may stem.

Background

The issue of digital marginalization that emerges from the combination of lack of access to

social support and the uneven technological literacy may be further compounded by aspects of usability (ease of use) and perceived utility of digital (online) technologies. The Technology Acceptance Model (TAM) (Venkatesh and Davis 2000) indicates several factors that affect the adoption of (potentially beneficial) technologies, particularly by older adults (Venkatesh et al. 2012). TAM is a widely used theoretical framework that examines how people accept and use a specific technology. While not without its shortcomings (Salovaara and Tamminen 2009), TAM has been successfully used in the (scant) work studying the factors affecting the adoption of technologies by older adults (Neves et al. 2013).

Two of the key adoption factors captured by the TAM are usability and perceived value (usefulness / utility). Grudin (1992) defines usability as the property of a software system to be 'easily learned and handled' by its intended users, with usefulness referring to the attribute of 'serving a recognizable purpose'. Within this context, the TAM is typically interpreted to indicate that, in order for seniors to adopt a software system (or more broadly, digital technology), such a system must be highly usable by them, but also offer a recognizable purpose. The latter factor is often reduced to the notion of offering older adults the motivation to learn how to use that system and potentially overcome usability barriers – motivation that is intrinsically tied to the system being perceived as offering a value. Such motivation (value) is prompted by a variety of factors, among the most frequent being the desire to maintain family connections or the need to leverage such connections (Neves et al. 2015; Dang 2016). Many of the most ubiquitous software tools widely used for daily activities (e.g., online banking) are often not designed to be usable by older adults (Franz et al. 2015; Munteanu et al. 2015). This further marginalizes seniors with respect to the adoption of digital technologies, as the perceived value of these tools needs to be relatively higher in order to motivate older adults' in investing efforts as required to overcome usability

issues.

Barriers to Designing FinTech for Older Adults

Designers and developers of essential digital services and tools intended for older adults (such as online banking or other online financial tools) must therefore find solutions that address the barriers to adoption as related to usability, perceived usefulness, and lack of (or reduced) digital literacy. These are interconnected with issues of older adults' social isolation and digital marginalization, which in turn further amplify such barriers. In this chapter we argue that, at the core of these barriers, lies one of the most fundamental concepts related to designing (interactive) digital tools: mental models.

Present in many disciplines (Rouse and Morris 1986), mental models can be seen as intrinsically related to the aspect of perceived usefulness and usability in the TAM. Within a technology space, mental models define what a user believes about how an interactive system or digital technology works (Nielsen 1990). That is, a mental model captures what users 'know (or think they know) about a system such as a website' (Nielsen 2010: np). For example, the ability of being able to type in search terms in the 'address bar' of modern (as of 2018) browsers is a feature added in response to users' mental model of entering terms into browser or website elements that have the appearance of a search box – this mental model likely developed as the results of users' accessing the websites of online search engines such as Google (Mental Models in Design 2018).

Mental models are influenced by many non-technological factors, including users' socio-demographic background or cultural norms and expectations (Moffat 2013; Neves et al. 2015). For designers of such systems, the challenge is to minimize the mismatch between users' mental

models and how the system is designed. A large gap between designers' mental models and users' models can result the technology adoption factors established by the TAM to be degraded – namely the perceived usefulness and usability. This is due to the appearance of two 'gulfs' caused by this mismatch, as defined by Norman (2013): the 'gulf of evaluation' and the 'gulf of execution'. The gulf of execution is the difference between what users think a system can do and what the system can actually do, while the gulf of evaluation captures how difficult it is for users to interpret a system's internal state. In particular, the gulf of evaluation captures the connection between mental models and the perceived usability / usefulness as defined by the TAM – for example, does the system provide easy to understand information that matches the way the user thinks of the system? A typical (albeit simplistic) practical example of the gulf of evaluation is the use of either 'on' or 'off' labelling on a Bluetooth connection sliding switch, which when the label shows 'off' but the slider position is opposite the 'off' label, this can interpreted as either 'status: off, slide to turn on', or just 'slide to turn off' (Whitenton 2018)

If designers of essential digital services fail to fully understand the mental models of older users, including their use of alternative ways of accessing the service, not understanding how the proposed service works, and not understanding the benefits the proposed new service is offering, then this may lead to older users' non-adoption of a new digital service. In particular, we look at mental models and adopting online services from the perspective of trust, especially in relative terms between the trust in online platforms and the trust in established ('traditional') services.

Solutions to Designing FinTech for Older Adults

Numerous design approaches exist that aim to improve the user experience with new digital tools or services. Yet many of these design methods are activated only later in the service

development cycle, often after assumptions about users' needs are already drafted from a variety of sources and methods. By contrast, the design of essential services (e.g., within the space of FinTech for older adults) can lead to increase adoption rates if more in-depth methods are employed that build an extensive understanding of users' specific practices. We make the case for the use of Contextual Inquiry (CI), a method successfully used in domains like the workplace for predesign stages, but not widely explored when designing for older adults. We evaluate how employing such requirement-collecting methods, complemented with user-centred design strategies such as Participatory Design (PD) can lead to a reduction in the gap between older users' mental models and those of the system's or service's designers, and subsequently, to an increase in adoption. We then discuss how this is particularly relevant for the design of FinTech for older adults, such as online banking or other online financial services.

Barriers to FinTech Adoption by Older Adults

Financial security in retirement is one of the most pressing concerns faced by older adults (Kemp and Denton 2003). As such, many older adults are actively pursuing strategies to ensure this goal is attained (Kemp and Denton 2003; Sixsmith et al. 2014). This seems to be a universal concern independent of several other factors, including the availability of government-funded or government-backed retirement plans that are found in countries with social safety programs such as Canada (Raphael 2001).

Some of the concerns with respect to the financial aspects of retirement are due to the complexity of planning long-term strategies that ensure income security in retirement (Vettese 2015). Additionally, retirees face the prospect of uncertainties at older ages, especially if income sources are not from government-backed or government-funded defined benefit plans. This can

lead to seniors resorting to other strategies (e.g., drastic reductions in spending and thus in quality of life) as a precautionary mechanism to ensure financial security (Vettese 2016). Many older adults face increased difficulty in managing their financial plans, even if otherwise they planned well for life events (Denton 2004). Some researchers suggest that cognitive decline, alongside other ageing-specific factors (e.g., lack of financial literacy), contributes to the older adults' difficulty in managing their finances and planning for a secure retirement (Loibl 2017). However, others disagree with the role of cognitive decline in older adults' financial planning, and instead suggest that 'domain-specific knowledge and expertise provide an alternative route to sound financial decisions' (Li 2015: 65). This indicates that designing services to support, encourage, and educate older adults with respect to their financial practices may provide a solution to this problem (Lusardi 2007).

Several policymakers have called upon financial institutions to provide educational programs or resources for older adults in order to assist them with planning for a secure retirement, including protecting their financial assets from fraud (Blazer 2015). Yet, such recommendations may be at odds with industry trends that see a shift from 'brick and mortar' banking and financial services to the online space (Campbell 2017). Such a shift may disproportionately affect older adults, since recent research has shown that seniors are the demographic group that has the lowest adoption of online banking and financial services (Alhabash 2015). Yet, there is some evidence that adoption of online FinTech can be increased if factors other than convenience are considered – for example, the establishment of a relationship of trust with a 'brick and mortar' financial institution can be successfully (albeit slowly) transferred to the online services offered by the same institution (Montazemi 2015).

Barriers to the adoption of online FinTech services by older adults have been explored in

other fields as well. In particular, research in Human-Computer Interaction (HCI) and within this, User Experience (UX) Design, have recently started addressing the barriers faced by this demographic. These research and design fields are concerned with understanding users in relation to technology, and with designing solutions that make interactions with technology easier, more meaningful, and more relevant to users (User Experience Design 2018).

An example of such research is work by Vines et al. (2012), who have conducted an ethnographic-like qualitative study of how older adults envision and engage with electronic payments. The study has revealed significant issues with respect to how older users perceived online FinTech services, such as lack of trust (in both the provider of the service and in the underlying technology) or lack of confidence in using the online version of these services (e.g., 'Electronic records are seen as ephemeral', as quoted in the above-mentioned paper). This suggests that, in addition to the dimensions established by the TAM (namely, perceived usefulness), a significant barrier is represented by the mismatch between how online FinTech services work and how older users perceive them: that is, their mental models of these services.

Mental models have been extensively explored in behavioural economics and financial research, most recently from the perspectives of individuals' relationship with economic and financial policies and developments (World Bank 2015), and within the contexts of (financial) decision making (Denzau 1994; De Bondt 1995). New perspectives have also emerged linking individuals' mental models to how financial services work, and the consequences of mismatch between these (Acemoglu 2009), such as consumers' perception of how a company operates within a market space. This, together with the UX research of (Vines et al. 2012) that identified differences of perception about how online financial services work, further supports our argument that the design and development of FinTech for older adults must focus on addressing the barriers

represented by older adults' mental models of such services (in addition to other UX-related barriers, such as perceived usefulness and usability).

Designing for Mental Models

We offer three case studies supporting our central argument that mental models are a key component of the barriers to older adults' adoption of online FinTech. These are drawn from our own qualitative and field research on understanding older adults' information practices in three key areas related to their retirement: social isolation, health information access, and online safety. We elaborate on two methodological aspects related to designing for mental models: understanding older user needs with respect to an online service, and engaging users in the design process in order to ensure the final service matches their mental models.

Understanding Users' Needs

There is a long history of methods in Human-Computer Interaction that include user input in the process of designing technologies. Most methods engage users through various approaches to elicit requirements for the design of interactive applications; such engagement aims to produce designs that meet users' needs. However, as older adults are often less familiar with technology or are reticent to adopt new technologies, designing for these users may benefit from initial research that does not ask seniors to directly join in the design process or respond to the technology right away. For this, data about users' information practices needs to be gathered outside of the design context, before a design solution is even considered. That is, an ethnographic approach is needed to build such an understanding of users' current practices. Ethnography is a social science research method that facilitates the understanding of issues affecting people as they engage in their daily

lives or in specific activities (e.g., workplace); this understanding is drawn from either over or covert extensive observations by the researchers (Hammersley and Atkinson 2007).

Grounded in on our own research experience, we argue that Contextual Inquiries as a form of Ethnographies are a suitable approach for understanding users (and subsequently, their mental models) in the context of activities essential to maintaining a financially safe, socially-connected, and healthy retirement for seniors.

Contextual Inquiry

Contextual Inquiry (CI) is a method for Human Computer Interaction research and requirements gathering, similar to ethnography, that seeks to observe and understand how a new design can fit within a current practice with minimal disruption. This method presents a particular way of doing observations that builds an understanding of user practices. These observations lead to the creation of a design that supports or improves upon the observed actions and is more likely to be adopted (Wixon et al. 1990; Beyer and Holtzblatt 1997). The observations for a CI are focused on the relevant activities and can be prompted by the researcher for the purpose of observation, with participants being encouraged to explain what they are doing and why.

This method is helpful in developing an in-depth, focused understanding of a user's practices, their related motivations and attitudes, and how a new design can fit with those practices. While it was initially intended for use in the workplace, it is also useful when working with any specific group of target users in a given setting, including to building an understanding of older adults' practices as a prerequisite for designing a technological solution. Yet, it is only recently that CI has started being used for this demographic. For example, this approach was taken by Muskens et al. (2014) to understand how older adults may use mobile devices as a replacement for TVs, which resulted in the design of an entertainment-focused media consumption tablet app that

mimics many of the channel-browsing features of traditional TVs. In our own work we have employed CI methods to gain insights into the role that paper or digital photographs play in prompting older adults to share stories about past memories – this lead to the design of an intuitive tablet app that increases social connectivity by engaging older adults in oral storytelling around digital photographs (Axtell 2017).

Contextual Inquiry Methods for Older Adults

Contextual Inquiry (CI) is a qualitative field method that employs in-situ observations of users, combined with thematic analysis of these observations to build a detailed understanding. Beyer and Holtzblatt (1999: 34) describe CI as 'an explicit step for understanding who the users really are and how they work on a day-to-day basis.' Users often have difficulty expressing what they do in detail and explaining their motivations, so CI observations expose the elements of the work that would not otherwise be articulated by a participant, but are an essential part of their process. These observations are around the tasks, activities, practices, and uses of artefacts (technological or not) relevant to the participant's process. Directly observing these allows the researcher to identify how a new design could be introduced within a participant's current practices with minimal disruption. To support these observations, Contextual Inquiries are guided by four core principles:

(1) Context: observations in the natural setting to get the best and most relevant data.

(2) Partnership: researcher and participant collaborate in understanding the work as only the participant knows everything about their practices.

(3) Interpretation: analyzing the results for themes and meaning which leads to a new design.

(4) Focus: sharing a common starting point to guide the observations and conversation and move towards a common goal.

These principles guide the process in order to understand what matters to users and analyze the results for themes that can lead to new design ideas. Through these, the observations expose more than the participant's actions, but also their knowledge, abilities, and attitudes. This process can also expose details about their particular practices that may not be conscious choices on their part.

The usual steps of a CI study are to: observe the relevant practices in the participant's environment, follow the observations with interviews guided by the users to expand on their actions and motivations, analyze the observations and the interviews to find themes and build understanding leading to an initial design, and evaluate the resulting design with the target users performing their actual tasks, if possible (Wixon et al. 1990). From a methodological perspective, these steps implement the four major phases of a CI, which are, as per (Wixon et al. 1990):

(1) Phase 1 (Inquiry): Talk to specific participants in target areas.

(2) Phase 2 (Interpretation): Interpret the data to capture the key issues emerging from the inquiry.

(3) Phase 3 (Models): Consolidate data across participants and build models that provide a holistic understanding of the identified issues.

(4) Phase 4 (Visioning): Redesign the way the tasks are performed, through the use of new technology.

The first three phases represent the requirement gathering part of designing new technology, focused on understanding what matters to users and on characterizing what users do (Wixon et al. 1990); the fourth phase helps with the concrete steps of designing solutions.

Contextual Inquiry Case Studies

Many of the issues affecting older adults' UX when interacting with current interactive technologies are known – for example, deteriorating visual acuity or decline of cognitive function, leading to current websites' or interfaces' lack of accessibility for older adults (Johnson 2015). Such issues further risk digitally marginalizing older adults, as prior research has revealed that usability is a key factor for the successful long-term adoption of potentially-beneficial technologies by older adults (Venkatesh et al. 2012). However, the tools and methodologies employed in the research and commercial development of Internet and mobile technologies at best follow UX design principles that are largely the same as those used for any other user group. In most cases, some of the current practices of technology development only marginally incorporate UX design approaches (and often only in name). At worst, some such approaches have been downright questionable – even described as 'snake oil' by some scholars (Sauro 2017). While this is in part due to a lack of industry awareness or knowledge about UX design and development, more often this is in fact due to a widespread lack of adequate tools to support senior-focused design and development.

The consequences of this are twofold: a further widening of the digital divide facing older adults, and a barrier toward market adoption of beneficial technologies such as online banking. As outlined in the previous section, richer UX methods are needed to overcome these barriers, amongst which some of the stronger ones are mismatched mental models. We have proposed updates and refinements to one such rich method – CI – which facilitate the design of technologies that are more usable by older adults and that lead to a better user experience for them. In our lab, Technologies for Ageing Gracefully, we have applied this method to several of the short and long-term user experience studies on designing interactive technologies to support older adults' essential

activities. We describe here the results of three such recent projects, demonstrating the suitability of our CI adaptions for collecting design requirements (grounded in an understanding of mental models) for this demographic. The projects address three essential aspects related to quality of life in retirement: safety, wellness (health), and social connectivity. We then draw parallels and implications for the FinTech industry, and outline recommendations for employing this method for the design of senior-centred digital financial tools. In the next section we elaborate on how additional user experience research methods (namely Participatory Design) can assist with implementing the design requirements collected through CI investigations with older adults.

Staying Safe and Avoiding Financial Scams (Online)

The number of Canadian adults aged 65 or older who are active users of the Internet is constantly increasing. The 2011 Census (Stats Canada 2011) indicate that 66 percent of such adults are daily Internet users. Yet such users are also the most vulnerable – often seen as 'novice' and lacking 'security awareness' (Grimes et al 2010). The Canadian Anti-Fraud Centre (CFAC) estimates that older adults are the preferred target of various Internet scams, with more than $10 million being reported lost annually to online financial fraud.

Prior research on this topic showed that older adults typically adopt technologies upon encouragement from family members, and they tend to acquire most of their knowledge about the device or tool from family as well (Boothroyd 2014). This applies to financial tools as well, such as online banking. However, the limited contact older adults have with family or friends limits opportunities that would allow seniors to learn about online safety and instead forces them to rely on mass-media for information, often presented in alarming terms (Boothroyd 2014). This may further exacerbate the mental models employed by older adults when interacting with online technologies, especially with respect to financial concerns. In our research (Munteanu et al. 2015)

we have found that, lacking a strong social network that seniors can use to troubleshoot Internet-related security problems, they avoid many online activities due to concerns about financial losses or breaches targeting their private data. This can have significant implications for FinTech designers and developers.

Our research conducted a cross-disciplinary investigation consisting of a mixed-methods approach, which aimed to answer several questions related to the information practices of older adults with respect to online safety. The study was conducted using our adaption of Contextual Inquiries. Ten older adults participated in the study, each of them taking part in an extensive (2+ hour) session consisting of CI observations, interviews, and questionnaires. The CI observations were structured around several tasks, such as processing email messages, some crafted by the research team to mimic a variety of common templates used by financial scammers posing as legitimate businesses. Additional messages were used that were legitimate but which were flagged as potential threats, such as emails from established but lesser-known charities. The main activity of the CI session consisted of engaging in typical tasks with a banking website – the website was designed to match the look and feel of a real bank but with some elements suggesting that this may not be the case.

The thematic analysis of data collected during these sessions revealed several interesting findings with respect to our participants' mental models of online financial tools and the barriers toward their adoption, particularly as related to safety concerns. The most salient theme was that of resistance to the use of online banking and similar applications. This was mostly driven by low trust, among other factors, in the online process of transacting both monetary value and private information. This varied depending on the entities involved in such transactions, with higher trust being placed in financial institutions having a recognizable physical presence. This confirms some

of the themes captured in the prior research on investigating barriers to transitioning from paper cheques to online tools (Vines et al. 2012).

In terms of mental models, we have identified a preference for interacting with 'real people' for financial transactions. Performing such tasks online competes with their current mental models – there is no 'safety net' online (as participants mentioned to us: 'if something goes wrong, whom can I talk to? Where do I go?').

Finally, aspects of the TAM were visible in other themes, such as the lack of motivation for adopting a new way of performing activities that were done 'in person' before. Some participants did not feel the need to migrate financial activities online and were satisfied with the status quo. Our observations also confirmed the usability aspects of the TAM – the new (online) tool must be not only easy to use, but instill confidence. Even for participants that saw a measurable benefit (e.g., increased convenience such as form not having to walk outside during winter), there were concerns about making mistakes and 'breaking things'. In some cases, these were mitigated by an approach to learning that was hands-on, with encouragement and support from family or friends.

Recommendations for FinTech. Contextual Inquiries can expose older users' mental models with respect to how they trust an online platform that transacts both monetary values and personal (financial) information, and how they perceive the benefit / effort trade-off with respect to learning how to use a new tool.

Accessing Essential Information Online

Although there has been much research in the last two decades on technology for knowledge acquisition and sharing, little of this has considered seniors and their sense of independence and control as the primary target. Moreover, where research has focused on older adults, it has predominately studied them as consumers of content, knowledge and care, rarely

focusing on their capacity to manage and even contribute to knowledge creation. To address this gap, we have engaged in a mixed-methods study to develop a more integrated approach to acquiring, managing, and sharing increasingly-complex information by older adults. For this, we have focused on online health information access as a representative case, in particular investigating the privacy aspects of older adults' mental models with respect to online information access and sharing. This is grounded in prior research (Prasad et al. 2012) which showed that seniors are willing to share private information (such as health) depending on whom it will be shared with.

In a study with twelve older adults we sought to answer several questions, such as: Who do seniors trust within their care or social circle when discussing private information and concerns (such as health)? How do seniors seek answers to questions and concerns they have? And, how do seniors judge the reliability and credibility of online sources of information?

The thematic analysis of data collected from contextual inquiries of typical online health information access activities (e.g., accessing information repositories) revealed several key findings. We found that seniors are active information seekers, actively engaged in reading several sources of information. When they lacked understanding of the information presented, they preferred to seek answers by themselves, out of both their desire to safeguard their privacy and their concern for not burdening their social or care circle. However, their expectation of full privacy and control over their health information was often at odds with their preference for prompt answers to their questions about the information found, especially when encountering technical jargon.

With respect to trust, we (unexpectedly) found that almost all participants in this study were aware of the reputation and trustworthiness of various online repositories of health information as

well as online discussion forums. Our observations suggested a higher level of trust in website that had ‘name recognition’ but which also had information written in a more professional (but also technical) manner.

Implications for FinTech: When conducting Contextual Inquiries with older adults, it is crucial to focus on activities that are related to information seeking (including question-answering tactics) with respect to the (technical) domain of the application that is to be designed. Such activities may reveal the mental models with respect to trust in information sources.

Sharing of Personal Artefacts

The last of the three cases studies we discuss here is centred around social connectivity. We followed the CI method in an observation of nine older adults and their interactions with family pictures, with the goal of creating a digital tool that supported casual picture interactions. Existing digital pictures solutions were not being adopted by older adults, particularly for use in reminiscence activities. To better understand why this was and what might support their reminiscence in digital spaces, we wanted to first understand what they get out of sharing stories around paper pictures and their practices with physical pictures, so CI was a natural choice for this study. We conducted CI sessions in participants’ homes to prompt casual oral reminiscence in its natural setting.

Across participants, we observed many different choices in how they stored and accessed their pictures, from photo albums to tablets. We also encountered common themes across participants, such as a curated wall of family pictures in a commonly-accessed space. The prompt for the observation was intentionally open, allowing the participant to guide the experience. They were asked to show the different ways they stored and shared their family pictures, to guide the researcher through some of these storage items, and to freely reminisce from them. Nearly all

participants used traditional photo albums, though some preferred framed pictures or tablets. As the observed practice involved speech, participants were not able to describe what they were doing in the process. Some research has also shown that these 'think-aloud' methods are less effective with older adults (Franz 2017). Instead, we followed the observation with an interview expanding on their recent reminiscence. This built on the observations to expose user motivations and requirements without biases or assumptions that may come with the expectation of new technology.

While this project was focused on designing novel interactive technologies that enhance social connectivity through storytelling based on digitized pictures, the analysis of data collected from the CI sessions revealed some interesting aspects about the participants' mental models. In particular, we found that participants' mental models of online cloud storage for digital pictures show that this is considered less permanent than paper options. This is aligned with other preliminary prior work (Petrelli et al. 2009; Keightley 2014) which revealed that older users' mental models of online storage is perceived to be insecure.

Implications for FinTech. Older adults' mental models of online technologies, especially as applicable to storage of valuable artefacts or information (e.g., cloud storage), may not fully reflect the risk-benefit ratio of such technologies as compared to their non-digital equivalents. When designing FinTech solutions that require safeguarding of valuable information or digital artefacts (e.g., pension documents), Contextual Inquiries can help identify the mental models held by older adults with respect to their perceptions of risk of losing this valuable information.

A UX Approach to FinTech Adoption

As we have illustrated earlier, designing technologies that support older adults' access to

essential services in retirement needs to overcome barriers related to mismatched mental models. This was evident in our research investigating a wide range of services, from access to online health info and to cloud-based social sharing of photos. Moreover, it was particularly salient in our work on understanding older adults' practices with respect to online safety such as avoiding financial scams. Extracting these insights into how older adults may interact with digital technologies that complement or replace existing services (such as banking or financial support) was greatly facilitated by our use of methods that more deeply expose users' mental models. Contextual Inquiries can reveal hidden elements of user's mental models that result from the difficulty associated with verbalizing one's process (Liaqat et al. 2018b). Accordingly, we have illustrated the value of ethnographic gathering methods such as Contextual Inquiries as a critical component of the design and development of technologies to support older adults' essential retirement services.

Studying users in context and being able to understand their mental models is an essential design step, but this in itself is not sufficient to ensure that the resulting design is fully adoptable by older users. Nor is there a single design method that can address all usability and adoption aspects. We suggest that methods that engage users more deeply at all stages of the design process be used – in particular, Participatory Design (PD), which can complement and augment many of the methods typically employed in User Experience Design (Preece et al. 2015).

Participatory Design integrates users into the technology creation process through a variety of methods such as interviews, observations, or design activities (Muller and Kuhn 1993; Muller 2003). While Participatory Design is used to elicit requirements throughout several stages of the design-development cycle, its core method (collaborative design) is most useful in the early stages of this cycle, as this prompts users to propose and visualize a potential design. PD involves users

at all stages of the design, and elicits their direct input for specifying the design and the functional requirements of a system (Schuler and Namioka 1993). Typically this is conducted in the form of small workshops, during which participants work in groups of two to four to complete sketching activities around the design of a low-fidelity user interface prototype on paper, using a variety of design props such as sticky notes, printed icons, markers, etc. (Liaqat et al. 2018b).

While Participatory Design has been extensively used to designing a wide range of applications for older adults, including in our own research – from fall prevention monitoring (Yu and Munteanu 2018) to learning support tools (Liaqat 2018a) – its role in designing FinTech for older adults is only recently receiving attention. The most notable such research is that of (Vines et al. 2012) who employed Participatory Design with older adults to design digital alternatives to paper cheques. Older adults' mental models of financial services was identified as the most significant barrier to the migration of such services to an online space, but the use of PD to design an alternative to a financial instrument as common and entrenched as paper cheques was critical in overcoming such barriers. This suggests that Participatory Design is a promising method for the design of FinTech for older adults.

Considerations for Older Adults

User Experience (UX) researchers face methodological challenges when working with older adults. For example, focus groups (a widely-employed UX research method), is more difficult to run with senior users due to the participants' declining communication abilities (Barrett and Kirk 2000). Other common UX methods such as interviews or usability assessments can result in inaccurate data by encountering issues such as participants responding with what they think the researcher wants to hear (Franz 2017). While these methods continue to be used, CI may better

support early research with older adults without these challenges.

In particular for FinTech, CI has the potential to exposure older adults' mental models that otherwise may not be uncovered through other elicitation techniques. This is due to the 'master-apprentice' model employed by CI, in which the researcher not only observes the users performing tasks in their own environment without being influenced, but is 'coached' by the user in how to perform those tasks. This is particularly useful when designing a new application that aims to replace an existing service, such as is common when transitioning financial services to an online-only operation. Often in such cases, the research or the design team may have their own mental models which are different than those of the target users with respect to how the service (and the application) works. This is an issue that may be very relevant to (online) FinTech, due in part to different generational perspectives on how financial services are or should be delivered. In addition to addressing the issues caused by generational differences in mental models, using Contextual Inquiries in the early stages of designing such technologies may also mitigate other barriers that older adults face in adoption digital technologies. One of these is the stigma associated to (lack of) technology use, which may influence how older adults respond when questioned directly about their activities during the requirements gathering stages of UX design (Franz 2017).

Earlier in this chapter we have presented the findings of CI studies with older adults that reveal an understanding of key practices that would have otherwise been more difficult to develop. These findings are relevant to several dimensions that define a positive retirement experience: financial safety, health knowledge, and social connectivity. These also illustrate how CI can help designers better understand older adults' mental models with respect to adopting solutions which are technologically similar to those found within FinTech. Based on these, we detail here three new methodological considerations shaping how to apply Contextual Inquiries to the early stages

of designing with older adults:

Observations separate from technology. To support CI observations in as natural a setting as possible, participants should not be biased by introducing issues of technology and its adoption before they have had the chance to demonstrate their current practices. CI observations should be completed before introducing the idea of a new or modified technology, to avoid the potentials for stigma and limited access. Introducing the concept of new technology before the observation can bias how senior participants demonstrate their activities.

First support current practices. New technologies often leave behind older adults and their preferred practices, so the understanding and resulting design should first aim to support current practices, and second to improve on potential existing setbacks or limitations. In our studies, we have observed seniors maintaining time-consuming or difficult but familiar practices rather than adopt a new technology that forces them to change their process. Technology adoption is more likely if older adults do not need to adjust their current activities or learn new processes, though this should not lead designers to consider emerging technologies as not adoptable. One of the case studies discussed in this chapter shows CI findings lead to designs supporting current activities (family picture reminiscence prompted by looking at photographs) along with expansions such as features supporting the creation of multimedia digital stories.

Realistic side-by-side comparison. When assessing the design, after completing the four phases of a CI, participants should be able to experience the new technology in as realistic a setting as possible and be given the chance to compare that to their current activities. Providing a practical example of how they might use a new design, ideally with their own data (e.g.,, their calendar, pictures, etc.), and enabling them to compare that to current practices provides concrete experience and contextualizes that experience within their familiar activities. This recommendation is based

in our own experience running studies where we have noticed how seniors benefit from relating the new design to their prior practices. Older adults should be asked to first assess just the parts that support the existing practices before being introduced to potential improvements or other changes in the new design.

Conclusion

Several barriers exist when designing interactive applications for older adults to support them in their retirement. We propose that mental models are such a key barrier, and we have found that CI – an often-overlooked UX research method – may be used by designers of critical services such as FinTech to better expose older adults' mental models to designer. Based on three cases studies of research on older adults engaging with essential digital services, we suggest several adaptations to CI that may increase its applicability to FinTech design:

(1) Observe and interview older adult users as they engage with the relevant activity without introducing new technologies;

(2) Build and understanding of their current practices in order to ensure these are first and foremost supported in any new technology or digital service that is to be developed;

(3) Evaluate new designs in realistic settings with older adults using their own artefacts;

(4) Compare these to users' existing processes in the same session so they can provide direct feedback about the new experiences.

The evaluation should separate existing practices and any potential opportunities provided by the new technology in order to remove the potential biasing effect of these new tools.

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Endnotes

1 We consider older adults as being 65 years old or older, as per Statistics Canada's definition (Stats Canada 2012), while also capturing research that includes adults age 55 to 64 if relevant, such as for studying longer-term concerns (e.g., retirement, health), as per Statistics Canada's reporting (Schellenberg and Turcotte 2007).

2 We acknowledge that there is a significant debate on the appropriate term to describe such a broad user group (Taylor 2011; Smith 2012). In this work, we interchangeably use the terms 'older adults' and 'seniors', as we have informally found that our participants (in studies conducted in our lab) refer to themselves by either of these two terms. Additionally, the present study was exploratory in nature and not aimed at a particular subset of this demographic. It should be noted that, in the region we are located, the term 'senior' is the most commonly used to denote 'older adults' without a more specific age definition, including by the relevant funding agency and government ministry that supports our work.