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

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Abstract

Older adults (65+) are at increasing risks of being "digitally marginalized". This 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 results in seniors having difficulties or being exposed to security risks when accessing essential services which are increasingly moving online: making critical life decisions, understanding health information or accessing health services, staying connected to families, or simply doing online shopping.

In our research we investigate how online technologies, that are designed to be inclusive of older adults' needs, abilities, and contexts, can help address some of the consequences of digital marginalization. We have uncovered several barriers toward the adoption of such technologies: mental models with respect to technology adoption; behaviours and attitudes related to critical decision making; privacy concerns related to accessing information online; and overall cybersafety concerns preventing seniors from engaging with such resources online. We propose design approaches that sectors such as fintech can incorporate into services and applications to better serve the needs and constraints of older adults.

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1. Introduction

Older adults[1] are often considered to be technologically less savvy than the average population (Grimes et al, 2010), which 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, 2013). 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, 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, and instead 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, 2009), and more importantly access to means that can aid in reducing the social and digital isolation (Czaja, 2007) from which this issue may stem.

1.1. 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

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1   We consider older adults as being 65 years old or older, as per Statistics Canada's definition (http://www.statcan.gc.ca/pub/11-402-x/2012000/chap/seniors-aines/seniors-aines-eng.htm), 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 (http://www5.statcan.gc.ca/olc-cel/olc.action?objId=89-519-X&objType=2&lang=en&limit=0).

2   We acknowledge that there is a significant debate on the appropriate term to describe such a broad user group (e.g. https://www.bcli.org/older-adult-older-person, or http://www.geripal.org/2012/03/elders-older-adults-seniors-language.html). 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.

and perceived utility of digital (online) technologies. The Technology Acceptance Model – TAM (Venkatesh, 2000) indicates several factors that affect the adoption of (potentially beneficial) technologies, particularly by older adults (Venkatesh, 2012). TAM is a widely used theoretical framework that examines how people accept and use a specific technology. While not without its shortcomings (Salovaara, 2009), TAM has been successfully used in the (scant) work studying the factors affecting the adoption of technologies by older adults (Neves, 2013).

Two of the key adoption factors captured by 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, 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, 2015; Dang, 2016). Many of the most ubiquitous software tools that are widely used for daily activities (e.g. online banking) are often not designed to be usable by older adults (Franz, 2015; Munteanu, 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.

1.2. Barriers to Designing Fintech for Older Adults

Designers and developers of essential digital services and tools that are 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 paper we argue that at the core of these barriers lays one of the most fundamental concepts related to designing (interactive) digital tools: mental models.

Present in many disciplines (Rouse, 1986), mental models can be seen as intrinsically related to the aspect of perceived usefulness and usability in TAM. Within the space of Interaction Design or User Experience Design, 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 a user "know (or think they know) about a system such as a website" (Nielsen, 2010). These models are influenced by many non-technological factors, including users' socio-demographic and cultural factors (Moffat, 2013; Neves, 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 the users' own model can result in several of the technology adoption factors established by 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 TAM (e.g. does the system provide info that is easy to understand and matches the way the user thinks of the system?)

We argue that, 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, not understanding the benefits the proposed new service is offering), then this may lead to older users' non-adoption of the new digital service. In particular, we propose to look at mental models within the space of 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.

1.3. Solutions to Designing Fintech for Older Adults

The second proposition for which we argue in this paper is methodological. Numerous design approaches exist that aim to improve the user experience with new digital tools or services. Yet many of such 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. We thus claim that 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, yet has not been widely explored when designing for older adults (to our knowledge, much outside our own work in this space). We explore 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 as modelled by the TAM. 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.

2. Barriers to fintech adoption by older adults

Financial security in retirement is one of the most pressing concerns faced by older adults (Kemp, 2003). As such, many OAs are actively pursuing strategies to ensure this goal is attained (Kemp, 2003; Sixsmith, 2014). This seems to be a universal concern that is 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 shared by OAs 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, they face the prospect of uncertainties past retirement, especially if income sources are not from government-backed or government-funded defined benefit plans – this leads 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). Such changes may be explained by OAs' increased difficulty in managing their financial plans, even if otherwise they plan well for other life events (Denton, 2004). Some researchers suggest that cognitive decline, alongside other ageing-specific factors (e.g. lack of financial literacy), contributes to the difficulty faced by OAs in managing their finances and planning for a secure retirement (Loibl, 2017). However, others disagree with the role of cognitive decline in OAs' financial planning, and instead suggest that "domain-specific knowledge and expertise provide an alternative route to sound financial decisions." (Li, 2015). This indicates that designing

services to support, encourage, and educate OAs with respect to their financial practices may provide a solution to this problem (Lusardi, 2007).

Several recent policies 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). However, 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 (CBA, 2017). In particular, this may disproportionately affect older adults – recent research has shown that seniors are the demographic group that has the lowest adoption of online banking and financial services (Alhabash, 2015). However, while scarce, there is evidence that adoption of online fintech can be increased if other factors than simply 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).

Such barriers for 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 particularly User Experience (UX) Design have recently started focusing on addressing the barriers faced by this demographic through user-centred design approaches. For example, (Vines, 2012) have conducted an ethnographic-like qualitative study that 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 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) or within the contexts of (financial) decision making (De Bondt, 1995; Denzau, 1995). However, in recent years new perspectives have emerged that explore individuals' mental models in relation to how financial services work, and

the consequences of the mismatch that exist between these (Acemoglu, 2009). This, together with the UX research of (Vines, 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).

3. Designing for mental models

We present here three case studies that support our central argument that mental models are a key component of the barriers to the adoption of online fintech by older adults. 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.

3.1. Understanding users' needs

There is a long history of methods in Human-Computer Interaction (HCI) that include user input in the process of designing technologies. Most of such methods engage users through various approaches in order 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. Grounded in on our own research experience, we argue that Contextual Inquiries are a suitable approach for understanding users (and subsequently, their mental models) in the context of activities that are essential to maintaining a financially safe, socially-connected, and healthy retirement for seniors.

3.1.1 Contextual inquiry

Contextual Inquiry is a method for HCI 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, Holtzblatt, & Knox, 1990; Beyer & Holtzblatt, 1997). The observations for a Contextual Inquiry 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 workplaces, it is 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. However, it is only recently (and still timidly) that CI has started being used for this demographic, e.g. work on designing an entertainment tablet app (Muskens et al, 2014) or our own work on supporting social connectivity through digital storytelling (Axtell, 2017).

### 3.1.2 Contextual inquiry methods for older adults

Contextual Inquiry is a qualitative field method that employs in-situ observations of users, combined with thematic analysis of these observations to build a detailed understanding. Holtzblatt describes CI as "an explicit step for understanding who the users really are and how they work on a day-to-day basis." (Holtzblatt & Beyer, 2012). Users often have difficulty expressing what they do in detail and explaining their motivations. 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 use 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 this way of observations, CI is guided by four core principles:

• 　　　Context: observations in the natural setting to get the best and most relevant data

•   Partnership: researcher and participant collaborate in understanding the work as only the participant knows everything about their practices

•   Interpretation: analyzing the results for themes and meaning which leads to a new design

•   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: 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 using techniques like affinity diagramming 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). Figure 1 visualizes the major phases of a Contextual Inquiry.
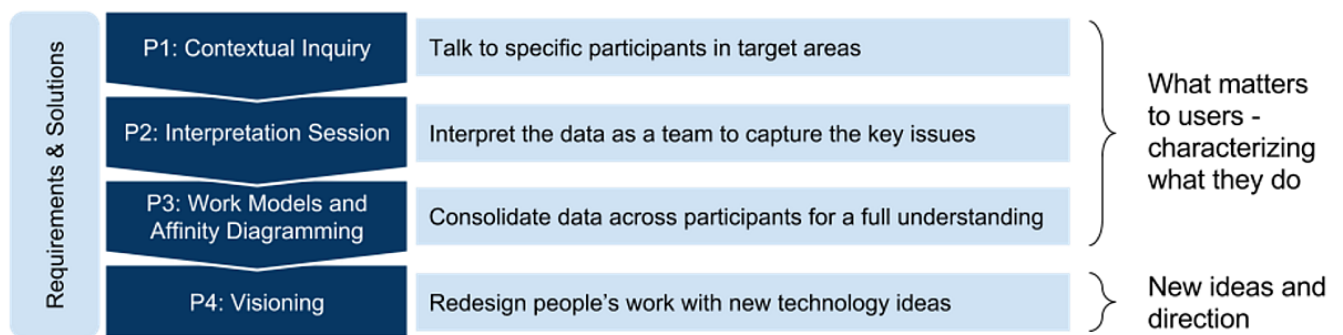
3.1.3 Considerations for older adults

Common methods for UX research have challenges particular to working with older adults. The difficulties of focus groups with senior users has already been mentioned (Barrett & Kirk, 2000). Similar issues are seen with other methods. 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, Contextual

Inquiry 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. The is particularly useful when the research may have different mental models than the target users with respect to the domain of the application – an issue that may be relevant to (online) fintech, due in part to generational perspective on how financial services are or should be delivered. This also lends itself well to research with older adults and technology as these users often need to manage issues with stigma when it comes to technology use, which may influence how they respond when questioned directly about their activities within the context of HCI research (Franz, 2017).

We detail here three new methodological considerations to apply CI 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. Contextual Inquiry observations should be completed before introducing the idea of a new or modified technology. Because of the potentials for stigma and limited access, introducing the concept of new technology before the observation can bias how a senior participant demonstrates their activities, because they will be concerned with how their experience will be changed by this research.

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 their current practices, and second seek 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, but the features that may only be practically possible with modern technologies (e.g., speech recognition or video

calls) should not be set aside solely because they are inherently not a part of the observation. The exemplar study in the next section shows how CI findings lead to designs supporting current activities (family picture reminiscence) along with expansions to those (implicit memory authoring).

Realistic side-by-side comparison
When assessing the design, after completing the four phases outlined in Figure 1, 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 benefited 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 any potential improvements or other changes in the new design.

With these considerations, the following is proposed as a methodology for Contextual Inquiry with older adults. Observe older adult users with the relevant activity without introducing the potential for new technologies. Following the observations, interviews should expand on the observation and end with questions on their use or perceived use of technology for their activity. Build an understanding based primarily on the motivations for their existing activities. Develop themes from the consolidated data, and from that create a design that primarily supports their existing activities and motivations and secondarily expands on those with opportunities presented by the introduction of digital technologies. Designs should be assessed by older adults in realistic settings and using their own artefacts and compared to the user's existing process in the same session so they can provide direct feedback on the different experiences. The assessment 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.

The following section presents 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.

3.2. Contextual inquiry case studies

As evidenced by recent R&D and commercial activity, the usability and user experience (UX) of interactive technologies designed for older adults is of significant concern (Johnson, 2015). This is grounded in prior research that has revealed usability as being a key factor for the successful long-term adoption of such beneficial technologies by older adults (Venkatesh, 2012). However, the tools and methodologies employed in the research and commercial development of Internet and mobile technologies at best follow user-centred 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 – Contextual Inquiry – which facilitate the design of technologies that are more usable by older adults and that lead to a better UX for them. In our lab (Technologies for Ageing Gracefully), we have applied this method to several of the short and long-term UX 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 lfe 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 UX

methods (namely Participatory Design) can assist with implementing the design requirements collected through CI investigations with older adults.

3.2.1 Staying safe and avoiding financial scams (online)

The number of Canadian adults over 65 or older who are active users of Internet is constantly increasing. The 2011 Census (Stats Canada) indicate that 66% 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 in this space 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 preliminary research (Munteanu, 2015) we have found that, without 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.

In our research we conducted a cross-disciplinary investigation consisting of a mixed-methods research approach, which aimed to answer several questions related to the information practices of older adults with respect to online safety. Methodologically 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+ hours) 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 into financial institutions that had 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, 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 (If something goes wrong, who can i talk to? Where do i go?).

Finally, aspects of 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 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.

3.2.2 Accessing essential information online

Although there has been much research and commercial activity 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 targeted 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 that aim 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, 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 have aimed 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. In particular, we have found that seniors are active information seekers, actively engaged in reading several sources of information. When it came to lack of 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 questions they had about the information found, especially when encountering technical jargon.

With respect to trust, we have (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 of 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.

Recommendations (and implications) for fintech: Incorporate into Contextual Inquiries activities that are related to information seeking (including question-answering tactics) by older adults 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.

3.2.3 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 Contextual Inquiry 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, and 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 store and share 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 Contextual Inquiry sessions revealed some interesting aspects about the participants' mental models. In particular, we have found evidence 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, 2009; Keightley, 2014) which revealed that older users' mental models of online storage is perceived to be insecure.

Recommendations (and 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.

4. A UX approach to fintech adoption

As we have illustrated earlier in this paper, 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 prior research investigating a wide range of services, from access to online health info and to cloud-based social sharing of photos. However, 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. CI can reveal hidden elements of user's mental models that result from the difficulty associated with verbalizing one's process (Liaqat, 2018b). In this paper we thus propose the use of ethnographic user requirement gathering methods such as Contextual Inquiries as a critical component of the design and development of technologies (such as fintech) that aims to support older adults' essential retirement services.

However, while studying users in context and being able to understand their mental models is an essential design step, this in itself is not sufficient to ensure 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-Centred Design (Preece et al. 2015).

Participatory design (PD) integrates users into the technology creation process through a variety of methods such as interviews, observations, or design activities (Muller, 1993, 2003). While PD 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 (Schuler and Namioka 1993) involves users at all stages of the design, and elicits their direct input for specifying the design and the functional requirements of a system. Typically this is conducted in the form of small workshops, during which participants work in groups of 2 to 4 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, 2018b).

While PD has been extensively used to designing a wide range of applications for older adults, including in our own research – from fall prevention monitoring (Yu, 2018) to learning support tools (Liaqat, 2018a) – its use to designing fintech for older adults is only recently receiving attention. The most notable such research is that of (Vines, 2012) who employed PD with older adults to design digital alternatives to paper cheques. While older adults' mental models of financial services was identified as the most significant barrier to the migration of such services to an online space, 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 PD is a promising method for the design of fintech for older adults.

5. Conclusions

In this paper we discussed some of the barriers toward designing interactive applications for older adults that support them in their retirement. We presented an argument that mental models are such a key barrier. We proposed that Contextual Inquiry – 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. We supported this argument with three case studies from our own research which showed how Contextual Inquiry helped expose the mental models of

interacting with information-centric online applications that share many commonalities with fintech: the need for safety when transacting monetary values or private financial information, perception of how such services operate online, the desire to maintain privacy but expecting prompt help; and the perception of online services being less secure than their paper counterparts.

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