"Too old to bank digitally? ": A Survey of Banking Practices and Challenges Among Older Adults in China

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ABSTRACT

The banking industry has been integrating digital technologies globally. However, accepting new technologies is challenging in particular for older adults. We focus on older adults' banking experiences in China, where digital transactions have been growing rapidly, to provide a perspective on how they adapt to this trend. We conducted an online survey with 155 older adults who are 60 or above ($M = 70, SD = 9$) from 18 provinces to explore their banking practices and challenges. Our results show that older adults conduct banking transactions frequently. However, few do so using digital platforms despite long wait times in physical banks. The main concerns reported by them are about security and usability. Nonetheless, they hold a positive attitude towards digital platforms (e.g., apps, virtual banks). Interestingly, age and gender have significant effects on particular banking behaviors. We discuss our findings in the context of prior studies and highlight design opportunities for improving banking accessibility for older adults.

CCS CONCEPTS

• **Human-centered computing** → **Accessibility**; • **Social and professional topics** → **Seniors**.

KEYWORDS

older adults, elderly, seniors, aging, banking, electronic payment, accessibility, technology use, digital inclusion, digital equity

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1 INTRODUCTION

Banking businesses have been increasingly moving online [10]. While about half of the US adults banked online in 2013 [26], over three quarters of Americans banked on mobile devices in just five years later [68]. The COVID-19 pandemic has further accelerated this trend globally [13, 18, 30] and many banks even shut down their branches [11, 33, 62, 70]. As face-to-face interactions in physical banks are gradually replaced by digital user interfaces on websites and mobile applications (apps), it is critical to ensure that all banking platforms are usable and accessible to people of all backgrounds.

Toward this goal, researchers have investigated people's experiences and attitudes toward online and mobile banking [31, 36, 78]. Studies found that the main barrier to online banking was the perceived risks [31, 36]. However, such studies primarily focused on young adults. Compared to young adults, older adults tend to be less tech-savvy and are likely encounter more difficulties when using new technologies due to factors such as generation/cohort effects, age-related declines, and less positive attitudes toward technologies [15, 29, 42, 44, 81]. Indeed, research has shown that older adults are more reluctant to adopt new technologies and use technologies to a lesser extent [17, 52, 74]. Consequently, older adults might face more challenges when adopting digital banking. This has motivated researchers to explore older adults' digital banking experiences [15, 27, 46, 53, 60, 61, 84]. However, these studies tend to focus on specific aspects of digital banking, such as user-friendliness [27], trust [61], fear [84], and self-efficacy and anxiety [60]. It is still unknown to what extent older adults use physical and digital banking platforms, their experiences with each banking platform, and the challenges that they encounter when banking.

One key step toward making technologies accessible to older adults is to deeply understand how they interact with such technologies and the barriers that they may face when using such technologies. In this work, we approach this problem by studying older adults' practices and challenges with both physical and digital banking platforms to provide a holistic view of their banking experiences. Furthermore, previous research shows that age might affect older adults' perceptions and experiences with new technologies [35, 67]. Between the older adults age groups, prior research has shown there are differences between young-old (60-69 years old), old-old (70-79 years old) and oldest-old adults (aged 80 and above) [14]. For example, a significantly lower percentage of oldest-old adults accessed the internet [35], which contributes to the age-related digital divide for oldest-old adults described by Schlomann et al [67]. Similarly, gender has also been shown to affect older adults' perceptions and experiences with new technologies [56, 60]. For example, male older adults were found to be more likely to use internet shopping [56] and internet banking service than female older adults [60]. Inspired by these observations, we are also interested in investigating whether older adults' age and

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gender might affect their banking behaviors. Specifically, we seek to answer the following research questions (RQs):

- RQ1: What are older adults' banking practices with physical and digital platforms?
- RQ2: What are older adults' personal banking experiences and challenges with these platforms?
- RQ3: How might age and gender affect banking behaviors?

To answer RQs, we conducted an online survey study with a representative sample of 155 older adults from 18 provinces in China, which has the largest older adult population and has been experiencing a fast growth in digital banking [31]. The survey focused on their banking practices, experiences, and challenges with both physical and digital banking platforms and different types of bank transactions. Moreover, the survey also collected participants' age and gender information to understand how these two factors affect their banking behaviors.

Our study shows that older adults bank frequently, and the vast majority (94.9%) of them go to physical banks, less than a quarter (23.2%) use ATMs, 10.9% use banking apps and only 5.8% use virtual (i.e., online-only) banks. Long wait time is a long-standing issue with physical banks. Interestingly, older adults who are more tolerant of longer wait time indeed tend to wait longer in practice. Nonetheless, older adults continue to use physical banks because of the perceived security and usability issues of the alternative digital banking platforms. Nonetheless, older adults hold a positive attitude toward digital banking and are willing to try out digital banking if others recommend to them. Furthermore, both age and gender have significant effects on banking behaviors, including usage frequency, acceptable wait time, platforms adoption and attitude toward virtual banks. This finding highlights the necessity of tailoring the banking experience design for different age groups and genders among older adults and calls for more research to uncover reasons causing such differences.

Finally, we present design considerations to make banking platforms more accessible to older adults, such as designing better queuing mechanisms to reduce long wait times in physical banks and motivating older adults to learn digital banking platforms while waiting such as via gamification. To address the perceived UX issues of digital banking platforms induced by age-related declines in visual and touch acuity, we suggest considering voice user interfaces and multimodal feedback (e.g., auditory signals) to reduce the dependence on touch interaction and visual feedback. Furthermore, we suggest designers consider providing pre- and post-action states for each key step [24] to help older adults better complete tasks on digital banking platforms. To our knowledge, this is the first quantitative study focusing on older adults' holistic banking experiences with both physical and digital banking platforms under the current emerging digital banking trends (e.g., digital payment, virtual banks). In sum, we make the following contributions:

- A quantitative understanding of older adults' banking practices and challenges with both physical and digital banking platforms and the associated types of banking transactions;
- A quantitative understanding of the effects of age and gender on older adults' banking behaviors;
- Design considerations for making banking platforms more accessible to older adults.

2 RELATED WORK

2.1 Banking Trend and Older Adults

Banking has become increasingly digital in the recent decade as information and communication technology (ICT) continues to advance. As a result, people visit physical banks and call hotline services less frequently [43]. Compared to other countries, Chinese e-commerce market is the largest and fastest growing in the world with a volume of 1.94 trillion USD in 2019 [23]. In the meantime, China has been experiencing a fast growth in digital banking [31] and becomes the forefront of digital banking. Indeed, China has the world's largest digital-only bank—WeBank [20] and almost becomes a cashless economy [34, 41].

Such a rapid shift toward digital banking leaves people less time to adapt to it and consequently may disrupt people's lives. Several studies investigated people's acceptance of online banking and found that security is the most important factor influencing people's adoption [31, 36]. Laforet et al. studied people's attitudes toward online and mobile banking and found that the main barriers to online banking adoption were the perception of risks, computer and technological skills and Chinese traditional cash-carry banking culture, and the main barriers to mobile banking adoption were lack of awareness and understanding of the benefits provided by mobile banking [36]. Moreover, Yuan et al. studied predictors of users' continuance intention of mobile banking and found that satisfaction, perceived usefulness, perceived task-technology fit, and perceived risk are the main predictors of continuance intention [80].

While informative, such studies were conducted primarily with young adults, such as students (e.g., [31, 78]). However, age has been shown to affect people's attitudes toward technology adoption in general [17, 63, 73]. Older adults tend to adopt new technologies slower and are less likely to use technologies in general than young adults [17, 52, 74]. For example, 25% of Americans over the age of 65 use internet compared to 56% of 30- to 49-year-olds and 36% of those in the 50- to 64-year-old age group [63]. Moreover, older adults tend to be less tech-savvy, and likely encounter more problems [17, 72, 79]. For example, older adults encountered more problem using smart phones than young adults [32, 45]. As a result, older adults may be affected more by this digital shift in banking than young adults.

To ensure the inclusiveness of digital banking for all age groups, it is critical to understand older adults' experiences and attitudes toward different banking platforms. As China has the world's largest and fastest aging population [47, 55] and also has the most rapid shift toward digital banking, we conduct this study with older adults in China to better understand their current banking practices and challenges. In so doing, we aim to reveal design opportunities to better improve banking experience for the aging population.

2.2 Banking Platforms and Older Adults

We present previous studies about how older adults bank on different platforms: *Physical Banks*, *ATMs*, and *Digital Banking*.

Physical Banks. Previous studies suggest that older adults prefer physical banking over other banking platforms [2, 3, 29, 53]. For example, in-person customer service is one of the top desired services from financial institutions among lower-income older

adults [2]. Compared to younger consumers, older consumers considered physical banking more important than other banking platforms [29]. More recently, Omotayo et al. conducted a survey with 239 older adults and showed that 80.3% were non-Internet banking users and preferred traditional banking [53]. However, older adults also complained about the inconvenience associated with visiting bank branches such as long wait time [53]. We aim to understand what affects their physical banking experiences as well as the pros and cons of physical banking with respect to other banking platforms among older adults.

ATMs. Automated teller machine (ATM) is considered as one of the beginning of the evolution of ICT for traditional banking products [15, 50]. Although early studies found that older adults aged 65+ years were less likely to use ATMs than younger adults [66, 82], later studies found that older adults gradually adopted ATMs over several decades (e.g., 15% in a 1985 study [28], 33% in a 1996 study [66], 44.6% in a 2004 study [19], and 61% in a 2008 study [56]). One critical reason why older adults did not adopt ATMs was that they felt uncomfortable and less in control of their finances when using an ATM [19]. O'Brien et al. further identified more factors influencing ATM adoption among older adults: usefulness, compatibility, complexity, technology generation, and relative advantage of a technology [56]. As banking technology continues to improve in the recent decade, older adults have more options for banking, such as digital banking. However, little is known whether and to what extent older adults still use ATMs for banking with respect to other platforms and their experiences and challenges with using ATMs.

Digital Banking. Previous studies investigated the adoption of digital banking among older adults (e.g., [15, 27, 46, 53, 60, 61, 84]). A 2020 study shows that most older adults did not adopt internet banking as they still preferred to use the traditional banking system [53]. Even if they used digital banking, they did not find banking websites easy-to-use [27]. Researchers further studied the differences in digital banking between older and young adults. For example, a Mckinsey report shows that digital banking usage in Asia's emerging markets is less popular among older adults than young adults [43]. Olsen et al. found that older adults were more frequent users of a person on the telephone while younger adults used the Internet and ATMs more often [52]. Instead of comparing the behaviors between older and young adults, we focus on older adults' experiences with different digital banking technologies (e.g., apps, virtual banks) as well as comparison with physical banking.

Other related studies primarily focused on a specific aspect of digital banking, such as trust [61], fear [84], self-efficacy and anxiety [60], and lacked a holistic view of older adults' banking experiences and challenges with both digital and physical banking platforms [15]. Furthermore, as new banking platforms, such as digital payment (e.g., AliPay, ApplePay, Google Pay, PayPal, Venmo, WechatPay, ZellePay) and virtual banks(e.g., NetBank, WeBank) have been gaining popularity, it is important to understand whether and how older adults use these new digital banking platforms with respect to other platforms [4, 6, 49, 57–59, 75, 77, 83]. Thus, in this work, we are motivated to *explore older adults' banking practices and challenges with both physical and digital banking platforms currently available and to identify design opportunities to make them more accessible to older adults.*

3 METHOD

As a first step to understand older adults' holistic banking experiences with both physical and digital platforms, we chose Survey over other qualitative methods (e.g., interview) because it allows us to gain a more quantitative and representative understanding of the general and holistic banking practices and challenges from a large number of participants. Thus, we conducted an IRB-approved online survey with older adults who are 60 and above [48, 51, 54].

3.1 Survey Design

The survey included different types of questions, such as multiple choice, Likert-scale, and short answer questions. The survey was separated into two main sections based on participants' banking experiences. The first section had 6 questions, which were for participants who did not perform bank transactions and aimed to uncover potential reasons. It also included questions to understand their willingness to adopt the new banking methods (e.g., electronic payment) . The second section had 24 questions, which were for those who had banking experience and focused on understanding their banking platforms, the types of banking transactions, and the frequencies of and experiences with physical bank, ATM, mobile application (app), virtual bank, and digital payment. The second section had five subsections, each of which included a series questions grouped by banking platforms (e.g., "in person", "using an ATM", and "using an APP") and electronic payment to lower the cognitive load on respondents and allow them to think more deeply about each topic [37]. Moreover, the survey used contingent questions [9] extensively to prevent confusion among our participants by hiding irrelevant questions based on their responses and also to save time and ensure the data quality. The survey is provided in the appendix.

3.2 Testing the Survey Tool

We followed Dillman's suggested three-stage process [21] to pretest the survey. First, the survey was reviewed by colleagues to uncover potential misunderstanding and unexpected problems. Next, we interviewed with older adults to evaluate its cognitive and motivational quality. Finally, we performed pilot tests with 3 older adults to identify any remaining issues that were not caught in earlier steps and incorporated their feedback to ensure the survey was easy-to-understand and could be complete in an appropriate time.

3.3 Participants

We distributed our study advertisement in local community centers and social media platforms. We also relied on word-of-mouth and snowball sampling by asking the survey respondents to distribute the survey to their social networks. For older adults who preferred to answer the survey orally, the research team met them in a public setting and collected their answers orally. We did not keep track of the exact number of such participants but they were from three provinces. We started the survey on 16^{th} Sept. 2020 and closed it on 17 th Jan. 2021. One winner was chosen and awarded $15.

Out of 158 responses, 3 responses were discarded for not meeting the age requirement or not giving informed consent. We then checked and made sure all answers did not have obvious quality issues (e.g, selecting all the same options). The results reported herein were based on the remaining 155 valid responses. Average survey

completion time was 3 minutes (SD = 171.1, Md = 2). Table 1 shows the participants' demographic information. The participants were from 18 provinces of China as indicated in Figure 1. Their locations ranged from the north to the south, and from the coast to inland. The average age was 70 (SD = 9), and the media age was 69 with the 25^{th} and 75^{th} percentiles being 63 and 76 respectively (IQR = 6.5).

Table 1: Participants' Demographic Information

Age	Num. (%) of participants
young-old (60 - 69)	82 (52.9%)
old-old (70 - 79)	48 (31.0%)
oldest-old (80 & 80+)	25 (16.1%)
Gender	**Num. (%) of participants**
Male	83 (53.5%)
Female	67 (43.2%)
Not disclosed	5 (3.2%)

Figure 1: Participants' Geographical Distribution

3.4 Analysis

For the single-choice questions and multiple-choice questions, we calculated descriptive statistics (e.g., percentage, mean, standard deviation). Because not all questions are mandatory, we noted the number of samples that the analyses were based on in Sec 4. For free-form text responses, two researchers analyzed them respectively and discussed to derive common themes. Further, we conducted Pearson's chi-squared test to understand whether older adults' banking practices correlate with their age group and gender [16].

4 FINDINGS

4.1 Banking Practices (RQ1)

4.1.1 Banking Overview. About 93% (N = 144) of the participants had banking experience, and only few (7%, N = 11) did not have any banking experience. The reasons for not banking included: 1) *not trusting banks*; 2) *not knowing how to bank*; 3) *preferring to keep money in hand*; and 4) *not having much money*.

Banking Frequency. The participants who had banking experience reported their banking frequency. Figure 2 shows the results. The vast majority (72.9%) of them banked *every month*. Among these participants who banked every month, 45% of them (or 33% of all participants who banked) even banked 2 to 3 times per month. It suggests that the stereotype that older adults do not bank is a myth; older adults not only banked, but also banked frequently.

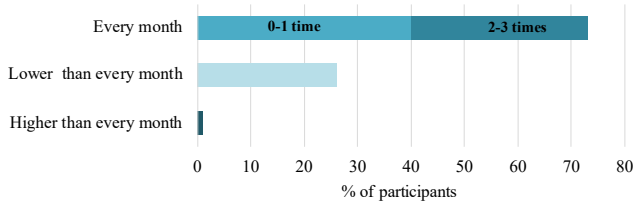

Figure 2: Banking Frequency (N = 144)

4.1.2 Banking Transactions. Among the 144 participants who had banking experience, 95.8% (N = 138) banked primarily by themselves and only 4.2% (N = 6) depended on their family members or friends to bank for them because they felt it was inconvenient or unnecessary to use banks, and believed that younger adults knew banking better.

Transaction Types. The 138 participants who banked primarily by themselves reported the types of banking transactions that they conducted. Figure 3 shows the 10 common types of banking transactions: *deposit and withdrawal (84.1%)*, *view details/balance (28.3%)*, *transfer money (18.1%)*, *manage wealth (15.9%)*, *change password (8.0%)*, *pay bills (7.2%)*, *manage investments (4.3%)*, *manage credit cards (2.9%)*, and *manage loans (1.4%)*.

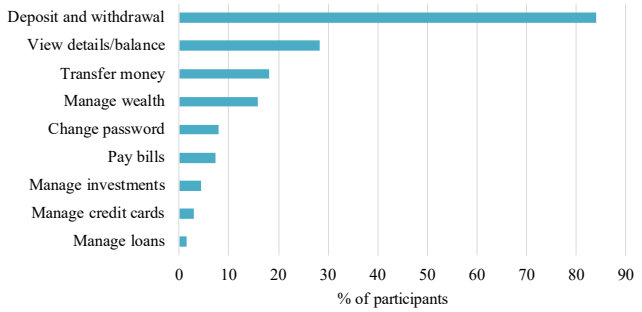

Figure 3: Types of Banking Transactions (N = 138)

Transaction Types vs. Banking Frequency. To understand how the types of banking transactions might vary for participants who banked at different frequencies, we plotted the relative proportions of the types of banking transactions for participants who banked at different frequencies. Figure 4 shows the results. It reveals two interesting trends. First, participants who banked more frequently seemed to do fewer types of banking transactions. In contrast, participants who banked less frequently seemed to try out more types of banking transactions. Second, for the participants who banked more frequently, they primarily dealt with the most common transactions, such as *deposit and withdrawal*; they did not engage with advanced transactions, such as *view details/balance*, *manage wealth*, *manage loans*, *manage credit cards* and *pay bills*. These trends suggest that 1) the increased banking needs were

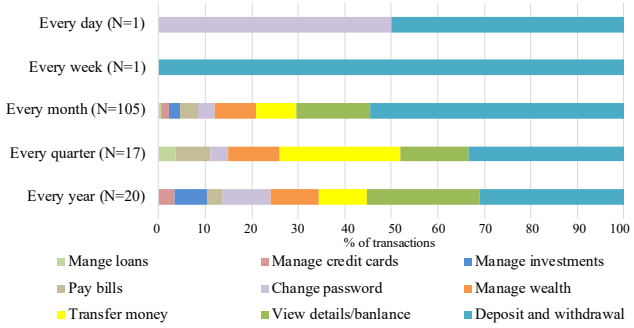

Figure 4: Correlation between Participants' Banking Frequency (vertical axis) and the Types of Banking Transactions they Conducted (horizontal axis)

mostly related to depositing or withdrawing money; 2) for older adults who banked more frequently, they did not necessarily conduct more advanced business transactions but rather repeated the same types of common transactions. This might be because older adults lack knowledge about advanced business transactions.

4.1.3 Banking Platforms. The 138 participants who banked primarily by themselves reported their banking platforms, which were *physical banks*, *ATMs*, *apps*, and *virtual banks*. Figure 5 shows how different platforms were used by the participants.

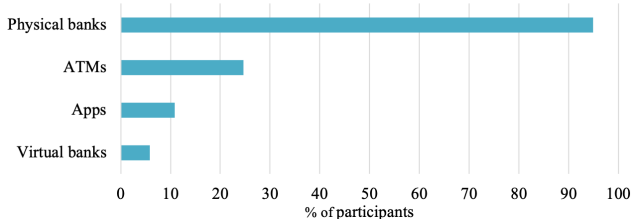

Figure 5: Banking Platforms Usage (N = 138)

Specifically, 94.9% (N = 131) used physical banks to conduct banking transactions, which made physical banks the most frequent banking platform among older adults. In contrast, among 138 participants, 24.6% (N = 34) used ATMs, 10.9% (N = 15) used apps, and 5.8% (N = 8) used virtual banks. Although the numbers for ATM, app and virtual bank were not as high as that for physical banks, they showed that older adults did use all the digital banking technologies.

Banking Platforms vs. Transaction Types. To understand the types of banking transactions that participants conducted on different banking platforms, we plotted the relative proportions of the platforms used with each type of banking transaction in Figure 6. It shows that: 1) All platforms were used for conducting each type of banking transaction; 2) Participants used physical banks more often for basic types of banking transactions, such as "deposit and withdrawal", "view details/balance", and "transfer money"; 3) Participants used digital banking platforms (e.g., apps, virtual banks) more often when they needed to deal with relatively more advanced types of banking transactions, such as "manage

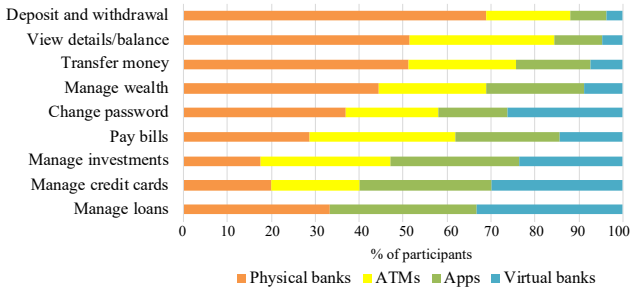

Figure 6: Banking Platforms Used for Conducting each Type of Banking Transaction (N = 138)

wealth", "pay bills", "manage investments", "manage credit card", and "manage loans." This suggests that digital platforms (e.g., apps, virtual banks) may have an advantage over physical banks in satisfying advanced banking needs. Another possible reason might be that participants who conducted these advanced types of banking transactions adopted digital banking platforms more often than those who only did basic types of banking transactions.

As the most recent technological innovation in banking, virtual banks were adopted by a small portion of the participants (5.8%, N = 8). Nonetheless, for those who did use virtual banks, half (50%) of them used it *almost everyday* with the rest using it *several times a month* or *less*. This suggests that virtual banks were well-received by those who were exposed to them. It also highlights an opportunity for virtual banks to gain more users among older adults.

Electronic Payment. Regardless of the platforms (e.g., ATMs, apps, virtual banks), 44.9% of the 138 participants who banked by themselves (N = 62) used *electronic payment*. Two of eleven participants who did not have any banking experience used electronic payment, while one of them even used it almost everyday. This shows that electronic payment was adopted more widely than ATMs, apps, and virtuals banks. This is interesting because electronic payment appeared around the same time as virtual banks [49, 59] and about 30 years later than ATMs [50]. However, we found that electronic payments had a higher adoption rate than virtual banks by nearly 8 times and ATMs by about 2 times. This highlights an opportunity to further understand why electronic payment gains popularity in a shorter span than ATMs and apps.

Figure 7 shows the electronic payment usage frequency (N = 64). Surprisingly, the majority (57.8%) of them used electronic payment *several times a week* and about a third (32.8%) of them even used it *almost everyday*. What's more, they used electronic payment mostly for *sending and receiving money*.

4.2 Banking Experiences and Challenges (RQ2)

We first present participants' experiences with and attitudes toward different banking platforms: physical banks, ATMs, apps, and virtual banks. Then, we describe their experiences with electronic payment.

4.2.1 Physical Banks. Previous studies showed that *waiting* is a concerning part of their experience with physical banks [53]. Thus, our survey focused on understanding older adults' waiting experience at physical banks.

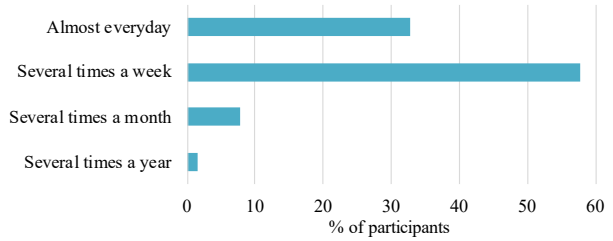

Figure 7: Electronic Payment Usage Frequency ($N = 64$)

Wait Frequency and Wait Time. Over half (52%) of the participants indicated that they needed to line up *every time* when they went to a bank; 25% indicated they needed to line up *more than half the time*; 8% needed to do so about *half the time*; and only 14% needed to do so *occasionally*. These numbers indicate that waiting was a frequent part of the physical banking experience.

To gain a deeper understanding of their wait times, we asked the participants to report how long they usually needed to wait before being serviced. Only 11% of the participants indicated that they were called within *10 minutes*, and 26% were called within *30 minutes*. In contrast, the majority (63%) of them needed to wait between *30 minutes and 2 hours* before being called.

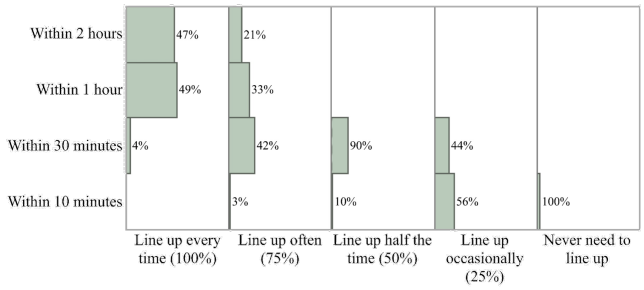

Figure 8: Wait Time (vertical axis) and Wait Frequency (horizontal axis) at physical banks ($N = 131$)

We plotted the duration and frequency of the participants' wait times in Figure 8 to better understand how these two factors might relate to each other. The figure indicates that participants who needed to line up more often (e.g., *every time*) tended to need to wait *longer* (e.g., "within 2 hours", "within 1 hour"). On the other hand, the participants who lined up only *half the time or less* tended to wait less (e.g., "within 30 minutes"). Unsurprisingly, participants who almost never needed to line up tended to wait the least (i.e., "within 10 minutes"). One potential reason might be related to the locations of their banks. As our participants were from various sized cities in different geographical regions of China, the number of customers that their banks need to serve may vary significantly. Banks located in a busy urban area or city center might have a higher number of visits than the ones located in a suburban or a rural area. The more often participants needed to wait in a bank, the more likely the bank had more visitors. As a result, the wait times would be longer for their visitors.

Acceptable vs. Estimated Wait Times. In addition to estimating their wait times, participants also reported their *acceptable wait times* (i.e., how long they were willing to wait in line before trying different banking platforms (e.g., ATMs, apps). Results show that 24% of the participants would leave after 30 minutes, another 24% would leave after 1 hour, and 2% would leave after 2 hours. Surprisingly, half (50%) of the participants were willing to wait *no matter how long it takes* to fulfill their banking needs.

We performed a Chi-square test to analyze whether their acceptable wait times were correlated with their estimated wait times and found a significant correlation ($\chi^2(9) = 84.1, N = 131, p < .0001$). To visually illustrate this correlation, we plotted the acceptable times against the estimated wait times in Figure 9. The numbers on the diagonal line indicate that their acceptable wait times align with their estimated wait times. This suggests that older adults who are more tolerant of longer wait times (i.e., longer acceptable wait time) indeed tend to wait longer (i.e., estimated wait time).

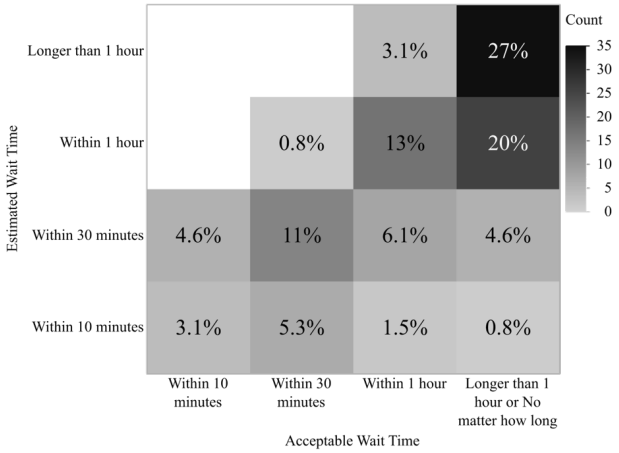

Figure 9: Acceptable and Estimated Wait Time at Physical Banks ($N = 131$)

Reasons for Waiting. Almost three quarters (70.7%) of the participants felt *it was unsafe to use ATMs or apps*. 63.6% of them felt that they *were used to manual processing in physical banks*. These top two reasons might reinforce each other. As participants were used to physical banking and unwilling to try ATMs or apps, they would continue to lack experience with ATMs or apps. Due to the lack of experience, they were more likely to continue to feel such platforms were unsafe.

The rest of the reasons were related to the *design of ATMs and apps*. Participants felt that *it was inconvenient to read the text on ATMs and apps* due to their poor eyesight (57.6%) and that *ATMs and apps were too difficult to use (40.4%)* (e.g., *"I don't know how to do online banking"*, *"I'm too old and and don't know how to use it"*). Finally, participants also indicated that some transactions could *not be handled by ATMs or apps* (38.4%). These reasons highlight participants' perceived difficulties with ATMs and apps, including trust, legibility and usability.

4.2.2 ATMs and Apps. Participants who used ATMs and apps rated the user-friendliness of conducting banking transactions on these two platforms on a 5-point Likert scale (1: extremely unfriendly to 5: extremely friendly) respectively. Figure 10 and Figure 11 show the corresponding ratings for ATM and app respectively.

ATMs. Although fewer participants ($N = 34, 24.6\%$) used ATMs than physical banking, those who did use ATMs felt positively about conducting various banking transactions using ATMs: *deposit and withdrawal (M = 3.97, SD = 0.17)*, *view details/balance (M = 3.88, SD = 0.40)*, *change password (M = 3.85, SD = 0.46)*, *transfer money (M = 3.85, SD = 0.37)*, and *pay bills (M = 3.82, SD = 0.53)*. There was a significant difference between *Deposit and withdrawal* and *Pay bills* ($\chi^2(8) = 23.5, N = 34, p < .01$). The results show that as the banking transactions became more advanced, participants' perceived user-friendliness dropped. It is worth noting that the most highly rated transactions (e.g., *deposit and withdrawal* and *view details/balance*) were also among the most common used types of banking transactions as indicated in Figure 3.

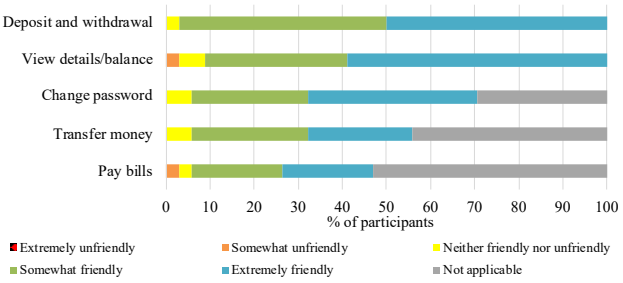

Figure 10: User-friendliness of Using an ATM to Conduct Banking Transactions ($N = 34$)

Apps. Compared to ATMs, apps were used by even fewer participants ($N = 15, 10.9\%$). Nonetheless, the ones who used apps conducted more types of transactions (N = 10) on it than ATMs (N = 5) as shown in Figure 11. Moreover, their experiences of using apps were overall positive: *deposit and withdrawal (M = 4.25, SD = 0.89)*, *view details/balance (M = 4.23, SD = 0.83)*, *change password (M = 4.38, SD = 1.1)*, *transfer money (M = 4.18, SD = 0.75)*, *pay bills (M = 4.5, SD = 0.55)*, *manage wealth (M = 4.20, SD = 0.92)*, *manage loans (M = 4.5, SD = 0.71)*, *manage credit cards (M = 4.00, SD = 0.71)*, and *manage investments (M = 4.00, SD = 0)*. There were no significant differences in the user-friendliness ratings between these transactions.

For more advanced banking transactions, such as managing loans, credit cards, and investments, most participants showed a lack of experience. As many as 93% of participants who used virtual banks never handled these transactions. For those who did, their experiences were generally positive with all ratings for these transactions being neutral or higher except for one response.

As for participants who did not regularly use ATMs or apps, 40.4% of them reported that they encountered difficulties with using ATMs or apps before. The most frequently mentioned difficulty was *being afraid of making mistakes* (82.5%). Other frequently mentioned difficulties were: *worrying about no printed receipt* (35%), *not knowing how to get started* (27.5%), *not knowing what the next step might be* (25%), *not being able to recover from their mistakes* (17.5%) and *not being able to fully understand function descriptions* (15.0%).

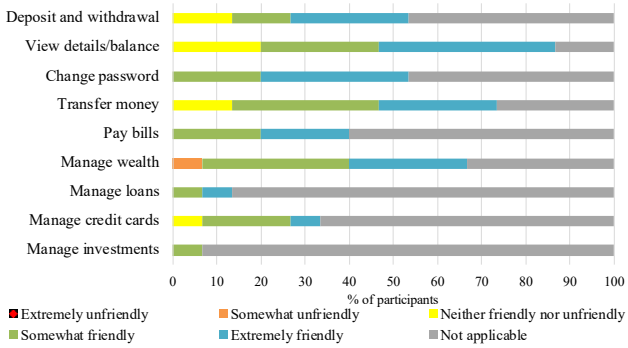

Figure 11: User-friendliness of Using an App to Conduct Banking Transactions ($N = 15$)

Virtual Banks. As virtual banks are the latest banking platform, few people have experience with it. Thus, instead of asking participants' experiences, our survey focused on asking their attitudes toward this banking platform by asking them to indicate the statement that most closely reflects their attitudes: *I will try various ways to use it myself*, *If someone recommends it, I am willing to try*, *I could not care less about virtual bank*, and *I resist using virtual bank*. As shown in Figure 12, 46.4% of participants held a somewhat *negative attitude* toward virtual banking, with 18.7% of them indicating that they would resist using it and 27.8% indicating they could not care less about it. This points out an opportunity to better understand the perceived barriers that make older adults withdraw from this latest banking platform.

On the other hand, more than half of the participants (53.6%) held a *positive attitude* toward it. Among these people, 3.2% were willing to try various ways to use it by themselves, and more than half (50.3%) were willing to try it if recommended by someone. This suggests that although older adults might be less likely to actively try out virtual banks on their own, they have an open mind and are willing to try out if someone recommends it to them.

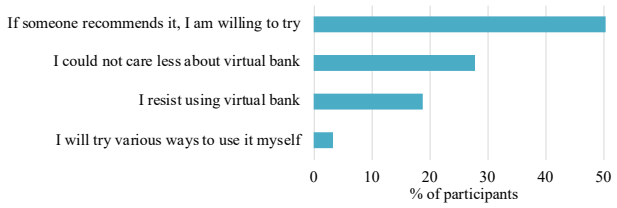

Figure 12: Attitude toward Virtual Banking ($N = 155$)

4.3 Effects of Age and Gender (RQ3)

We performed analysis to evaluate how age and gender might affect older adults' banking practices and experiences.

4.3.1 Effects of Age. We conducted correlation analysis (Chi-square test) between the three age groups (see Table 1) and the following

Table 2: Banking Behaviors and Attitudes in Relation to Age

Relationship with Age	
ATM Usage	$\chi^2(2) = 17.0, N = 138, p < .001 **$
App Usage	$\chi^2(2) = 8.0, N = 138, p < .05*$
Transfer Money	$\chi^2(2) = 9.1, N = 138, p < .05*$
Manage Wealth	$\chi^2(2) = 11.8, N = 138, p < 0.01 **$
Pay Bills	$\chi^2(2) = 6.1, N = 138, p < .05*$
Acceptable Wait Time	$\chi^2(6) = 21.6, N = 131, p < .001 **$
Electronic Payment Usage	$\chi^2(2) = 36.3, N = 155, p < .001 **$
Attitude to ATMs/Apps	$\chi^2(2) = 6.3, N = 99, p < .05*$
Attitude to Virtual Banks	$\chi^2(6) = 26.7, N = 155, p < .001 **$

factors: bank usage, frequency of bank usage, preference of banking platforms, ATM usage, app usage, transfer money, manage wealth, pay bills, actual wait time, acceptable wait time, electronic payment usage, virtual bank usage, and view of virtual bank. Table 2 shows all the significant relationships [1].

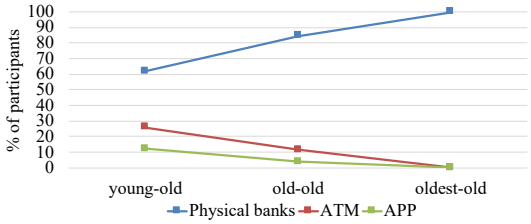

Figure 13: Correlation between Platforms Usage and Age Groups ($N = 138$)

First, to better understand the effect of age on banking platforms, we plotted the usage of three major banking platforms (i.e., physical banks, ATMs, apps) against the three age groups (i.e., young-old, old-old, and oldest-old) in Figure 13. As age increases, significantly fewer participants tended to use ATMs and apps. In fact, none of the oldest-old participants used ATMs or apps. In contrast, as age increases, more participants tended to use physical banks although the difference between age groups was not significant.

Second, we plotted the types of the transactions shown in Table 2 for three age groups in Figure 14. As age increases, significantly fewer participants tended to use each of these three types of transactions (i.e., transfer money, manage wealth, and pay bills).

Third, as age increases, the acceptable wait time increased significantly. While only 32.8% of young-old participants were willing to wait over 1 hour or no matter how long, the number increased to 75.0% and 65.0% for old-old and oldest-old participants respectively.

Fourth, as age increases, the usage of electronic payment decreased significantly. While 60.2% of young-old participants used electronic payment, only 27.1% of old-old participants and none of the oldest-old participants used it.

Fifth, as age increases, participants were more likely to feel that the ATMs and apps were hard to use. While 32.5% of young-old participants felt this way, 35.9% of old-old and 65% of oldest-old participants held this view.

[1] significant levels: *: p<.05, **: p<.01, ***: p<.001

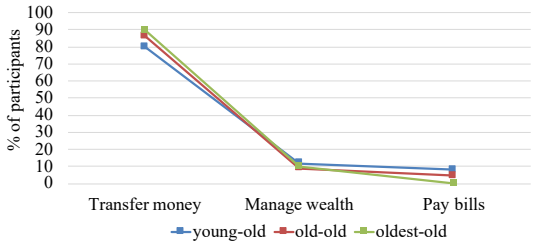

Figure 14: Correlation between Transactions and Age Groups ($N = 138$)

Table 3: Banking Behaviors in Relation to Gender

Relationship with Gender	
Banking Frequency	$\chi^2(8) = 15.59, N = 144, p < .05*$
Transfer Behavior	$\chi^2(2) = 8.96, N = 138, p < .05*$
Electronic Payment Usage	$\chi^2(1) = 4.36, N = 150, p < .05*$
ATM/App Usage (Confusion about how to start)	$\chi^2(1) = 8.48, n = 39, p < .01 **$
ATM/App Usage (Confusion about next step)	$\chi^2(1) = 7.03, n = 39, p < .01 **$

Last, as age increases, participants were more likely to hold a negative attitude toward virtual banks, similar to the trend of the attitudes toward ATMs and apps. As shown in Figure 15, while the majority of young-old (58.5%) and old-old (58.3%) participants held positive attitudes (e.g., "If someone recommends to me, I am willing to try") toward virtual banking, the number dropped to below 10% for oldest-old participants. At the same time, negative attitudes (e.g., "I could not care less") raised from around 20% for young-old and old-old participants to around 60% for oldest-old participants.

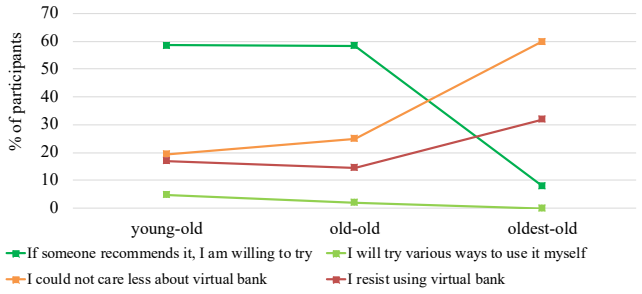

Figure 15: Correlation between Attitude toward Virtual banks and Age Groups ($N = 155$)

4.3.2 Effects of Gender. Similar to age, we conducted correlation analysis (Chi-square test) between gender and banking behaviors of participants. Table 3 shows the five significant relationships.

First, there was a higher percentage of male participants who banked more than once per month than female participants (83.8% vs. 63.9%). Second, there was a higher percentage of female participants who used the "transfer money" transaction than male participants (9.5% vs. 4.9%). Third, there was a higher percentage

of male participants who used "electronic payment" than female participants (48.2% vs. 31.3%). Last, regarding ATM/app usage, there was a higher percentage of female participants who did not know how to get started than male participants (45.5% vs. 5.8%). Similarly, there was also a higher percentage of females who did not know what the next step might be than males (40.9% vs. 5.9%).

5 DISCUSSION

We discuss our findings in light of literature and their implications.

5.1 Banking Practices and Challenges

Banking Frequency. Almost three-quarters (74%) of participants conducted banking transactions more frequently than on a monthly basis, with 44.8% of the participants even using it 2-3 times per month. This is comparable with previous studies that found 82.3% [53] and 94% [12] of older adults used banks at least once a month. This shows that older adults conduct banking transactions with a relatively high frequency.

Interestingly, 90.6% of participants used electronic payment almost everyday or several times a week, which was higher than the usage of any other banking platforms. Most of them sent and received money at least several times a week. This shows a positive feedback loop in using technology, where more frequent usage makes them familiar with technical operations, and more familiarity makes them more willing to use it.

Types of Banking Transactions. The most frequent banking transactions were current deposit and withdrawal (84.1%), and check details or balance (28.3%), and transfers (18.1%). These findings corroborate the results of both Omotayo et al's [53] and Camilleri and Grech's [12] surveys, which found that the two most common transactions were transfers and balance checking. However, both studies found a higher percentage of older adults who "pay bills" than ours. One possible reason might be that these two studies focused on internet banking for which "pay bills" was a major transaction, while ours surveyed a wider set of transactions on all possible banking platforms.

Another interesting finding was that a very low percentage of participants (8%) reported that they needed to change passwords for their bank accounts. This is contrary to the common stereotype that older adults tend to forget passwords and thus often need to change them. One possible reason could be that older adults might be mindful about their memory lapses and adopt proactive approaches to manage their passwords such as writing them down [64].

For the types of transactions conducted by fewer participants (Figure 3), they were conducted more often on ATMs and apps than other platforms (Figure 6). Take credit card business as an example, only a small percentage of older adults could open a credit card due to age restrictions imposed by many banks in China [76]. For those who did have credit cards, they might find it much easier to pay credit card using apps than going to physical banks.

Next, we compare our findings about **banking platforms** with previous studies and discuss the implications.

Physical Banking. Physical banking was the most commonly used banking platform among older adults with 94.9% of the participants used it. This finding is in line with previous studies that showed older adults prefer traditional physical banking systems in both developed and developing countries (e.g., Finland [42], the UK [3, 7], Malta [12], Nigeria [53], and Portugal [71]). Compared to alternative banking platforms (e.g., ATMs and apps), physical banks provide "the ability to talk face-to-face to a bank representative" and "the convenience of the physical bank location" [29].

Additionally, waiting was a common concern about physical banking as 86% of the participants reported that they had to wait at least half of the time. One key reason for choosing physical banking was not because of its superior services but because of the perceived risks and user experience issues of the alternative platforms, such as ATMs and apps. This finding is consistent with previous studies conducted in the 2000s [31, 36]. This suggests that the waiting has been a long-standing issue with physical banking in many countries, which has not been well addressed.

Interestingly, we also found that participants who were more tolerant of longer wait time also tended to wait longer. Furthermore, we found a significant relationship between participants' acceptable wait time and whether they used a virtual bank ($\chi^2(4) = 13.1, N = 131, p = .01$) and electronic payment ($\chi^2(4) = 31.7, N = 131, p < .0001$). The majority (78.8%) of the participants who never used electronic payment were willing to wait no matter how long it might take. This suggests that participants who did not use virtual banks or electronic payment had no or limited alternative platforms to satisfy their banking needs. Consequently, they were forced to wait in line, no matter how long it takes, to receive in-person service. The implication is that helping older adults learn to use virtual banks or electronic payment might be a viable approach to reducing the need of waiting in physical banks.

ATMs and apps. Compared to physical banking, ATMs and apps were used by fewer participants (24.6% and 10.9% respectively). ATM usage was lower than the 44.6% found by Darch and Caltabiano [19] and the 56% found by O'Brien et al [56], which were conducted in Australia and the United States respectively. Similarly, app usage was also lower than the 24% among Baby Boomers found by American Bankers Association [8]. These comparisons show that although China is becoming the forefront of digital banking, older adults in China still have a relatively lower adoption of traditional technological platforms, such as ATMs and apps.

Participants who did use an ATM or app felt positively about conducting transactions on these platforms as shown in Figure 10 and Figure 11. Nonetheless, many participants also provided reasons for not using ATMs or apps. One reason was related to *safety and security*. It was perceived unsafe to use an ATM or bank app. This finding echos the findings of prior studies, which found older adults were concerned about the security of on-street ATMs (e.g., their PIN being seen, being mugged, fearing that an ATM has been tampered with, not knowing what to do if they cannot get their card out of the machine) [3] and feared about online safety and security [40].

Another reason was related to *user experience (UX)* challenges. They felt that the design of ATMs and apps did not consider their needs and often had legibility issues (e.g., texts are too small to read). As older adults often have declining physical and perceptual abilities, such as impaired dexterity and poor eyesight, they tend to have difficulty accessing content on digital screens (e.g., ATMs and apps) [2]. Indeed, 21.1% of our participants reported having poor eyesight. What's more, participants also felt that the interaction

flows of the digital banking services did not properly guide them to start a transaction and proceed it.

Additionally, another reason was that participants did not know how to bank online or felt that they were unable to do certain banking transactions online, which were reflected in some written feedback: *"I don't know how to bank online."* and *"I feel that maybe I am too old to use digital banking."* This finding highlights that it is important to lower both "perceived" and actual difficulties of online banking for older adults.

Furthermore, while previous studies suggested that older adults felt banking websites were not user-friendly [27] and mobile apps were difficult to use [71], their findings were based on the perceptions of older adults who did not have experience of using banking websites or apps. In contrast, our findings were based on reports from older adults who did have experience using ATMs and apps.

Virtual Banks. Although only a fraction of the participants used virtual banks, over half (53.6%) of all participants held a positive attitude toward virtual banks and were willing to try one if someone recommended it. This finding is accordance with the results from both Omotayo et al.'s [53] and Asmi et al.'s [7] studies, which found that 59.9% and 55% of non-users were willing to try some form of digital/virtual banks respectively. It is worth noting that although many older adults have an intention to try virtual banking, they likely need external motivators (e.g., others' recommendations) to adopt it. As a result, future work should explore ways to provide external motivators to older adults, such as offering more training and sending encouragement from their family and friends [12].

Electronic Payment. Interestingly, although electronic payment was a newer technology, it was already adopted by 41.3% of the participants, which was two times of those who used ATMs and four times of those who used apps. Further, this adoption rate of the electronic payment was higher than Malta (40%) [12], Finland (23.7%) [42], and Nigeria (19.7%) [53]. This suggests that older adults in China seemed to bypass traditional technological platforms (e.g., ATMs and apps) and picked up their speed on adopting newer technologies (e.g., electronic payment).

5.2 Effects of Age and Gender

Age. Within older adults, age has a significant effect on their usage of banking platforms, several types of banking transactions (e.g., transfer, wealth management, pay bills), acceptable wait time, and adoption of electronic payment. For example, we found that 60.2% of young-old participants used electronic payment while only 27.1% of old-old participants and none of oldest-old participants used it. Although Harris et al. found that age cohort was a significant predictor of many aspects of mobile, online, and physical banking, their survey focused on generational effects between young and old adults (i.e., Baby Boomers, Generation X, and Generation Y) [29]. Similarly, Camilleri et al. observed the trend that the older generation was significantly less likely to adopt digital banking than the others, but their age groups covered both young and older adults (i.e., 18-34, 35-49, and 50-68) [12]. To our knowledge, prior studies did not investigate the impact of age on banking behaviors within older adults. In contrast, our study shows that even among the three age groups of older adults (i.e., young-old, old-old, and oldest-old), age has a significant effect on certain banking behaviors. In general, participants of an older age group had higher physical bank usage, lower ATM and app usage, higher willingness to wait, and lower openness to virtual banks.

Gender. Our findings show that gender has an effect on banking frequency, transfer behavior, ATM/app usage, and electronic payment usage. For example, we found that 48.2% of males used electronic payment, which was significantly higher than 31.3% for females. The effect of gender on banking behaviors corroborates with previous studies that suggested gender-based differences in banking practices and perceptions [29, 42, 60], such as males used more internet banking services than females [42] and gender was a significant predictor of preferring convenient physical bank locations and ATMs [29] as well as of perceived usefulness of digital banking [60]. More research is needed to understand why there might be a gender effect on older adults' banking behaviors.

5.3 Design Opportunities

Based on our findings, we present design opportunities and recommendations for improving older adults' banking experiences.

Firstly, physical banking is still the dominant banking platform for older adults, and long wait times continue to be a long-standing issue. Although some older adults seem to be acceptable of long wait times, this is likely a compromise due to their unfamiliarity with alternative banking platforms. Future research should investigate factors causing long wait time and optimize interaction flows in physical banks to reduce wait time. For example, physical banks may design better queuing mechanisms to reduce the wait time. Meanwhile, it is also worth considering how best to leverage the wait time to motivate older adults to learn digital banking platforms. One possible approach is through gamification [65]. A recent study in the DIS community pointed out factors to consider when designing gamification for older adults [5]. For example, older adults play for socializing, avoid competition, and prefer collaboration and care-taking [5].

Secondly, the adoption rates of ATMs, apps, and virtual banks are still relatively low. Many older adults are unfamiliar with these platforms and concerned about their trustworthiness. Luckily, older adults have positive attitudes toward these digital banking platforms in general and are willing to try ones that are recommended. Future research could consider to help older adults form social learning groups, in which they could learn new banking technologies in a peer-to-peer manner and receive recommendations from their trusted friends or family members.

Moreover, the low adoption rate is also related to user experience (UX) issues. One category of UX issues is caused by older adults' declining visual and touch acuity. For example, texts displayed on the ATM or app screens are not legible. In addition to using better lighting and non-glare glass [1], we suggest designers consider providing multimodal feedback for mobile and virtual banking apps. Lee et al. found that the multimodal feedback with auditory signals would benefit for older adults to complete mobile phone tasks [38]. Alternatively, instead of solely relying on touch interaction, we also suggest designers consider alternative interaction modalities. For example, voice user interfaces (VUIs) have recently been argued to be a promising approach for older adults [69]. Recently, researchers found that what and how older adults verbalize their

thoughts could indicate the problems that they experience [25]. However, challenges remain when designing VUIs or using subtle voice patterns to find UX problems for older adults. One such challenge would be to recognize various dialects of a language that are often spoken by older adults in different regions.

Low adoption rate is also caused by unfamiliar user interface (UI) elements. For example, participants felt digital banking platforms did not provide their familiar printed receipts. To address this issue, we suggest designers consider applying skeuomorphic design [22] when designing UI elements (e.g., receipts) to bring familiarity to older adults, in particular those who are new to digital banking.

To address other UX issues, such as the terms on the UIs are hard to understand, the interaction flows do not help them get started and move forward or recover from their mistakes, we suggest designers consider applying senior-friendly design guidelines [24] to create feedback for each step. For example, to inform older adults about how to get started and move forward or recover from mistakes properly, pre- and post-action states [24] should be provided for each key step to help older adults understand which step they are in, what they would expect to see after completing a step properly, and which step they would move into.

Interestingly, emerging at the roughly same time, the adoption rate of electronic payment among older adults is higher than that of virtual banks by nearly eight times. Electronic payment provides a successful example of the latest technologies being adopted quickly by older adults. Thus, it is worth investigating why electronic payment gains more popularity over virtual banks in such a short time to provide insights for future technology design.

It is worth noting that our research only scratched the surface of the UX issues associated with various digital banking platforms. More research is warranted to uncover and understand more UX issues that older adults encounter with digital banking technologies.

Thirdly, our study found the effects of age on banking behaviors and revealed that the old-old and the oldest-old are less likely to use digital banking platforms (e.g., ATM, app, virtual banks) than the young-old. This highlights the necessity of tailoring the banking experience design to different age groups within older adults because it is possible that the designs that work well for the young-old might fail for the old-old or the oldest-old. One possible approach is to design multiple versions of the UIs that could construct different paths to complete tasks with varied complexity, such as the multi-layered interface design [39], and to deliver the most appropriate UI at each step by learning from older adults' interactions at that step.

Lastly, our study found that female participants banked less frequently and also conducted certain types of transactions on digital banking platforms less frequently than their male counterparts. More research is needed to validate the effect of gender on banking among older adults and to further uncover the factors that might cause such gender-based differences.

5.4 Limitations

Our participants lived in 18 provinces of China, ranging from the north to the south and from the coast to inland. Thus, our survey findings provide a reasonably informative perspective of banking practices and challenges among older adults in China, which has been experiencing one of the fastest growth in digital banking. Such perspective would help designers, researchers, and banking policy makers locate issues and improve banking experiences for older adults. However, the economic condition, local culture, banking infrastructure of a region could affect its residents' banking practices and challenges. Therefore, one should be cautious about generalizing the findings to older adults in other countries or even to older adults in China in general.

As a survey study, our research provides quantitative insights with limited ability to pinpoint the underlying causes for certain banking behaviors. For example, it remains unknown why older adults have a much higher adoption rate for electronic payment than other digital banking methods (e.g., ATM, app). We also did not collect additional demographic information (e.g., education level, income) that may have an effect on the banking practices and experiences of older adults. Thus, in-depth qualitative research with older adults is warranted to discover their motivations and understand the nuances and reasons in their banking behaviors.

6 CONCLUSION

We have presented a survey study with 155 older adults from 18 provinces in China to understand their banking practices and challenges with both physical and digital banking platforms. Our results show that most older adults (72.9%) conduct banking transactions frequently (e.g., once or more per month). However, not all banking platforms are used evenly. The vast majority (94.9%) of the participants go to physical banks, roughly a quarter (24.6%) use ATMs, about 10% use mobile banking apps, and even fewer (5.8%) use virtual banks. Meanwhile, close to half (44.9%) of the participants use some form of electronic payment. Long wait time is a critical issue of physical banking. The fewer digital banking options older adults know, the more tolerant they are toward long wait times. Some are even willing to wait however long it takes to get their banking needs met. In addition to low familiarity, security and usability (e.g., user interaction, legibility) are outstanding concerns about digital banking platforms among older adults. Nevertheless, older adults hold a positive attitude toward digital platforms in general. These findings highlight the need to reduce wait time for physical banking, to increase familiarity with digital banking among older adults, such as via offline and online training programs, and to improve the security and usability of digital banking platforms.

Moreover, our study shows that age and gender have significant effects on particular banking behaviors. Young-old tend to use digital banking platforms more often and physical banks less often than old-old and oldest-old; young-old tend to conduct more advanced banking transactions than old-old and oldest-old; young-old and old-old hold more positive attitudes toward digital banking (e.g., virtual bank) than oldest-old. Compared to males, females bank less frequently. While lower percentages of females use "electronic payment", higher percentages of females use "transfer money" service and are confused about ATMs. These findings suggest the necessity of tailoring the banking experience design to different age groups and call for more research to uncover factors that may cause gender-based differences among older adults. Based on our findings, we further present design opportunities to make banking more accessible to older adults.

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