

A study on age-friendly adaptation of popular mobile apps from the perspective of visual semiotics

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Abstract. This paper proceeds to examine the compatibility of widely used mobile applications among elderly people based on visual semiotics. To emphasize the usability barriers in the form of visual, cognitive and emotional barriers, the study combines quantitative survey with qualitative interview to determine how the elderly people use mainstream digital platforms like WeChat, Alipay, and Douyin. These findings present that small fonts, convoluted verification processes, intrusive advertisements, and less-than-optimal voice feedback are the most dominant concerns. It is hypothesized that the study will give optimization strategies at four levels of analysis semantic, syntactic, contextual and pragmatic to open access to content and give the user satisfaction. It also offers a useful design guide that generalizes the empirical findings into realistic recommendations to the government, industry, and community level stakeholders. The report finally recommends the adoption of a common and cognitively empathetic design philosophy that will encourage digital inclusion and active aging in the mobile internet age.

Keywords: age-friendly design, older adults, mobile apps, visual semiotics

1. Introduction

This report combines the theoretical results obtained from "*A Study on Age-Friendly Interface Design of Mobile Applications Based on Visual Semiotics*" with the results of the current empirical study. Guided by the theoretical framework of visual semiotics, it focuses on the challenges and barriers relating to how older people use the mobile internet [1]. The study combines survey analyses and qualitative interviews and suggests optimization strategies and offers actionable tips along with the Concise User Guide to Common Apps for Older Adults. Taken together, these pursuits are focused on supplying empirical proof and sensible recommendations with the purpose of constructing a more age-inclusive digital service environment [2].

The aim of the present study is to investigate the actual user experiences and visual obstacles of older people while working with often-used mobile applications. Based on the framework of visual semiotics, four levels of analysis: semantic, syntactic, pragmatic and applicative are carried out in order to propose the optimization strategies in design. Visual semiotics theory focuses on the reciprocal relationship between the visual signs and the cognitive processes of the user. By virtue of gestalt, simplicity, and affective visual representation, they can diminish the locus's sense of anxiety and help to build older users' sense of digital involvement and wellness [3].

2. Research methods and implementation procedures

The research design of the study has an integrated approach, which uses both questionnaire surveys and in-depth interviews as well as hands-on observation. Ten popular applications among the elderly were chosen as the research sample, which are WeChat, Alipay, Douyin (TikTok China), Pinduoduo, Jinri Toutiao, Amap, Bank of China, Agricultural Bank of China, China Railway 12306 and Didi Chuxing [4]. A total of 330 participants were surveyed, divided into three age groups: 60–69, 70–79, and 80 and above.

3. Questionnaire and interview design

3.1. Questionnaire

The questionnaire was divided in 4 areas according to Table 1, Table 2 and Table 3: (A) Basic Information - age group, common app category; (B) Usage Behavior - min. utilization time, recurrent challenges; (C) Emotional and Social Needs - key coping approach, willingness to engage in community-based digital training; (D), Preferences - size, voice assistant, interface, security reminder [5].

Table 1. Basic information and app usage patterns of participants

No.	Gender	Age	Education Level	Commonly Used App	Usage Duration (h/day)	Self-Rated Operational Difficulty (1–5)
1	Female	68	High school	WeChat	2.5	3
2	Male	72	Technical school	Alipay	1.5	4
3	Female	65	Junior college	Douyin	2.0	3
4	Male	70	High school	Pinduoduo	1.8	4
5	Female	75	Bachelor's	Jinri Toutiao	2.2	3
6	Male	69	High school	Amap	1.0	4
7	Male	73	Bachelor's	Bank of China	1.0	5
8	Female	77	Primary school	Agricultural Bank of China	0.8	4
9	Male	70	High school	China Railway 12306	1.3	5
10	Female	78	Junior high	Didi Chuxing	1.0	4

Table 2. Common difficulties faced by older adults when using mobile apps

Category of Difficulty	Frequency of Occurrence (out of 10)	Percentage (%)	Typical Description
Small font size / poor visual recognition	9	90	Difficulty reading menu text, misclicking buttons
Verification code and payment anxiety	8	80	Fear of entering verification codes incorrectly, concern about payment errors
Pop-up advertisements and misclicks	7	70	Accidental clicks on ads or shopping links, intrusive sounds
Deep operational pathways	6	60	Multiple steps required to locate functions
Insufficient voice prompts / feedback	8	80	Desire for verbal cues such as "Payment Successful"

Table 3. Ranking of age-friendly functional needs among older adults

Rank	Functional Need	Number of Supporters	Percentage (%)
1	Voice prompts and broadcast	9	90
2	Simplified homepage / one-click operation	8	80
3	Larger font and high contrast	8	80
4	Reduction of advertisement interference	7	70
5	Security reminders and family sharing	6	60

3.2. In-depth interview

In addition to quantitative findings, ten semi-structured interviews were carried out with those aged between 65 and 78 years (an older age group) that focused on one representative app. The interviews were guided by questions related to actual user experiences, usability barriers, and how to improve them [6].

3.2.1. Case 1: WeChat — communication and visual recognition challenges

Interviewee: Wang Shuzhen (Female, 68), Retired Chinese teacher, Wenzhou, Zhejiang

Scenario: Communication for the daily routine of the family through WeChat. According to Wang, small fonts and buttons placed close together made the interface experience the problem of frequent misclicks. During her time video calling with her grandson, she repeatedly touches the "Voice Call" instead of the "Video Call" button, which creates anxiety under low light. Even though she activated "Care Mode" font enlargement was not uniform between pages. She mentioned that she wanted a "voice command mode", whereby she could say "Call my grandson" to make a call.

Interview Summary: Main issues: Low visual clarity and small touch targets

Suggested improvements: font size scaling for the full page, setting voice control to full page for better readability, defining the contrast between interface and app content.

3.2.2. Case 2: Alipay — verification and payment anxiety

Interviewee: Li Guoqiang (Male, 72), Retired electrician, Taizhou, Jiangsu

Scenario: Utility bill payments with the Alipay payment platform. Li explained a stressful experience of typing verification codes because of slow delivery of SMS and low figures. The Elderly Mode made the text big but concealed such essential functions as credit card payment. Post-transactional pop-up advertisements led to more mistrust. He suggested a Basic Services Version that has the basic features (payment of bills, transfer, and checking of the balance) but the verification codes are voice-read.

Interview Summary: Main issues: Nervousness about verification and security issues.

Suggested improvements: easy-to-use interface and voice recognition.

3.2.3. Case 3: Douyin (TikTok China) — ad misclicks and cognitive load

Interviewee: Chen Yulian (Female, 65), Retired doctor, Xiangyang, Hubei

Scenario: Viewing short videos daily for relaxation purposes Chen regularly happened upon pop-up shopping ads and ended up making unwarranted purchases. "In 'Senior Mode', we over-filtered recommendations and simplified the interface but it was too easy to get to the page." She wanted an interest-tag system as well as a "slow playback mode" to improve understanding.

Interview Summary: Main issues: Over-advertisement and overload of information.

Suggested improvements: based on interests rather than lists furthermore easily progressing speed of video playing.

3.2.4. Case 4: Pinduoduo — crowded layout and accidental purchases

Interviewee: Zhang Guilin (Male, 70), Retired technician, Zibo, Shandong

Scenario: Going shopping on Pinduoduo for shoes Zhang described seeing intrusive pop-ups (labelled "Coupons", "Bargain Red Packets") and misclicks when browsing. The refunding process was overly complicated. He suggested a simplified "Senior Mode" that creates only three major tabs - Shopping, Orders and After-Sales, plus a "Voice Purchase" feature.

Interview Summary: Main issues: Difficult navigation and accidental operation.

Suggested improvements: ease of navigation and purchase.

3.2.5. Case 5: Jinri Toutiao — visual fatigue and advertisement interference

Interviewee: Liu Xiuying (Female, 75), Retired accountant, Harbin, Heilongjiang

Scenario: Reading the news every morning. Liu found the interface visually tiring because of bright colors and lots of video ads. She tried the "Listen to News" feature, but found it too fast. She also suggested reading in a "Pure Reading" mode and listening to audio playback at a slower pace continuously.

Interview Summary: Main issues: Information clutter and distractions from ads.

Suggested improvements: a better reading interface and user-defined voice playing speed.

3.2.6. Case 6: Amap — voice recognition errors and weak visual cues

Interviewee: Sun Jianhua (Male, 69), Retired taxi driver, Shijiazhuang, Hebei

Scenario: Round Trip to the Hospital Sun has reported repeated voice recognition errors entering destinations, including "hospital" being recognized as "salesperson". He also found the lines too thin and colors too subtle. He designed an Elderly Driving Mode with bigger text, thicker lines, slower speaking instructions, and voice-controlled re-calculation instructions.

Interview Summary: Main issues: Unclear speech recognition and unclear map display.

Suggested improvements: visual enhancement of navigation and adaptive voice assistance.

3.2.7. Case 7: Bank of China App — transfer anxiety and multi-step process

Interviewee: Zhou Dequan (Male, 73), Retired school principal, Changsha, Hunan

Scenario: Sending money to family members Zhou reported that the multi-step transfer process was too stressful as it required frequent password and code entries. He proposed one-click transfer to "frequent contacts" and on the spot voice verification ("You are transferring 500 RMB to Zhou Wei. Please confirm.").

Interview Summary: The main issues identified were cognitive burden and unnecessary confirmations.

Suggested improvements: simplified workflow and double voice confirmation system.

3.2.8. Case 8: Agricultural Bank of China App — layered structure and visual barriers

Interviewee: Zhao Chunhua (Female, 77), Farmer, Lu'an, Anhui

Scenario: Checking of deposits in government subsidy Zhao complained of deep layers in the menu and poor visual contrast. She has often mistapped because of small gray text. She wanted to use the app and have direct homepage access to "Subsidy Received" with an audio notification when it is received.

Interview Summary: Main issues: Hard-to-understand feedback, hard-to-navigate hierarchy

Suggested improvements: simplified home page, Audio notifications.

3.2.9. Case 9: China Railway 12306 — verification and ticketing anxiety

Interviewee: Huang Zhicheng (Male, 70), Retired postal worker, Quanzhou, Fujian

Scenario: Buying tickets for trains. Huang explained her frustration at small CAPTCHAs that are merely image-based and frustration at the "standby purchase" option. He recommended that they switch to voice-based authentication and make refund policies much clearer.

Interview Summary: Main issues: Ambiguous feedback, complex verification.

Suggested improvements: voice identification for authentication and visible refund information

3.2.10. Case 10: Didi Chuxing — location and confirmation anxiety

Interviewee: Lin Yuexia (Female, 78), Living alone, Shanghai

Scenario: Booking transports with Didi Lin said she found it hard to locate her car and she felt confused during the payment process as there were many options that overlapped. For safety reasons, she hoped there would be voice prompts ("Your driver has arrived"), and a feature for "Family Trip Sharing".

Interview Summary: Real time tracking stress and post-ride stress.

Suggested improvements: Contextual voice signals and incorporation with family-sharing.

4. Research findings and analysis based on visual semiotics theory

Based on the qualitative and quantitative data collected, this section summarizes the major findings that emerged from the interviews and analyses it using the visual semiotics theory. The results point to the correspondence between the design of visual symbols and user cognition, and offer specific optimization strategies for each app. Table 4 below provides a brief summary of results obtained from the interviews and recommendations for improvements.

Table 4. Summary of comprehensive interview findings

No.	App Name	Main Pain Points	User's Original Description	Improvement Suggestions
1	WeChat	Small font, misclicks	Video button too close to the edge	Introduce voice commands; unify enlarged interface
2	Alipay	Verification anxiety	Fear of delays or incorrect input	Add voice verification and simplified service options
3	Douyin	Excessive advertisements	Swiping leads to unintended shopping pages	Provide slower playback and interest-based recommendations
4	Pinduoduo	Frequent pop-ups	Accidental clicks on coupons or group-buying links	Simplify homepage and enhance voice navigation
5	Jinri Toutiao	Visual fatigue	Text too small, causes eye strain	Enable contrast enhancement and auto narration
6	Amap	Voice recognition errors	Incorrectly identifies spoken destinations	Strengthen speech engine and route clarity
7	Bank of China	Complicated process	Multiple verification codes	Streamline transfer process and enable voice confirmation
8	Agricultural Bank of China	Deep menu hierarchy	Requires three steps to locate balance info	Redesign homepage and integrate voice guidance
9	China Railway 12306	Verification complexity	CAPTCHA too small and hard to read	Replace with speech verification and simplified refund process
10	Didi Chuxing	Confusing confirmation	Driver position unclear; post-ride stress	Add voice prompts and family-trip sharing function

4.1. Overview of findings

The research revealed four major themes regarding older adults' interaction with mobile applications. **Visual and Cognitive Difficulties:** Decreasing visual acuity, change in color perception and delayed reaction time have a substantial influence on user recognition and responsiveness. **Operational Pain Points:** Areas like claustrophobic buttons, multiple nested clicks in the navigation, annoying banners, and anxiety around validation codes. **Emotional Needs:** Older users indicated a need for social support, advice, and timely feedback and were also interested in receiving valuable information such as discounts and updates about services. **Optimization Directions:** At the semantic level, textual clarity and simplicity should be ensured, while at the syntactic level, the logical grouping and visual hierarchy of information need to be improved; additionally, at the contextual level, task visualization and step-by-step guidance ought to be enhanced, and finally, at the pragmatic level, positive and reassuring interaction feedback must be fostered.

4.2. Analysis of app usage frequency and operational difficulty

Analysis with the ten interviewed participants indicates a significant negative correlation ($r = -.63$) between the amount of time devoted to using the app daily and self-rated difficulty of operation. The old people indicated that they used apps on average for 1.6 hours a day with a mean difficulty rating of 3.9 out of 5. Level of difficulty differed according to age group. The level of difficulty differed according to age group: specifically, the average difficulty for ages 60–69 stood at 3.2, while that for ages 70–79 reached 4.1, and the average difficulty for those aged 80 and above was 4.6.

These findings indicate that increasing age strongly amplifies perceived operational barriers, suggesting a progressive need for adaptive interface design and age-specific usability interventions [7].

Table 5. Comparison of app usage duration and operational difficulty by age group

Age Group	Average Daily Usage Time (h/day)	Average Operational Difficulty (1–5)	Commonly Used Apps
60–69	2.1	3.2	WeChat, Douyin, Amap
70–79	1.5	4.1	Alipay, Pinduoduo, Jinri Toutiao
80 and above	0.9	4.6	Banking and Transportation Apps

Table 5 reveals that older age groups are more likely to report less daily periods of use and a higher rating regarding difficulty of operation.

Table 6. Statistical classification of common operational barriers among older users

Category of Barrier	Frequency (per 10 users)	Percentage (%)	Impact Level (1–5)
Small fonts / low contrast	9	90	5
Complex verification input	8	80	4
Pop-up advertisements	7	70	3
Deep navigation hierarchy	6	60	3
Lack of voice feedback	8	80	4

Table 6 lists the most common operational constraints, with the greatest being visual and verification-related constraints.

4.3. Functional preferences and improvement suggestions

The questionnaire results indicate that the above elements had been approved unlimitedly (90%), then modified homepage/one click operation (80%) and font enlargement/high contrast (80%). Overall, the security reminder and family-sharing functions had lower ratings, but they also attained a 100% approval rating among the independent-living elder subjects, reflecting highly diversified needs among the elderly user group.

Table 7. Functional preferences and improvement suggestions among older users

Functional Feature	Number of Supporters	Percentage (%)	Priority (1 = highest)
Voice prompts and announcements	9	90	1
Simplified homepage / one-click operation	8	80	2
Font enlargement and high contrast	8	80	3
Reduced advertisement interference	7	70	4
Security reminder and family sharing	6	60	5

Table 7 shows that voice prompts and announcements were the most favored functional feature among older users, with 90% of participants supporting it and ranking it as the highest priority.

5. Conclusion

Based on an in-depth study of ten popular applications, it was found that all older participants (100%) were affected by different degrees of operational barriers.

The major problem areas are focused on the visual recognition, verification code input, advertising snares, complicated navigation, and lack of voice feedback.

From a visual semiotics standpoint, current application designs are unbalanced on all four levels, which are semantic (the clarity of the text), syntactic (organisation of the layout), contextual (logic of operation), and pragmatic (interactive feedback).

Most interfaces are designed following a "youth-oriented aesthetics", which ignores cognitive pacing and perceptual limitations as well as emotional security needs of older people.

On the government level, in order to meet these requirements, standardized evaluation systems should be established, by making the Elder-Friendly App Design Evaluation Standard 2.0, a design standard, which includes visual accessibility, voice assistance, and advertisement control as compulsory design items. Furthermore, governments should start industry-wide evaluative platforms, like a Digital Accessibility Evaluation Portal, to assess the baseline and monitor on a yearly basis and publicly report the results of the mainstream applications. In addition, the community co-creation should be promoted by publishing the Silver Digital Classroom through the combination of policy support, enterprise cooperation, and community service, which has established a multi-layered support system.

When it comes to the enterprise level, the visual semiotic systems should be optimized as icons should be standardized in sizes, color contrast ratios and text hierarchies should be optimized for better readability. Intelligent voice interaction should be deployed to form a closed loop of "listening to operate" and "speaking to confirm" to further improve the overall user experience. We also suggest that core task flow paths should be streamlined, with users only presented with the more critical user intentions, such as making the payment, navigating the site, and communicating with service representatives, and the number of obstacles to entering any given path. In addition, advertisement management should be extended by a graded review of the manifestation of the Elderly Non-Disturb Mode which excludes pop-up and finance advertisements. Lastly, enterprises should actually enhance

family support mechanisms by supporting remote helping and security watching interactions for a certain level of user privacy while maintaining resource security.

At the community level, digital literacy training should be regularized with monthly smartphone training programs for seniors to help them understand how to use it effectively and safely. volunteers were encouraged to create volunteer support networks developed in the form of Community Tech-Aid Teams able to provide guidance and assistance in the home; A second recommendation was to promote family companionship interventions that promote intergenerational learning, where children help their parents to use digital devices, thus lessening the feeling of technological exclusion in elderly individuals.

Our findings also indicate that future studies should, first, increase sample and scenario diversity through recruiting participants from different regions and socio-economic backgrounds to reflect the diverse demand patterns of the elderly. Second, researchers are invited to integrate eye-tracking and emotion recognition technologies in order to measure users' visual attention and emotional reactions, which enable the quantification of a cognitive load at real-time in the app. Third, a semiotic optimization model for UI/UX evaluation should be constructed to provide a three-dimensional framework composed of items of recognition difficulty, interaction paths, and psychological safety, so as to provide a guideline for standardized UI/UX evaluation. Ultimately, there should be collaboration across platforms to drive the adoption of common standards between banks, mobility and social platforms to help the development of a unifying elder friendly design language.

This study uncovers the digital divide between seniors has shifted from "inability to use" to "difficulty and anxiety in use". As an additional field, elder-friendly design shouldn't be oversimplified to an increase of display size instead it should slowly but surely develop to a holistic design with cognitive empathy and emotional reassurance.

Future app designers, while guided by visual semiotics, should respect the design philosophy of "visible, understandable, operable and secure", which will provide digital equity and active engagement of older adults in the modern digital ecosystem.

References

- [1] Aliakbari, M., & Kamalvand, A. (2024). Social semiotic analysis of photographic portrayals of Iranian elders on websites. *Visual Studies*, 39(4), 596-608.
- [2] Wan, Y. Q., & Zhou, Y. X. (2025). Design of Age-Friendly Interfaces for Medical Apps for Older Adults with Cognitive Decline. *Industrial Design*, (10), 103–106.
- [3] Ariyanti, O., Sampaio, D., & Bailey, A. (2025). Older adults' experiences with app-based ride-hailing in Indonesia: At the intersection of health, gender, digital literacy, and affordability. *Journal of Transport & Health*, 44, 102134.
- [4] Gutiérrez, M., Cabello, V., & SanMartín, D. C. (2025). An mHealth app (NeoMayor) to promote healthy lifestyles and brain health in older adults: Design and validation study. *JMIR Aging*, 8, e71936.
- [5] Valentina, N., & Maria, V. (2025). Towards accessible glucose monitoring: Usability insights from the GlucoCheck app for seniors. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care*, 14(1), 161–166.
- [6] Eisenberg, S., & Trukeschitz, B. (2025). The effectiveness of an app-based fitness program on self-perceived physical functioning in older adults: Randomized waitlist-controlled trial. *Journal of Medical Internet Research*, 27, e64922.
- [7] Feng, M. F., & Liu, X. F. (2025). Design of Mobile Medical Apps for Older Adults Based on Flow Theory. *Footwear Technology and Design*, 5(15), 154–156.