

# Research on Age-Friendly Design and Perceived Cost of Government Service Apps Based on User Experience: A Case Study of the Tianfu Citizen Cloud App

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## Abstract

With the acceleration of population aging in China, older adults have become an increasingly important user group of digital government services. Government service applications now function as a primary interface for public service delivery; however, their design often fails to adequately accommodate the needs of elderly users, resulting in elevated perceived costs and limited usability. This study examines the relationship between age-friendly design and perceived cost by taking the Tianfu Citizen Cloud App as a case. A mixed-method approach, combining content analysis, case study, and data mining, is employed to analyze interface design characteristics and user feedback. The findings indicate that insufficient consideration of elderly users' cognitive and physiological characteristics leads to increased learning, time, and psychological costs. Based on these findings, this paper proposes targeted optimization strategies aimed at improving usability and reducing perceived cost. The study contributes to the ongoing discussion on digital inclusion by providing practical insights into the design of more accessible government service applications.

**Keywords:** Government Service Apps; Age-friendly Design; User Experience; Perceived Cost

## 1. Introduction

China is experiencing a rapid demographic transition characterized by a growing aging population. According to the seventh national census, individuals aged 60 and above account for more than 18% of the total population. As digital government initiatives continue to expand, government service applications have become essential tools for accessing public services.

Despite their convenience, these applications often present substantial challenges for elderly users. Declines in visual acuity, memory, and digital literacy may hinder their ability to navigate complex interfaces and complete multi-step procedures. As a result, a considerable proportion of older adults remain excluded from the benefits of digital public services.

Age-friendly design has been proposed as a key approach to addressing this issue. By aligning interface design with the characteristics and needs of elderly users, it is possible to enhance usability and reduce barriers to access. However, existing studies have paid limited attention to how such design features influence users' perceived cost.

To address this gap, this study explores the relationship between age-friendly design and perceived cost through an empirical case analysis. It aims to answer the following research questions:

- (1) What are the main shortcomings in the age-friendly design of government service applications?
- (2) How do these shortcomings influence the perceived cost of elderly users?
- (3) What design strategies may effectively reduce such costs?

## 2. Literature Review

### 2.1. Age-Friendly Design and User Experience

User experience (UX) is a foundational concept in human–computer interaction, encompassing users’ perceptions, emotions, and responses during system interaction. The five-layer model of UX—strategy, scope, structure, framework, and presentation—provides a systematic framework for evaluating digital products.

In the context of government service applications, age-friendly design can be incorporated across these layers. Age-friendly design principles emphasize the need to adapt technological systems to the cognitive and physical characteristics of older adults (Czaja et al., 2019).

For example, the presentation layer may emphasize readability through larger fonts and higher contrast, while the structure layer may reduce complexity by simplifying navigation paths. These adaptations are particularly relevant for elderly users, whose cognitive and perceptual abilities may differ from those of younger users.

### 2.2. Perceived Cost and Cognitive Load

Perceived cost refers to the overall burden experienced by users during interaction, including cognitive, temporal, and emotional dimensions. Cognitive load theory offers a useful framework for understanding this concept. It distinguishes among intrinsic, extraneous, and germane cognitive load, with extraneous load often arising from suboptimal design. User adoption behavior can also be explained through technology acceptance frameworks, which highlight the role of perceived effort and performance expectations (Venkatesh et al., 2012).

For elderly users, poorly structured interfaces and unclear operational logic may significantly increase extraneous cognitive load. This, in turn, can manifest as higher learning cost, longer task completion time, and increased psychological pressure (Guo et al., 2022). Therefore, reducing unnecessary cognitive burden is essential for improving usability (Xiao et al., 2024).

### 2.3. Research Gaps and Contribution

Although previous studies have explored age-friendly design and digital inclusion (Chen & Yang, 2024; Yu et al., 2021), several limitations remain. First, the relationship between age-friendly design and perceived cost has not been sufficiently examined. Second, many studies rely on a single methodological approach, limiting analytical depth. Third, empirical research focusing on specific government service applications remains relatively scarce (Ji & Ma, 2023; Zhao & Yang, 2020).

This study contributes to the literature in three ways. First, it integrates age-friendly design and perceived cost within a unified analytical framework. Second, it adopts a mixed-method approach to provide a more comprehensive analysis. Third, it offers practical recommendations based on a real-world application case.

Based on the existing literature, this study proposes a conceptual framework linking age-friendly design, perceived cost, and user experience. Age-friendly design is treated as the independent variable, influencing perceived cost across three dimensions: learning cost, time cost, and psychological cost. Perceived cost, in turn, affects overall user experience and usage intention (Mi et al., 2022; Zhu et al., 2024).

This framework integrates insights from cognitive load theory and technology acceptance research, suggesting that reducing unnecessary cognitive burden can enhance usability and promote continued usage (Czaja et al., 2019; Venkatesh et al., 2012).

Existing studies on digital government and age-friendly design have primarily focused on usability improvements and policy-level discussions (Chen & Yang, 2024; Yu et al., 2021). Meanwhile, research grounded in technology acceptance theory has emphasized the role of perceived usefulness and ease of use in shaping user

behavior (Venkatesh et al., 2012).

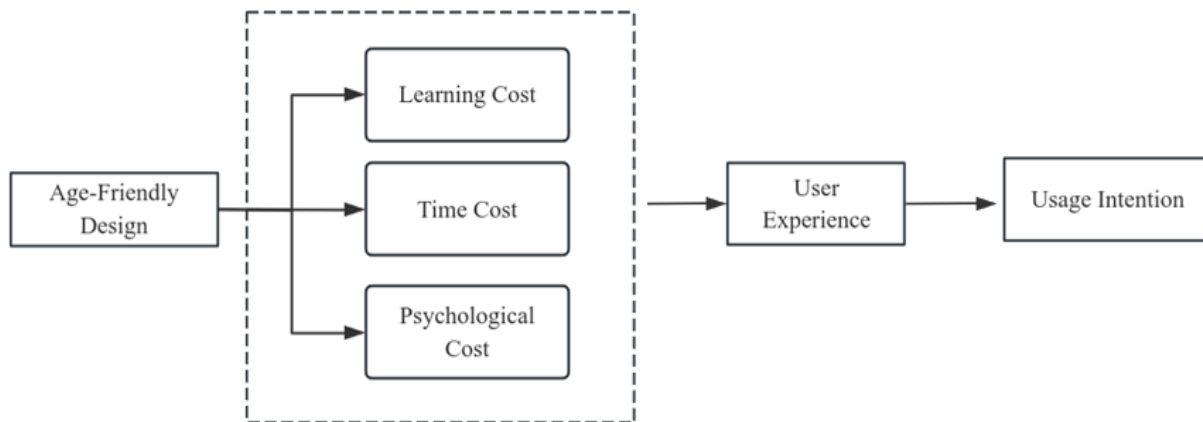


Figure 1. Conceptual framework of age-friendly design and perceived cost (adapted from Czaja et al., 2019; Venkatesh et al., 2012)

However, relatively few studies have explicitly examined perceived cost as a multidimensional construct, particularly in the context of elderly users interacting with government service applications (Guo et al., 2022; Xiao et al., 2024). Moreover, the integration of cognitive load theory into age-friendly design research remains limited.

By positioning perceived cost as a mediating mechanism between design features and user experience, this study seeks to bridge these strands of literature and provide a more nuanced understanding of how interface design influences digital inclusion outcomes.

### 3. Research Methods

#### 3.1. Research Design

This study adopts a mixed research method integrating qualitative and quantitative approaches, taking the widely used and representative Tianfu Citizen Cloud App as a case to examine its age-friendly design features and the perceived cost of elderly users. The research is carried out in a progressive manner around three methods: case study, content analysis and data mining. First, the case study is used to clarify the App's functional positioning, design features and usage scenarios; then the content analysis method is employed to quantitatively evaluate the level of the interface's age-friendly design; finally, data mining is relied on to explore the actual usage pain points of elderly users. These three methods support and corroborate each other, providing a robust empirical basis for the research conclusions.

#### 3.2. Methods

Content analysis was adopted to evaluate the interface design of the Tianfu Citizen Cloud App, with a focus on its layout structure, visual elements (such as font size, color contrast and icon clarity), and interaction mechanisms (such as navigation paths and button placement). In addition, this study analyzed relevant policy documents and official publicity materials to assess how age-friendly design is communicated and supported at the institutional level. The analysis followed a systematic coding process to conduct a systematic evaluation of the age-friendly features of its interface design and identify explicit problems in the design.

Case Study Method: Through the direct operational experience of the research team members, the full-process usage scenarios of the Tianfu Citizen Cloud App were sorted out, with a focus on analyzing the operation steps, page jump logic, relevant function search, and completion of multi-step applications for the frequently used

functions of elderly users. Meanwhile, the official policy documents and promotional materials related to the App were collated to analyze the policy orientation and implementation effect of its age-friendly development, thus forming a deeper understanding of the research object.

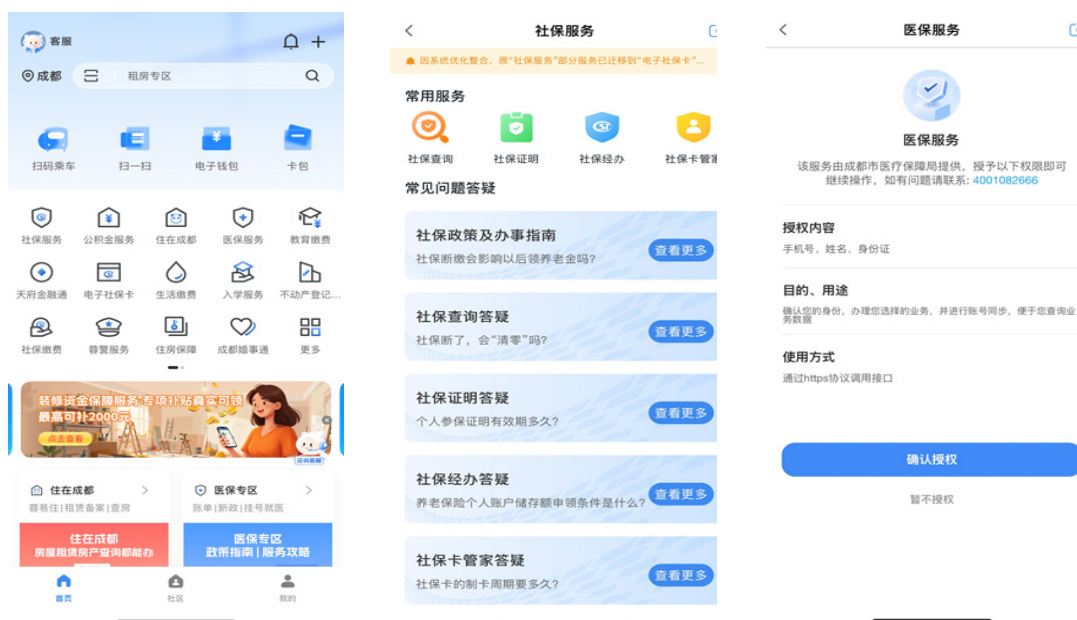
In addition, data mining techniques were applied to collect user feedback from app stores (including Huawei AppGallery, Myapp and the Apple App Store) and online platforms (Weibo and Zhihu). Using text analysis methods such as word frequency analysis and sentiment analysis, the study identified the common problems reported by users and explored the subjective expressions of perceived cost among elderly users, thereby providing empirical evidence for the correlation between design deficiencies and perceived cost.

### 3.3. Data Sources

Data are drawn from three main sources below.

#### 3.3.1. Interface Observations and Screenshots

Interface observations and screenshots: A total of 50 screenshots covering key functional modules (e.g., home page, Social Security Services, healthcare services) are captured and annotated to illustrate design features. Example screenshots showing dense information layout and low-contrast text are included in the analysis.



#### 3.3.2. Official Policy and Publicity Materials

Official policy and publicity materials: These include the “Tianfu Citizen Cloud App Operation Report” and official user guides, which provide context on design intent and service scope.

#### 3.3.3. User-Generated Content, Including Over 1,000 Application Reviews and Online Discussions.

A total of 1,000 app store reviews and online discussion posts were collected. Examples of user reviews include "The operation process is complicated and hard to see", "I searched for a long time but still couldn't find the required service", and "I feel flustered every time I use this software". These examples were used to illustrate the three dimensions of perceived cost.



### 4. Research Conclusions

The analysis reveals several key findings.

First, the current design of government service applications does not fully accommodate the needs of elderly users. Issues such as dense information layout, insufficient visual contrast, and complex navigation structures are commonly observed.

Second, these design shortcomings contribute directly to increased perceived cost. Learning cost is elevated due to unclear instructions and unfamiliar interaction patterns. Time cost increases as users require more effort to complete tasks. Psychological cost is reflected in frustration, anxiety, and reduced confidence in using digital tools.

Third, perceived cost is not a single-dimensional construct but rather a combination of learning, time, and psychological factors. These dimensions interact with one another and jointly influence user experience and continued usage intention.

Overall, the findings suggest that improving age-friendly design can play a critical role in reducing perceived cost and enhancing digital inclusion.

### 5. Recommendations

Based on the findings, several practical recommendations are proposed.

First, operational processes should be simplified to reduce unnecessary complexity. This may involve streamlining procedures, minimizing repetitive data entry, and improving task continuity through better system integration.

Second, visual design should be optimized to enhance accessibility. Increasing font size, improving color contrast, and reducing visual clutter can significantly improve readability and usability for elderly users.

Third, supportive features should be incorporated to assist users during interaction. These may include guided instructions, voice-based interaction, and accessible help functions. Providing timely feedback and assistance can reduce uncertainty and improve user confidence.

Finally, it is important to adopt a user-centered design approach that actively involves elderly users in the

development process. Such participation can help ensure that design solutions are aligned with real user needs.

## 6. Conclusion

Taking the Tianfu Citizen Cloud App as a case study, this research explores the correlation between the age-friendly design of government service apps and the perceived cost of elderly users. It is found that current government service apps are generally plagued by such issues as dense information distribution, poor visual presentation and complicated operational procedures. These apps fail to fully adapt to the cognitive and physiological characteristics of elderly users, leading to high levels of perceived learning, time and psychological costs among this group; moreover, these three dimensions of cost interact with one another, which significantly diminishes elderly users' experience and their intention to continue using the apps.

This research reveals a significant correlation between age-friendly design and the perceived cost of elderly users, and indicates that optimizing age-friendly design is a critical path to reducing perceived costs and bridging the digital divide for the elderly. The age-friendly transformation of government service apps requires systematic improvements in aspects such as simplifying operational procedures, optimizing visual presentation, and adding voice interaction and guided auxiliary functions. In addition, a user-centered approach must be adhered to, with elderly users involved in the design process, to ensure that the transformation aligns with their actual needs.

The age-friendly development of government service apps is not only a technical design optimization, but also a reflection of the inclusive and humanistic care practiced by digital governments. Only by integrating the concept of age-friendliness into the design of government service apps can the elderly equally share the fruits of digital development, drive the transformation of digital government services from usable to easy to use, and enhance the overall inclusiveness and service quality of digital government services. The conclusions and recommendations of this research also provide practical references for the subsequent digital age-friendly development of government services.

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