



Research on the Aging-Friendly Interface Design Strategy of Smart Travel Apps from the Perspective of Digital Care

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SUMMARY: *Based on the theory of care, this paper examines the interface design of smart travel applications in the digital era and proposes design strategies that integrate both humanistic care and technological inclusivity. Using grounded theory as the research approach, interviews and observations of older adults have been conducted, and a relational construction model has been established through coding analysis. First, the contextual associations of older adults with travel apps were analyzed; second, various factors influencing their use were identified; and finally, four distinct but interrelated design strategies were proposed: interface usability, relationship connection, value reconstruction, and identity recognition. This study extends beyond the limitations of traditional usability paradigms by adding a relational perspective, asserting that older adults are not isolated or defective users of digital technology but rather valuable subjects who possess rich relational resources in intergenerational and peer-group networks. Therefore, the design of smart travel applications from a relational perspective can effectively meet the travel needs of older adults.*

KEYWORDS: *digital care; Aging friendly design; Smart travel app; Relational paradigm; grounded theory*

1 Introduction

China's current age-old society is extremely old and worsening. According to the above statistics, by the end of 2024, the number of people aged 60 and over in China will be approximately 320 million, making up about 23% of the total population. In accordance with the standard for designating a deeply aging society by the World Bank, a country or area is considered to be in a deeply aging stage when the proportion of older persons aged 65 and above exceeds 14%. China has thus entered the stage of deep ageing. Furthermore, with the development of intelligent cities across the country, the number of internet users has been continuously expanding, and the proportion of older internet users aged 60 and over has reached 53.7%; thus, older people are becoming an essential group in the mobile internet user community [1, 2]. By 2020, China had already launched a series of targeted policies to promote the care and services for older adults. The Internet industry has been proactive in exploring relevant measures and specific applications of elderly care services in response to this.

With the wave of ageing-friendly changes, the first group of websites and apps that have participated have proactively taken the lead in innovation, focusing on the needs and operating characteristics of older adults. They have released a series of special operating modes sequentially, such as a caring version, an elderly mode, and an aged person's mode. At the same

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time, they have released friendly-interface designs that meet the habits of older adults and are working to improve the user experience of the elderly group in all areas of their daily lives, such as social media, news, shopping, healthcare, finance and tourism. Therefore, aging-friendly renovation cannot be achieved merely by the spontaneous initiative of enterprises. A key problem in promoting the construction of digital inclusivity at a new stage is how to transform fragmented enterprise actions into a system of enduring industry norms. In May 2025, three national associations jointly launched the "social cooperation and public welfare driven" joint action, and proposed the Joint Action to Promote the High Quality Development of Internet Adaptability and Barrier-Free Environment (2025-2028) for a specific response plan to the digital transformation of public services; this is a three-year social cooperation initiative and action plan aimed at systematically advancing the inclusive construction of digital services [3].

Due to the accelerated ageing of the population and the continuous deepening of digital government construction, public service applications have gradually entered the daily lives of more and more people. For example, according to the statistical data on the usage rate of mobile phone functions among older adults in November 2025, the scale of monthly active users for travel services has risen by 15.4% year-on-year and is now ranked second [4]. This shows that older adults have actual demands for digital life and are actively using convenient and secure tools when travelling. It also shows that more and more elderly people are being able to use digital intelligence more actively and deliberately to reduce travel difficulties and improve travel convenience.

2 Definition and related research on the aging adaptability of smart travel apps from the perspective of digital care

2.1 Concept of Digital Care

With the rapid development of digital technology, the problem of the digital divide is becoming increasingly prominent. Countries, governments and enterprises in various industries have all introduced many core terms directly related to aging, such as caring design, inclusive design, emotional design, people-centered, safety and service friendliness. The theory of digital care is a new design value and theoretical perspective that has emerged recently by cross-pollinating care ethics, emotional design theory and inclusive design theory in the context of deepening population aging and accelerating the transformation of society into a digital society. Different from traditional usability and accessibility focus, the idea of digital care believes that in the development of digital technology, one should not only pursue functionality but also actively inject humanistic values such as respect, inclusiveness and warmth, pay attention to users' subjective feelings and actual well-being in the process of using digital technology, and provide emotional support and care services for specific groups. Therefore, in the introduction of the concept of digital care into the design of elderly-friendly interfaces for smart travel apps, the design goal needs to be elevated from a single guarantee of accessibility to in-depth care. We should strive to encourage older adults to be willing to use the app, and further extend from meeting their basic functional needs to creating a safe, reliable, trustworthy and supportive high-quality digital experience for them.

2.2 Research on Digital Care

Based on the current literature review of digital care in academia, the relational paradigm can be defined as follows: digital technology is not merely a supporting tool but an active participant that is able to be actively and fully incorporated into daily life. Traditional literature on the

relationship between people and technology has generally adopted the concept of a usability relationship; that is, people use technology to achieve specific goals and increase the efficiency of their actions. The relational paradigm extends this by proposing that in particular situations of life, people and technology interact with one another in tangible and observable ways, and their relationship is dynamic and concrete. It can be understood that interaction itself is a process through which both parties clarify their own identities, jointly seek the meaning of their actions, confirm the value orientation of their actions, and give each other the meaning of their actions, thus forming a truly emotional, connected, and warm relationship.

Based on the research conducted abroad so far, it can be observed that the new era in foreign research on digital care is no longer limited to identifying technological tools; rather, scholars now examine these tools in relation to human-technology interaction. Therefore, many foreign academics have long recognized that the main issue of age-appropriate digital design is not a deficiency in technological capacity among older adults. The real problem is that there is a lack of understanding of the emotional logic and identity needs of elderly users at different stages of life in the use of technology. More remarkably, mature theoretical and practical achievements have already been made abroad. Based on the difficulties that older people encounter when using such products, Liu B conducted an in-depth study of their physiological, psychological and behavioural traits, which led to the actual demand for designing age-friendly products [5, 6]. Islam and others put forward the conceptual design framework of "RACares" for RA in the field of mHealth and clearly showed that, to improve the effectiveness of mHealth applications in terms of user experience and relationship building, the design goals should organically integrate empathy response, personalised memory and long-term relationship maintenance elements [7]. Offerman and others have also indicated that the purpose of technology is not merely to monitor the patient's physiological indices but also to proactively and accurately identify problems with their physical and mental health. Research by these scholars has integrated nursing philosophy into the remote patient management system and shifted the focus of remote patient management from monitoring to caring for patients.

Zhong Fang, Liu Xin, and Liang Ru are some of the domestic scholars who have conducted all-encompassing and systematic research on the elderly population from many aspects, such as age group, status of physical function, and health level, expanding and deepening the discussion on the internal diversity of the elderly population. Lin Yuqin and others from Wuhan University have also clearly put forward in their review that currently the focus of China's aging design research is on sensory disorders, cognitive disorders, and behavioural disorders, as well as a standardised process of "demand mining obstacle analysis optimisation design" [8-10]. Dou Jinhua, Qi Ruoxuan and others have conducted a high-level division of the attributes of older adults in various environments according to situational theory. They have proposed various strategies for intelligent voice user interfaces and summarized a specific process of memory-assisted dialogue [11]. Zhang Ting and others have conducted an in-depth analysis of the aging experience of digital medical applications from the perspective of the Human Information Processing Model (HIP). A clear and easily recognizable copy is determined to be a high-weight design indicator; this aligns with the basic idea in cognitive psychology that first one must ascertain whether the information can be processed correctly and then whether the technology can reduce the user's sense of identity anxiety [12]. It should be noted that in empirical studies conducted by domestic scholars on relational connections, papers written by Wang Qian, Shang Peipei, and others about the Replika emotional AI platform have provided clear responses to the research results on emotional logic and identity demands, representing the initial work of research direction transformation [13].

In short, in terms of the development of research paradigms, it can be seen that foreign research on digital care has moved from the usability paradigm to the relational paradigm and

now views digital technology as a social actor embedded in daily life. Research on the relationship between people and technology is currently underway at home. Most research in this area still focuses on the concept of usability; that is to say, it aims to optimise the design of technological functions and scientifically evaluate their application results. Research from a relational perspective is still in its early stages. However, in recent years, there has been an increase in research at home in China on the relational aspect, and several studies have explored issues such as digital care from a subjective standpoint and combined them with specific situations in daily life practice to make innovative explorations. Therefore, it has also created new directions for research on digital care in China.

2.3 Current Status of Aging friendly Design in the Context of Smart Mobility

With the emergence of the information age, the design of the interface for travel applications has become increasingly rich, but the complexity of functions has also brought various difficulties for older people in their use, and older people often face the dilemma of digital survival. At present, academic discussions on age-appropriate design often begin with the usability and ease of operation of functions. Although some adjustments, such as enlarging font sizes and reducing complexity, have been made, many existing age-appropriate designs fail to address the actual demands of older adults for cognitive load, learning anxiety and emotional comfort, etc. Therefore, simply making age-appropriate modifications formally cannot truly motivate older adults to continue using them. Although the original goal of building an age-friendly transformation for the APP was to create a convenient environment for older people, there are still a number of urgent problems that need to be addressed in terms of the current design of the APP interface for older users. For example, in order to meet policy requirements, some apps have adopted simple and crude methods to reduce functions significantly during the renovation, and the core functions that are ultimately retained fail to meet the actual needs of older people. Secondly, the aging-friendly interface transformation of the APP has mostly focused on the first-level interface, and the second-level and deeper pages have not been fully and systematically optimized. The third and most typical problem is that although the interface form conforms to the basic policy of appropriate aging transformation, older users are still confused and lost during actual operation. For instance, some apps have released an elder mode that, in the pursuit of extreme simplicity in the interface, only retains basic functions such as phone booking but removes essential operating functions such as order management. This forces older users to switch back to the standard mode repeatedly during use, greatly disrupting the continuity of use and weakening the actual value of the elder mode. In addition, the dual gap between technology and cognition has also created serious obstacles for a large number of older users in the actual use of digital products and services, directly restricting their basic right to enjoy public services in the digital age.

In short, given that current research and practice in aging adaptation are still within the framework of the usability paradigm, little attention and systematic analysis have been paid to the emotional needs and value recognition behind the usage behavior of elderly users. More importantly, older people are not deficient users; rather, they are full-fledged participants in digital life with relational needs when interacting with technology, others, and society. Therefore, this paper introduces the perspective of digital care theory, extends the research paradigm from usability to relational, and conducts an in-depth discussion on the design strategies for age-friendly interfaces of smart travel apps to help older people gain dignity, autonomy and happiness in digital travel [14, 15].

3 Research and coding process of elderly travel apps

In 1967, the American scholars Barney Glaser and Anselm Strauss published "Discovering Grounded Theory: A Strategy for Qualitative Research" and formally introduced grounded theory to the field of Western social science research. In the following decades, it has had a significant impact on the Western social science community and was known as one of the most widely used qualitative research interpretations frameworks at the end of the 20th century. Grounded theory is a qualitative research method that develops theories based on data, and it is particularly suitable for studying the dynamic process of older adults forming relationships with the digital world in their daily lives. Therefore, in this article, when investigating the behaviour and obstacles to using travel apps among older adults, grounded theory will be employed to start with specific phenomena, gradually move to abstract concepts, and finally build a theoretical system. Organize the interview data and observation records from the previous study in layers, apply three-level coding, and build the theoretical framework.

3.1 Sample selection for research

The 19 elderly people with experience using travel apps selected as the sample for this survey are all aged 60 and above, and they have been divided into several age groups: 61-65 years old, 66-67 years old, and 70 years old and above. All the respondents have used travel apps such as Didi Elderly Edition and Gaode Map Elderly Mode at least once in the past three months, and the elderly in the sample have good communication and expression abilities, various family structures, and various types of living alone or with their children. They also have different degrees of numerical experience and are used at different times. Therefore, this sample is diverse enough and well-saturated, as shown in Figure 1.

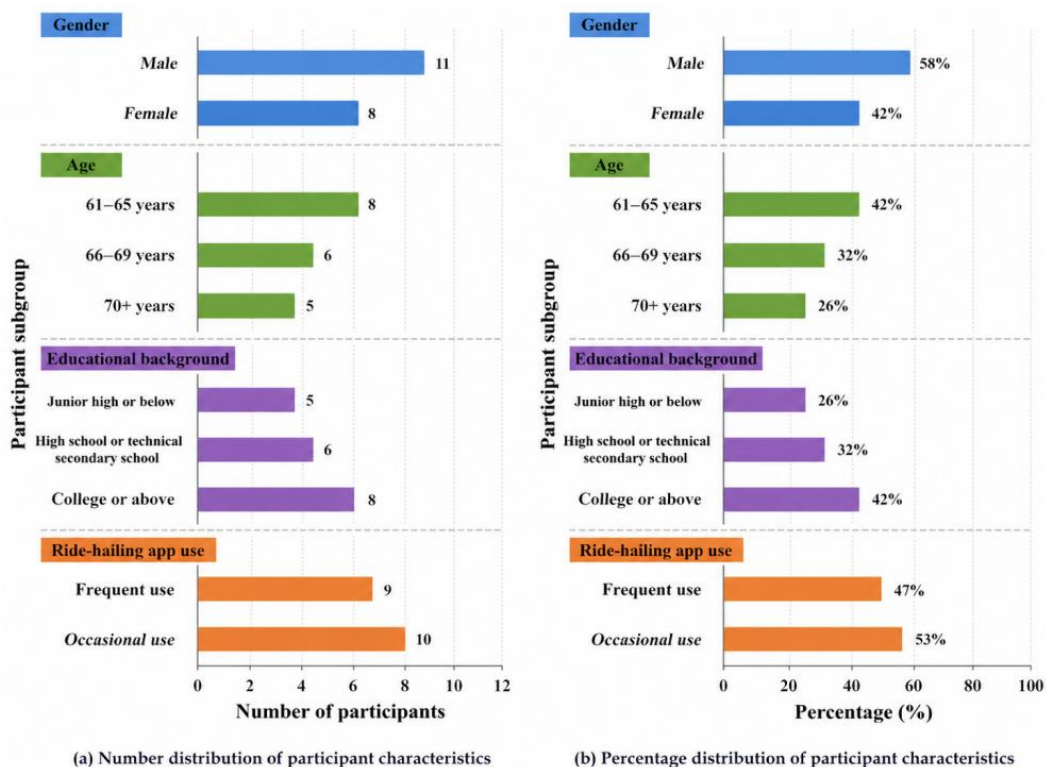


Figure 2: Basic Information of Interviewees

3.2 Interview outline design

Semi-structured interviews will be used as the main way of collecting data in this paper. To ensure that the interview plan is both scientific and feasible, an initial draft of the plan was developed based on a review of related studies and discussions within the research group. Based on the feedback from the pre-interviews, revise and optimize the content, wording of questions, and order of questions in the outline, and finally establish an official interview plan. The general features of the interviewees have been obtained in the initial communication. The main content of the formal interview is as follows: (1) How do you feel when using the ride-hailing app, viewing the screen and pressing buttons? Have you ever encountered situations where you cannot see clearly, cannot find a button, or click it incorrectly? (2) Do you think the icons and steps in the app are easy to learn? Have you ever encountered a situation where you cannot understand an icon or forget the previous steps during operation? (3) Are you worried about binding bank cards and online payments? What are your main concerns? (4) Do you ask your children or other people for help when you are unable to operate it? Or would you rather figure it out yourself? Why? (5) Would you tell others about your experience using the app? What was their response? (6) After learning how to use a ride-hailing app, has your travel become more convenient? Have you been able to go to more places because of it? (7) When did you first start using this app? What has changed since then? The specific information is shown in Figure 2.

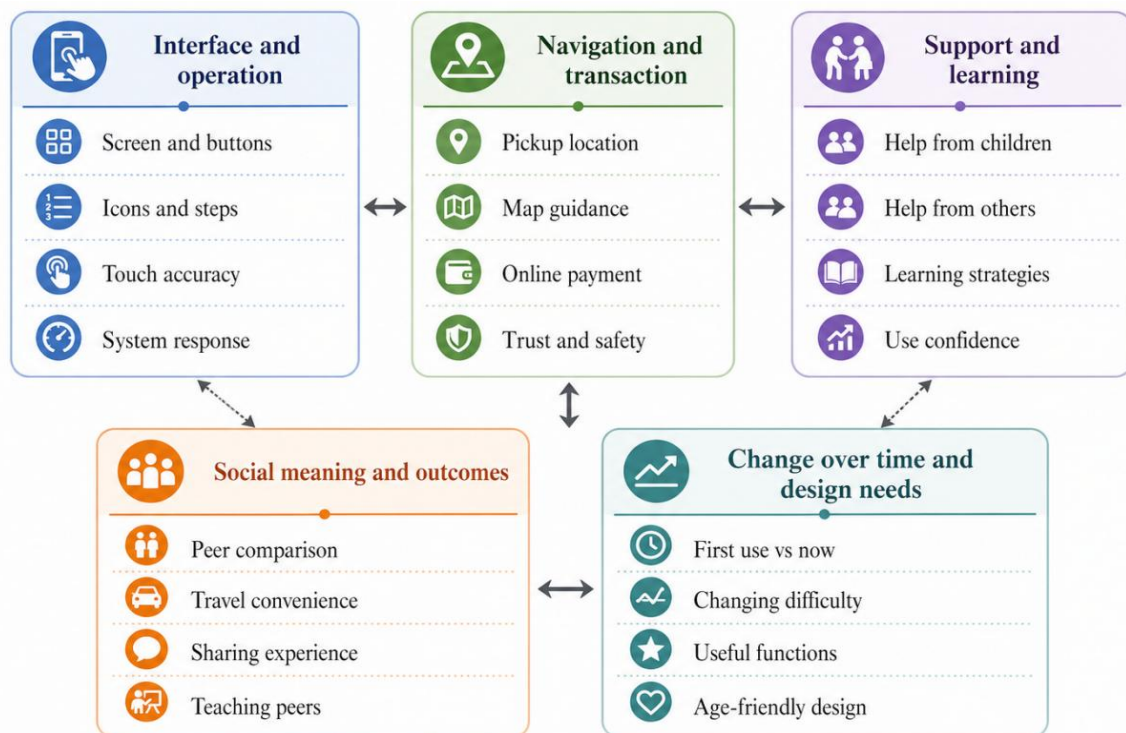


Figure 2: Design of Interview Outline

3.3 Data Collection

The formal interview will be conducted face-to-face and one-on-one offline. Researchers can ask flexible questions about the contents of the interview naturally and appropriately during the interview, and have deep discussions on important issues. Each interview will be limited to 15-30 minutes long, with an average of about 20 minutes. Before the interview starts, the

researcher will first explain the relevant concepts and research goals to the interviewee, and after receiving their consent, record the entire process. After the interview, the researchers will transcribe the recorded material word-for-word into text and standardize the semantic and colloquial expressions, as well as personal narratives, in the text, finally obtaining 19 formal interview texts for analysis.

3.4 Encoding process

Grounded theory was used as the method in this study, and strictly followed the logical sequence of concrete phenomena \rightarrow abstract concepts \rightarrow theoretical framework for data analysis. Therefore, a three-level coding process of open coding, axial coding, and selective coding was employed to extract concepts and summarize categories from the raw data, and finally construct a theoretical framework that can effectively explain the digital behaviour characteristics of older adults and provide empirical support for future age-friendly design strategies. During the coding process, all interview texts were numbered in the form of "T+serial number" (e.g., T1 is the interview text of the first interviewee). The coding work was jointly carried out by two researchers, and regular group discussions were held to conduct systematic cross-checking of the coding results to ensure the consistency and reliability of the coding.

By analysing the original interview text sentence by sentence, high-frequency and representative original sentences have been selected from it. As mentioned by the elderly respondents in the user interface section, "The button to confirm the ride is grey; I thought it couldn't be clicked", and "The text is too small; even wearing reading glasses, it is difficult for me". During operation, the interviewed elderly also mentioned that "There are so many markers on the map; I do not know where I am". After being able to call a car through the app, I can go see my grandson by myself and no longer have to bother my child all the time; In the group of our square dance team, everyone will share and use the app to search for information about nearby square dance activity locations and transportation methods, and I will actively participate in the discussion. Based on this, the original interview texts were annotated and summarised to form initial concepts; these were defined and integrated to finally form 16 basic categories, such as visual recognition, text readability, and touch operation. Due to space constraints, some representative original texts and initial encodings are displayed in this article as an example. The particular contents are as follows: Figure 3.









Framework	Core Dimensions	Essential Meaning
 <p>Usability Framework</p>	 <p>Perception and Operation</p>	Visual Perception Users recognize and distinguish interface elements (color, size, position, density).
		Readability Users easily read interface text (font, size, contrast).
		Interaction Users effectively interact with interface elements (touch area, accuracy, responsiveness).
	 <p>Context Awareness</p>	Task Process Users recognize task steps, quantity, complexity, and confirmation loops.
		Spatial Navigation Users accurately perceive location, information density, landmarks, and usage patterns.
	 <p>Safety and Trust</p>	Payment Security Users perceive security in financial operations (e.g., binding bank cards, top-ups).
		Privacy Security Users feel secure about personal information (e.g., payment passwords).
		Rule Transparency Users recognize transparency in rules (e.g., cancellations, waiting times, dynamic pricing).
	 <p>Relational Framework</p>	 <p>Support and Reliability</p>
Informal Support Users get help from peers (family, friends, community).		
 <p>Emotional Experience</p>		Emotional Strain Negative emotions from task difficulty affect usage tolerance and parent-child relationships.
		Support Perception Emotional support and role recognition reduce burden and enhance learning motivation.
 <p>Identity and Relationship</p>		Identity Recognition Operational failures, unclear rules, and communication gaps trigger identity crises.
		Role Construction Users gain identity through teaching others and achieving after technology adoption.
	Social Connection Users engage in group interactions in interest communities, enhancing social connections.	

Figure 3: Open Encoding Results (Partial)

Open coding was conducted first to compare and group related concepts into a higher-level category. Then, the categories were further subdivided; for example, visual perception, operational interaction, task flow and map functionality fell under "interface usability", and payment security and transparent rules were grouped as "secure trust". Based on the above work, 16 basic categories and 12 main categories were formed by open coding in this article. Through further refinement and labelling, the main categories that affect the use of older adults have finally been reduced to five: perception and operation, situational perception, security and trust, support and dependence, and identity and relationship. The particular contents are as follows: Figure 4.

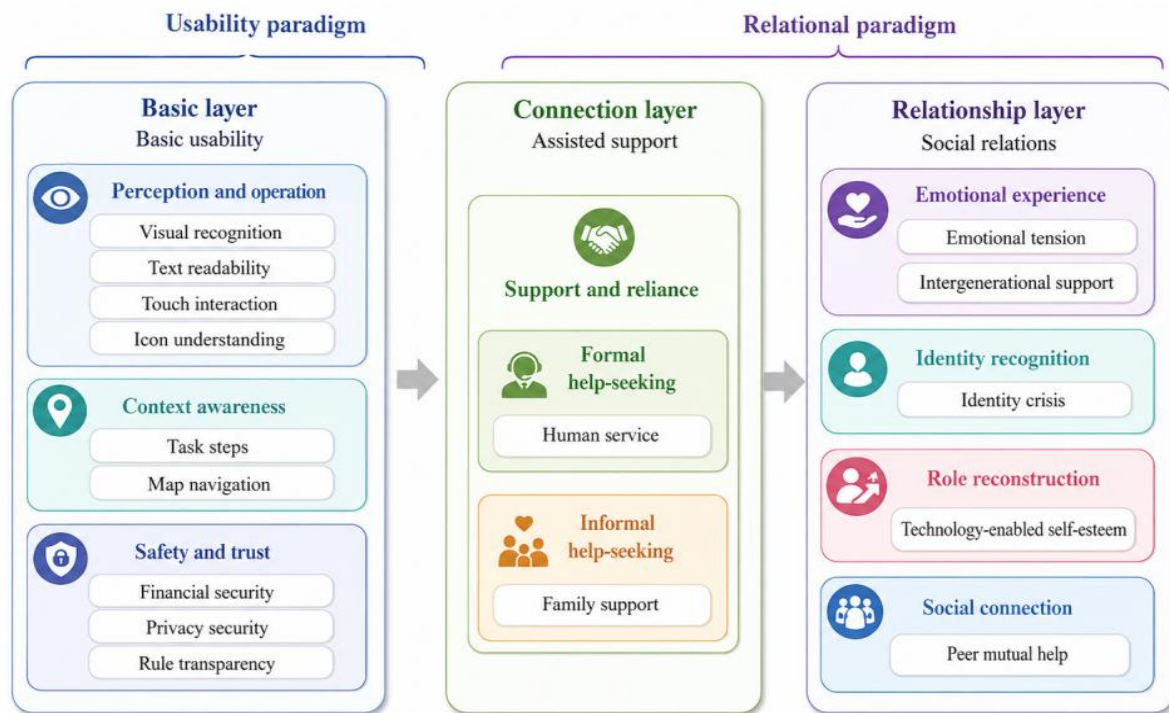


Figure 4: Main Axis Coding Results

Selective coding is the process of extracting core categories and exploring their logical relationships through in-depth comparative analysis of the main categories generated by axial coding. This article compares and analyzes 12 main categories and their pathways of action, and draws conclusions. Some of the categories are directly related to the usability level of the interface itself and belong to the basic operational threshold for elderly users to use smart travel apps; the other category is highly consistent with users' perception of trust in auxiliary support and affects whether elderly people are willing to try using it and whether they continue to use it; the third category involves intergenerational interaction, peer assistance and self-worth realization, and essentially reflects the deeper social relationships and psychological demands of the elderly when using technology. Therefore, this article categorizes the 12 main categories into 5 core categories. Based on this, this article sorts out the logical relationships of each core category to form a smooth and internally logical storyline: in the context of using smart travel apps, perception and operation, situational perception and safety trust are the basic prerequisites for elderly technology adoption, directly determining their initial willingness to use. When elderly people encounter operational difficulties, they will naturally seek help and support, such as assistance from children or manual customer service. The interactive context during the process of seeking help can generate emotional experiences, which in turn promote the reconstruction of identity and relationships. Negative interactive experiences are likely to cause self-doubt and avoidance of use among the elderly, while positive experiences are more conducive to technical learning. At the same time, the behavior of mutual assistance and sharing among peers among the elderly can compensate for the lack of intergenerational support and naturally reconstruct their self-worth in the process of teaching others. The successful experience of using technology itself will be sublimated into a sense of self-esteem brought about by technological empowerment, while continuous setbacks may trigger an identity crisis. Therefore, technology empowers self-esteem and identity crisis, which are mutually causal and influential, jointly shaping the behavior patterns of elderly users towards smart travel apps. The specific information is shown in Figure 5.

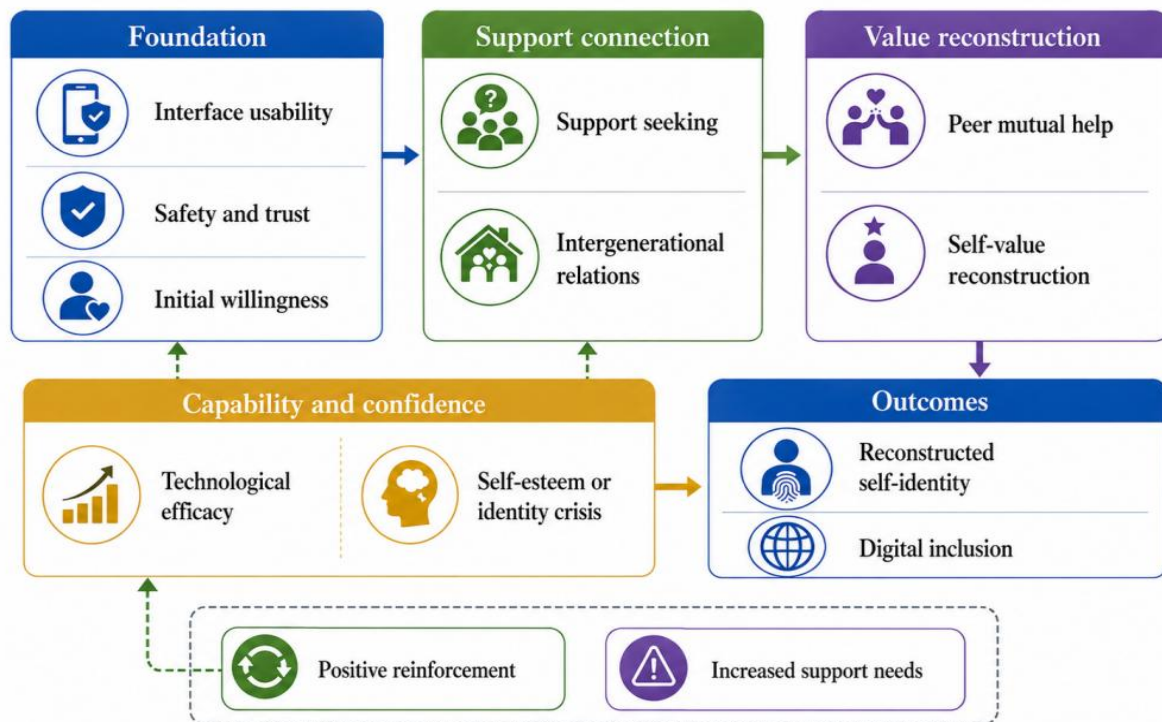


Figure 5: Selective Encoding Results

3.5 Constructing Theoretical Models

This paper will systematically and thoroughly investigate the various problems elderly people face when using travel apps, as well as the reasons for these problems, by employing a three-level coding analysis method. First, open coding will be conducted on the original data to extract 16 basic categories, and then axial coding will be used to summarize each basic category; finally, 12 main categories and 5 core categories will be obtained. Based on this foundation, seven action paths for each category will be identified through selective coding, as shown in Table 5. Based on the analysis results above, the core value of this theoretical model lies in breaking through the previous framework that limited the study of elderly digital behavior to the technical problem of whether the interface is user-friendly, and moving towards the social and technical issues of how to build a sustainable relationship between people and the digital environment. It can provide theoretical support and a path for application in developing relational systems by increasing the usability of existing systems, as shown in Figure 6.

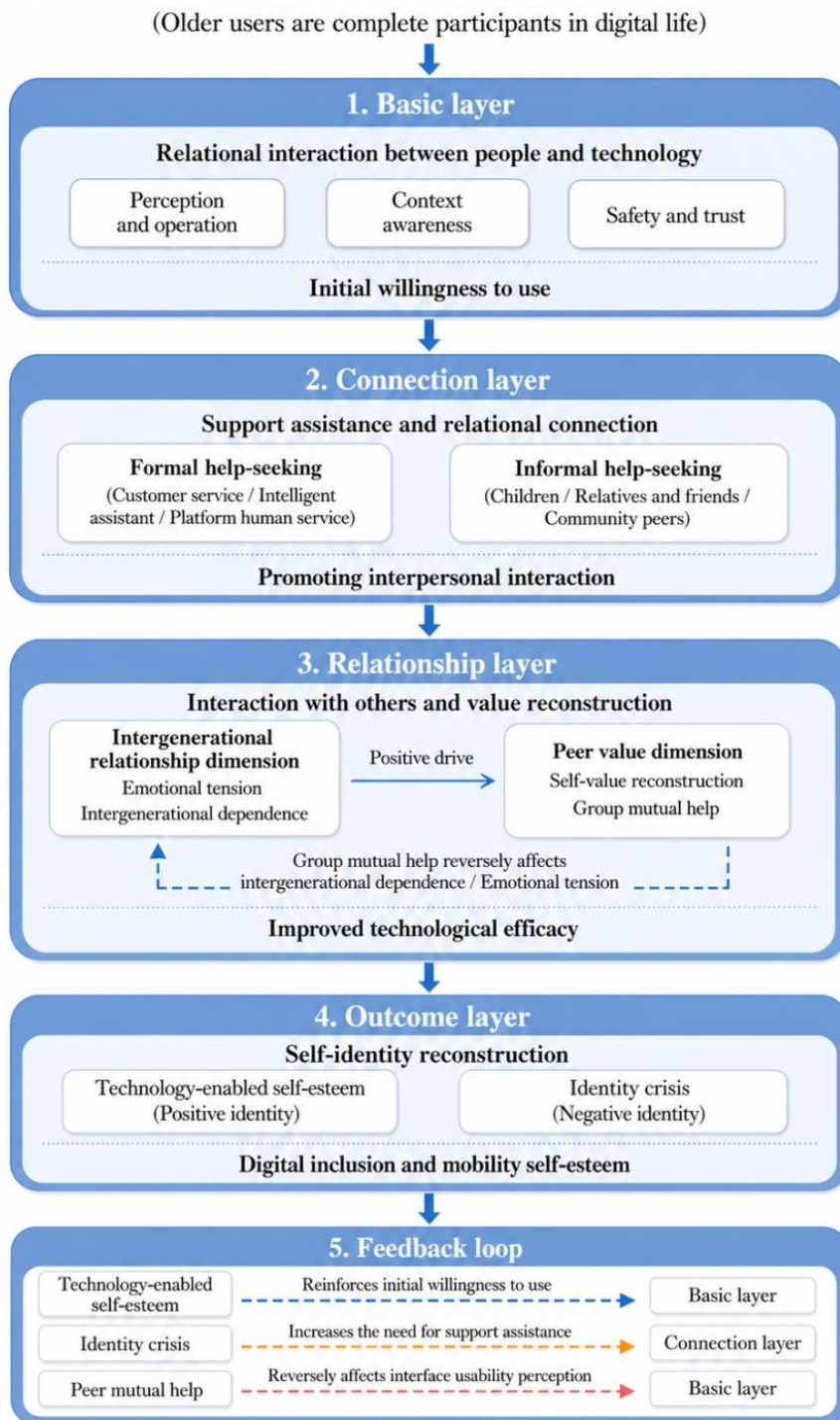


Figure 6: Interactive Model of Aging Adaptability for Smart Travel APP

3.6 Theoretical saturation test

As theoretical saturation is the most clear and reliable standard for determining when data collection should be stopped, this paper used the principle of theoretical saturation in the research process [16, 17]. After encoding, comparing, categorising and repeatedly verifying the interview data of the first 16 interviewees, the data obtained from the next 3 interviewees were selected as test samples for comparative analysis. The results show that no new concepts,

scopes or relationship structures appeared at this time. Based on the above, it can be concluded that the theory has reached a certain limit.

4 Design strategies for aging friendly interfaces from the perspective of digital care

The Digital Care Theory is used as the foundation for this paper to extend the traditional usability paradigm and build a relational paradigm; therefore, the behaviour and relationship needs of elderly users in smart travel can be fully explored here. Based on the relational interaction model constructed in previous studies, corresponding strategies are proposed at multiple levels: the basic layer, the connection layer, the relationship layer, the result layer, and the feedback loop; these aim to help older people break away from passive use of technology, actively and freely participate in digital life, and ultimately attain free travel.

4.1 Interface usability design strategy for relational adaptation

Given that the foundation layer is the starting point for older adults in their use of the app, the first experience they have using this layer directly affects whether they will continue to use it; thus, according to the theory of digital care, we need to respect the physiological characteristics of older adults, meet their diverse needs as different groups, and build an emotional connection between people and technology.

The foundation for usability and trust assurance mainly comes from the usability of the interface design. First, a visual design with large fonts, high contrast and simplified operating paths is used; core travel functions such as one-click car hailing and real-time location tracking are kept, and unnecessarily complex options are hidden to reduce the cognitive load on older users caused by information overload. Second, the design features a graded font size adjustment function to allow users to flexibly change the size of the text, and bold font shapes are employed to enhance the readability of the text [18]. Third, elements such as secondary confirmation pop-ups, payment security instructions, risk warning prompts, etc., are integrated into the interface. The system and the transparent security trust mechanism have successfully reduced the doubts and distrust that older people have in digital technology. Finally, the service model has moved from passively responding to the needs of older people to an active form of care, and the idea of relationship adaptation has been fully incorporated into the design of the interface. For example, setting up operation prompts and voice guidance functions to provide clear instructions for older people, creating an entrance for one-click switching to "elder mode", simplifying interface operations, and pre-setting commonly used addresses for quick selection of travel destinations. Therefore, technology is no longer a cold instrument; instead, it can actively recognize the needs of older people, proactively adapt to their travel habits, and respond to their emotional appeals with care.

Lowering the initial threshold for older people to use smart travel apps at the basic level can help them get used to using the app smoothly, reduce identity crises caused by operational frustration, and thus provide a good foundation for older people to fully and freely participate in digital life and obtain relational needs in the digital environment in the future.

4.2 Relationship Connection Design Strategy for Multi dimensional Auxiliary Support

In terms of design, when older adults have problems with the operation of travel apps, multiple avenues for obtaining help with low psychological pressure should be provided. Assistive

support should not be used as a last resort by older adults; instead, it should be integrated into the normal course of using the app, and the strategy of multi-dimensional auxiliary support, as shown in the connection layer of the model, should aim to connect formal and informal help-seeking paths, motivate interpersonal interaction among older adults and others, and build warm and stable social relationships [19, 20].

Given the different physiological characteristics and working patterns of older adults in formal help-seeking situations, the design of the interface should be more intuitive and explicit. Set up a clearly indicated help entry point in a prominent position on the interface, and place large-sized operation buttons in an easily visible and user-friendly area so that older adults can access the service more conveniently. Establish a one-click direct connection to the human customer service function to reduce the complexity of voice navigation significantly; thus, the waiting and operation time for older users will be shortened, and the efficiency of service response will be enhanced. The optimized voice assistant function should fully address the various practical requirements of older adults, consider their different listening and comprehension abilities, and add a built-in speed-adjustment function to enable older adults to adjust the speed of voice broadcasting according to their own needs; provide dialect recognition based on the language habits of older adults in different areas. At the same time, in order to prevent older users from being unaware of this essential information due to unclear or misunderstood content, a new instruction replay function has also been added to provide this information in full and correct.

Due to the anxiety that older adults may feel when operating in informal help-seeking situations and the anxiety they are likely to experience travelling alone, a friend and family assistance module has been added to allow older adults to initiate real-time voice calls and share their travel locations directly via social platforms such as WeChat. This way, they can promptly obtain help from family and friends and meet their urgent emotional needs for companionship. Based on this, we will build and expand the community peer assistance function, use technology to help older adults in the same community travel together and share good routes, promote mutual connection and dependence among older adults in the community, and truly form a community atmosphere of mutual help, warmth and love.

At the level of connectivity, older people are no longer just looking for help from others to solve problems or meet their various needs during travel; they are also interacting and communicating with people and making friends. In doing so, they feel accepted and belong, and intergenerational relationships are breaking away from the constraints of traditional passive help-seeking to form a new model of active collaboration and mutual cooperation among older adults, young people, and peers, thus building a bridge for subsequent interpersonal interaction and value reconstruction.

4.3 Value Reconstruction Design Strategies for Intergenerational and Peer Interaction

Older people are not necessarily isolated digital users. They are deeply involved in the dual-relationship network of intergenerational and peer interaction in their families. By fully utilising the bond between the two, technology learning can be integrated naturally and reasonably into existing interpersonal interaction scenarios, and the role of the relationship network can be fully realised. The core of the relationship layer in the corresponding model of intergenerational and peer interaction strategies is to enhance the effectiveness of technology in practice and reconstruct the self-worth identity of older adults through two-way interactions between generations and peers.

Design a caring model teaching guide for elderly people to learn anytime through the lens of reconstructing intergenerational relationships. Firstly, the application can support the recording

and storage of personalized teaching videos on the children's side to address various problems that elderly people face in learning, such as "not being able to teach" and "not being able to learn". Secondly, the application should have a learning progress recording function so that children can check the specific situation of their parents' mastery of the function and completion of operations at any time. In order to make the elderly's desire to ask for help more natural and alleviate intergenerational emotional tension, the application provides warm and appropriate prompts when the elderly's operation fails, such as: "You can ask your children about this problem; they may have encountered it before, don't worry." After the children assist the elderly in completing the operation, the application will automatically and timely send a thank-you reminder. This design can allow children to genuinely feel recognized for their own contributions and subtly reduce intergenerational dependence; it can genuinely alleviate intergenerational emotional tension, prevent the problem of a lack of autonomy for older adults due to excessive intervention from younger generations, and strengthen positive and healthy emotional connections between the two generations.

From the perspective of peer value reconstruction, systematically and hierarchically build bridges that activate peer experience sharing and skill transfer. Design a peer experience section and use intuitive forms, such as voice and short videos, to encourage older adults to share their real experiences and tips for using the product in an easy-to-understand manner for older users. Promote various interest communities, such as fishing, square dancing, photography, etc., to create shared travel routes, location collections and other functions, and integrate the use of technology into these interest activities. In order to enable older adults to truly become digital mentors, a "I'll Teach You" function has been specially developed to provide a platform for older adults who are proficient in application programs to showcase and impart knowledge. Older adults can record teaching videos, which will be reviewed by the platform and published on the platform with peer recommendation labels. At the same time, a "silver-haired expert" certification logo has been established to offer clear and positive honor incentives for older users who actively share and are willing to help, stimulating their enthusiasm and initiative, creating a good atmosphere of mutual assistance. In collaboration with communities and senior universities, an aging-friendly travel workshop has been launched, and activity registration entrances and offline communication spaces have been embedded directly into the application; a clever two-person learning mode has also been designed to allow two older users to pair up for learning and check each other's learning progress, mutually view collection routes, share more travel options and practical information, and further promote communication and cooperation among peers to jointly enhance their ability to use digital technology.

By operating the dual networks of intergenerational and peer relations, older adults have transitioned from being passive learners in technology to active members and contributors in these networks, thus receiving value recognition through peer assistance and maintaining self-worth during intergenerational collaboration.

4.4 Identity design strategies that empower self-esteem and digital integration

From the perspective of digital care, the aim of the design is not to help older adults learn to operate travel applications; rather, it should provide them with a positive subjective experience of "I can do it, I am useful, and I can keep up with the times" when using these applications. Therefore, the design strategy to empower self-esteem and identity is to use experiential design methods to ensure that technology can genuinely offer positive empowerment for the self-esteem of older adults. By incorporating several experiential elements, elderly users can reduce the sense of identity crisis caused by being out of touch with society and no longer needed, fully feel that their abilities are being recognized and

valued, thereby strengthening their sense of identification with a positive identity and forming a complete and benign digital care loop.

In the process of actively identifying with the construction, interface design should highlight the positive feedback brought by "independently completing travel". For example, every time an elderly user successfully completes a ride-hailing operation, the system promptly and clearly gives "Congratulations on completing your Nth trip on your own, your performance is excellent!" Positive prompts enable elderly users to directly perceive the positive results of their behavior. In addition, a travel achievement wall section is set up in the interface to display in detail various data of elderly users using this application for independent travel, such as the total number of trips, specific locations and travel times of each trip, etc. When elderly users view their data records, they can easily see the specific achievements and progress in their travel, thus creating a sense of accomplishment. To further expand the channels for elderly users to receive social recognition, support the sharing of travel information by elderly users in family or friend groups in the design. After elderly users share their travel information, if they can receive positive feedback from family and friends, such as likes and recognition, they will truly appreciate the value of autonomous travel, and their sense of autonomy and value will be strongly enhanced.

Given that older adults are likely to feel helpless due to operation difficulties caused by digital devices in negative identity intervention, a plan to gradually guide and provide tailored support will be introduced. Fully consider the personal characteristics of older people in terms of learning ability, memory, usage habits, etc., and design assistance plans that meet their actual needs. In addition, a linkage auxiliary support module has been set up to provide timely help for older people who need assistance because of an identity crisis, offering them a warm and caring experience of digital technology.

Based on the user experience of older adults, one should analyze the positive experiences to optimize the interface, address the deficiencies in negative experiences by adding auxiliary support, create a virtuous circle of "user experience feedback optimisation reuse", thereby encouraging older adults to participate more actively in the digital era and forming an ideal cycle of digital technology caring for older adults.

5 Conclusion

This paper introduces the theory of digital care to the area of aging-friendly design for smart travel apps and demonstrates the transition from the usability paradigm to the relational paradigm. The traditional usability paradigm focuses more on whether the interface is user-friendly and the operation is efficient, treating older adults as objects that need to be adapted. In contrast, the relational paradigm, from the perspective of digital care, regards older adults as complete subjects with dignity, emotions and social relationships. When smart travel apps truly achieve the paradigm shift from usability to relatedness, they will no longer be simple tools but will truly become bridges connecting older adults with digital society, and naturally serve as practical support for older adults to participate in society, live independently and enjoy life with dignity in their later years. This is the most direct, beautiful, and warm ultimate goal of the theory of digital care, and it should also be the fundamental value of aging-friendly interface design.

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