



How to make AI a true gateway to digital life for the elderly? – Key factors and empowering pathways for the continuous use of conversational AI among older adults

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Abstract

Introduction. Against the backdrop of digital transformation and population aging, the development of conversational AI, by lowering the barrier to use through natural language interaction, offers new opportunities to enhance the digital participation of older adults. This study focuses on the context of older adults using conversational AI and aims to explore, from the perspective of social cognitive theory, the key factors and empowering pathways that promote the sustained technology adoption among the elderly.

Method. We conducted a questionnaire survey on 306 older adults with experience using conversational AI.

Analysis. We conducted quantitative analysis on the questionnaire data using SmartPls3 software and structural equation modelling measurement methods.

Results. This study found that self-efficacy and outcome expectations are core antecedent variables predicting older adults' intention to continue using conversational AI. Outcome expectations fully mediate the relationship between self-efficacy and continuance intention. Mastery experience and affective arousal are the primary sources of self-efficacy. Mastery experience, vicarious experience, verbal persuasion, and affective arousal all have significant effects on outcome expectations.

Conclusion. At the theoretical level, this study extends social cognitive theory to the emerging context of conversational AI use among Chinese older adults, empirically testing its core mechanisms and thereby achieving a contextualised application of the theory. At the practical level, the study proposes a four-dimensional support strategy, offering actionable intervention pathways for building an age-friendly digital ecosystem.

Introduction

Against the backdrop of accelerated digital transformation, the challenges faced by the elderly population in terms of digital inclusion are becoming increasingly prominent. As an information-vulnerable group, older adults often find themselves trapped in information poverty and developmental constraints due to insufficient digital literacy and usage skills and are marginalised as 'digital refugees' (Shen & Hu, 2024). Although China has introduced policies such as the *Action Plan for Enhancing Digital Literacy and Skills Across the Population* (Cyberspace Administration of China, 2021) and the *Implementation Plan on Effectively Addressing the Difficulties of Older Persons in Using Intelligent Technologies* (General Office of the State Council, 2020) to promote digital inclusion for the elderly, recent assessments indicate that only 58.5% of older adults possess basic digital skills (Cyberspace Administration of China, 2024), revealing a significant gap between this reality and policy objectives. More alarmingly, the negative impacts of digital exclusion extend beyond information access, with research confirming its significant association with cognitive decline, increased social isolation, and higher risks of depression among older adults (Alcaraz et al., 2019; Murayama et al., 2011; Spence et al., 2020). Therefore, promoting the integration of the elderly into the digital society is not only a matter of technology diffusion but also an urgent issue concerning public health and social equity. The rapid development and inherent characteristics of conversational artificial intelligence (AI) offer a promising approach to reducing digital barriers for the elderly.

Traditional digital technologies (such as mobile applications and web services) typically rely on graphical interfaces, multi-layer menus, and complex operations, requiring users to possess a certain level of technical literacy, visual recognition, and navigation skills. This poses substantial usage barriers for the elderly, whose cognitive and physiological functions are gradually declining (Czaja & Ceruso, 2022). In contrast, conversational AI offers a promising technological pathway to overcome the limitations of existing digital technologies. By enabling natural language interaction such as voice assistants (such as Siri, Xiao Ai) or text-based chat applications (such as ChatGPT, DeepSeek), it transforms human-computer interaction into an intuitive mode resembling interpersonal dialogue (Sun et al., 2024). Users do not need to learn complex interface logic; they can perform operations using everyday language. It supports multiple input methods, including voice and text, reducing reliance on eyesight and manual dexterity. Furthermore, it can capture ambiguous expressions, remember conversation history, and provide continuously personalised responses. These characteristics suggest that conversational AI is not only expected to compensate for the shortcomings of traditional technology in age-friendly design but may also reconstruct older users' perceptions of ease of use and usefulness by reducing cognitive load.

Social cognitive theory, with its triadic reciprocal determinism framework of *person-behaviour-environment*, provides a powerful perspective for understanding the process by which older adults accept and continue to use conversational AI (Bandura, 1977). Social cognitive theory emphasises the crucial roles of self-efficacy and outcome expectations in shaping behavioural intentions, which are cultivated through four experiential sources: mastery experience, vicarious experience, verbal persuasion, and affective arousal. Although existing research has identified self-efficacy and outcome expectations as core predictors of user technology adoption (Ma et al., 2023), the formation pathways and mechanisms of these cognitive factors remain underexplored within the emerging interaction context of conversational AI, particularly when focussing on the elderly user group in China.

Therefore, this study aims to investigate the influencing mechanisms of Chinese older adults' continued use of conversational AI based on social cognitive theory. It specifically focuses on: (1) How do the four sources of experience in social cognitive theory influence older adults' self-efficacy and outcome expectations regarding the continued use of conversational AI? (2) How do these cognitive factors further affect their intention to continue using it? By addressing these

questions, this study hopes to provide references for promoting digital inclusion practises for the elderly and enhancing their digital participation in an intelligent society.

Theoretical basis and literature review

Research on factors influencing older adults' use of conversational AI

Existing research indicates that older adults' use of conversational AI is primarily concentrated in dimensions such as daily living assistance, health information queries, and social companionship (Huang et al., 2025; Jin et al., 2024). However, this process remains constrained by multiple factors (Huang et al., 2025).

Although conversational AI is generally regarded as a low-barrier technology, from the perspective of older adults, interaction obstacles remain the primary and most immediate issue in their initial contact with and continued use of AI (Huang et al., 2025). Older adults often encounter difficulties remembering wake words or needing to repeatedly rephrase commands to fit the system's normative expressions (Kim, 2021; Pradhan et al., 2020). Ethnic minority elderly individuals may even have to deliberately switch from their daily language style to ensure their speech is accurately recognised (Brewer et al., 2023; Harrington et al., 2022). Furthermore, the response quality of conversational AI directly determines the user experience (Sou et al., 2025). For instance, low-quality or inaccurate outputs can easily trigger frustration among older adults (Brewer et al., 2023). Even advanced generative AI systems like GPT-4 can sometimes produce responses that deviate from the true intentions of elderly users (Xyengkou et al., 2024).

Notably, the cognitive evaluations and emotional experiences of older adults towards conversational AI constitute the core internal factors influencing their usage intention and continued behaviour. The perceived empathic ability demonstrated by AI is a significant positive factor promoting continued use among the elderly (Desai et al., 2023; Sou et al., 2025). Conversely, anxiety about AI technological iteration (Shandilya et al., 2022), concerns over privacy and security, doubts about their own operational capabilities (Cuadra et al., 2023), and worries about losing independence due to over-reliance on technology (Harrington et al., 2023; Kim, 2021) can easily foster negative perceptions, thereby weakening their intention to use. Research indicates that older adults often view conversational AI as a low-pressure, non-judgemental social supplement for daily companionship or entertainment, while simultaneously emphasising that it cannot replace genuine human relationships (Trajkova et al., 2020; Xyengkou et al., 2024). In information-seeking scenarios, the credibility of the information provided by AI, especially the authority of health-related information, becomes a critical factor influencing usage among the elderly (Desai et al., 2023; Harrington et al., 2022). Furthermore, older adults' lack of a clear understanding of how conversational AI works and its data processing procedures further exacerbates their privacy and security concerns and distrust, ultimately having a negative impact on their intention to use (Huang et al., 2025).

Existing studies have provided diverse perspectives for understanding the factors influencing older adults' use of conversational AI. However, overall, several theoretical and methodological limitations persist in this field. First, there is a lack of theoretical integration. Current research often focuses on isolated influencing factors, lacking a holistic theoretical framework that can integrate cognitive, affective, and social interaction mechanisms. Second, there is insufficient consideration of cultural context and group heterogeneity. Existing findings are largely based on Western socio-cultural backgrounds, with relatively little attention paid to the elderly population in China, thus limiting the applicability and generalisability of these conclusions to the Chinese context.

Social cognitive theory

Social cognitive theory, as an integrative theoretical framework widely applied in human behaviour research, has extended its application to numerous fields such as information-seeking behaviour (Ross et al., 2016), knowledge sharing (Olatokun & Nwafor, 2012), and learning motivation research (Middleton et al., 2019). Within this framework, self-efficacy and outcome expectations have been identified as core factors driving individual action (Bandura, 1977).

Within the theoretical framework of social cognitive theory, self-efficacy is regarded as a core cognitive variable driving individual action. It reflects an individual's belief in their capability to successfully perform tasks in specific situations (Bandura, 1977), particularly in the domains of ability acquisition and skill development (Bandura, 1988). The formation of an individual's self-efficacy primarily stems from four types of life experiences: mastery experiences, vicarious experiences, verbal persuasion, and affective arousal (Bandura, 1977). Among these, mastery experiences—the attainment of successful experiences—have the most significant effect on shaping self-efficacy. Successfully accomplishing tasks can consolidate confidence, while failure can easily lead to self-doubt and hinder sustained effort. Vicarious experiences (i.e., observing the behaviours and outcomes of others) can also effectively enhance efficacy beliefs. Witnessing similar individuals successfully achieve goals without negative consequences can often strengthen an individual's confidence in their own abilities (Wise & Trunnell, 2001). Verbal persuasion refers to enhancing an individual's efficacy beliefs through the guidance, encouragement, and feedback of others (Bandura, 1977). Finally, an individual's affective state also constitutes a source of information for self-efficacy; positive affective arousal helps enhance confidence and self-efficacy (Lent et al., 2017).

Another key variable in social cognitive theory is outcome expectations, which refer to an individual's judgement or anticipation of the probable results that a specific action will produce (Bandura, 1977). When an individual expects that an action will yield valuable outcomes, their tendency to undertake that action is significantly enhanced. Previous research has shown that the four types of experiential sources shaping self-efficacy (mastery experiences, vicarious experiences, verbal persuasion, and affective arousal) also constitute important antecedents of outcome expectations (Bandura, 1977; Chen et al., 2022). Specifically, the acquisition of successful mastery experiences can significantly strengthen an individual's outcome expectations for future actions. Vicarious experiences enhance outcome expectations through observing the positive results of others' actions. Verbal persuasion influences an individual's judgement of outcomes by providing valuable information. Finally, an individual's affective state also significantly influences outcome expectations, negative affective arousal tends to weaken expectations of positive outcomes, while positive affective arousal serves to promote them (Lent et al., 2017).

Social cognitive theory has established a relatively solid explanatory foundation in the field of technology adoption and continuance research (Chan et al., 2023; Fang et al., 2024; Warner et al., 2011). However, when directly applying it to the emerging human-computer interaction context of conversational AI, its explanatory boundaries and applicability still face several challenges worthy of in-depth exploration. First, existing research from the social cognitive theory perspective has mostly focussed on traditional graphical user interface technologies (Boateng et al., 2016; Zhou et al., 2020), whose interaction models differ fundamentally from AI systems based on natural language for multi-turn, context-aware conversations. The parasocial nature of the latter may influence the formation mechanisms of self-efficacy and outcome expectations. Second, at the level of theoretical application, some studies tend to examine the single construct of self-efficacy in isolation (Kim, 2010), or use social cognitive theory as a supplementary perspective rather than a core framework (Hanham et al., 2021; Vaziri et al., 2020), failing to systematically integrate the two core factors of self-efficacy and outcome expectations. This leads to a fragmented understanding of the driving mechanisms behind user behaviour. Finally,

current research on older adults' use of conversational AI is primarily based on Western cultural backgrounds (Huang et al., 2025). However, within the Chinese socialist cultural context, the cognition, learning, and use of technology by the elderly are deeply embedded in China's cultural and social relational structures. This may reshape the connotations and operational pathways of core social cognitive theory constructs such as self-efficacy and outcome expectations for older adults. Therefore, based on the above analysis, this study intends to systematically apply social cognitive theory to the context of Chinese older adults' continued use of conversational AI, thereby addressing the shortcomings of existing research in terms of theoretical integration, depth of mechanisms, and cultural adaptability.

Research hypotheses

Based on social cognitive theory and related literature, this study proposes hypotheses and constructs a conceptual model, as illustrated in Figure 1.

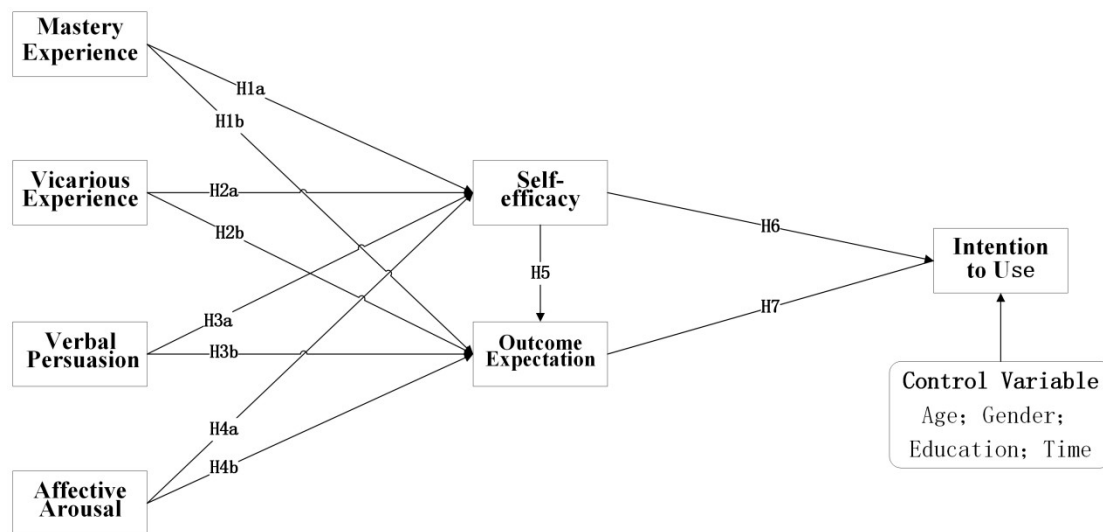


Figure 1. Conceptual model.

Antecedents of self-efficacy and outcome expectations

Based on the fundamental propositions of social cognitive theory (Bandura, 1977), mastery experiences, due to their involvement in the specific execution and repeated practise of tasks, are regarded as the foundational source shaping self-efficacy and outcome expectations (Chen et al., 2022). In the context of conversational AI use, mastery experiences encompass not only technical operation but also communication skills, including successfully posing questions, understanding responses, and managing multi-turn dialogues. This differs from mastery experiences in traditional technologies, which typically refer to interface navigation. The experience of older adults successfully engaging in natural language communication may cultivate a unique conversational self-efficacy, thereby enhancing their confidence in continuing to use conversational AI and their expectations of its benefits. Existing research provides strong support for the positive impact of mastery experiences on self-efficacy and outcome expectations (Bleicher & Lindgren, 2005). Therefore, the following hypotheses are proposed:

H1a: Mastery experiences positively influence older adults' self-efficacy in the continuous use of conversational AI;

H1b: Mastery experiences positively influence older adults' outcome expectations regarding the continuous use of conversational AI.

Vicarious experiences derive from an individual's observation of others' behaviours and their outcomes. Their effectiveness lies in providing observers with referable behavioural strategies

and techniques, and confirming the attainability of potential benefits (Ashford et al., 2010; Bandura, 1977). Research indicates that when older adults observe peers or individuals with similar identities achieving positive outcomes in technology use, their self-efficacy in accomplishing similar tasks is significantly enhanced, while their outcome expectations of also being able to obtain corresponding positive results are elevated (Kariuki et al., 2021; Okpara et al., 2022). In the context of conversational AI use, vicarious learning involves not only observing whether others use the technology but also how they use it, such as their ways of expression, tone, and conversational strategies. Unlike observing others using devices like computers or mobile phones, observing natural language interaction offers more transferable behavioural patterns. Multiple studies demonstrate that vicarious experiences have a significant impact on users' self-efficacy and outcome expectations (Chen et al., 2022; Fang et al., 2024; Warner et al., 2011). Therefore, the following hypotheses are proposed:

H2a: Vicarious experiences positively influence older adults' self-efficacy in the continuous use of conversational AI;

H2b: Vicarious experiences positively influence older adults' outcome expectations regarding the continuous use of conversational AI.

Verbal persuasion refers to the process where others convey information about the efficacy of technology use and expected benefits through verbal communication, thereby influencing users' assessments of their own capabilities and their judgement of the technology's value (Yang et al., 2024). The influence of verbal persuasion is particularly significant when individuals are uncertain about their own abilities (Ashford et al., 2010). It is noteworthy that in the context of conversational AI use, verbal persuasion may have a different mechanism of action compared to traditional technologies. Because this type of technology possesses parasocial interaction characteristics, its conversational nature makes information about the technology's usefulness potentially more relatable to individual experience, more targeted, and more perceptible. This can thereby enhance older adults' confidence in using the technology and their expectations of its benefits. Existing research has confirmed that persuasion from credible sources such as doctors, family members, or friends positively influences users' self-efficacy and outcome expectations (Clark & Nothwehr, 1999; Hollis-Sawyer & Sterns, 1999). Accordingly, the following hypotheses are proposed:

H3a: Verbal persuasion positively influences older adults' self-efficacy in the continuous use of conversational AI;

H3b: Verbal persuasion positively influences older adults' outcome expectations regarding the continuous use of conversational AI.

Affective arousal refers to users' immediate emotional responses, including positive emotions (such as excitement, pleasure) and negative emotions (such as anxiety, tension). These emotional responses influence users' judgements of their own capabilities and their assessment of the technology's value (Bandura, 1977). In the context of conversational AI use, the positive affective arousal of older adults may have multiple sources. It arises not only from the successful completion of tasks but also from the perception of anthropomorphic qualities embedded in the AI's responses (such as expressions of empathy, humorous replies, or a sense of companionship). Conversely, negative emotions may stem from the *uncanny valley* effect or frustration caused by conversation interruptions, which differs from the frustration induced by difficulties in operating traditional interfaces. Existing research has shown that negative emotions like technophobia can weaken users' self-efficacy and outcome expectations regarding technology use (Jeng et al., 2022; Yoon & Joo, 2021). Conversely, positive emotions have been proven to effectively enhance self-efficacy and outcome expectations (Chen et al., 2022; Fang et al., 2024; Lent et al., 2017). Therefore, this study proposes the following hypotheses:

H4a: Affective arousal positively influences older adults' self-efficacy in the continuous use of conversational AI;

H4b: Affective arousal positively influences older adults' outcome expectations regarding the continuous use of conversational AI.

The influence of self-efficacy and outcome expectations on usage intention

According to social cognitive theory and related research, an individual's behavioural intention to perform a specific action depends on their belief in their capability to complete the task and their expectations of the benefits that the action will bring (Bandura, 1977; Chiu et al., 2006; Cho et al., 2010; Liu, 2025). Notably, research in the context of digital technology indicates that older adults' outcome expectations regarding technology use are significantly influenced by self-efficacy (Lam & Lee, 2006). In the context of conversational AI use, self-efficacy may be more closely associated with communication confidence than with technical proficiency. Older adults who believe they can hold a conversation with AI are likely to form stronger outcome expectations regarding its informational benefits. It follows that when older adults simultaneously possess the confidence to independently operate conversational AI and hold positive expectations about its value, their intention to use conversational AI will be significantly enhanced. Therefore, the following hypotheses are proposed:

H5: Self-efficacy positively influences older adults' outcome expectations regarding the continuous use of conversational AI;

H6: Self-efficacy positively influences older adults' intention to continue using conversational AI;

H7: Outcome expectations positively influence older adults' intention to continue using conversational AI.

Research methods

Research instruments

This study draws on established scales and contextually adapts the original items to align with the research setting. All items were measured using five-point Likert scales. Details are provided in Table 1.

Construct	Item		Reference s
Mastery Experience	ME1	I have been able to successfully use conversational AI to find practical information I need	(Bronstein & Tzivian, 2013)
	ME2	When I encountered operational difficulties using conversational AI, I was able to solve them myself and ultimately achieve my goal	
	ME3	Through successful use of conversational AI, I have gained more confidence in my operational abilities	
Vicarious Experience	VE1	My peers or family members use conversational AI	(Bronstein & Tzivian, 2013)
	VE2	My peers or family members have mentioned that conversational AI has been very helpful to them	
	VE3	People around me have talked about their positive experiences using conversational AI	
Verbal Persuasion	VP1	Someone suggested that I use conversational AI to search for information	(Bronstein & Tzivian, 2013)
	VP2	Someone encouraged me to use conversational AI to meet information needs	
Affective Arousal	AA1	I feel pleasant and relaxed when using conversational AI	(Bronstein & Tzivian, 2013)
	AA2	Communicating with conversational AI doesn't make me feel anxious or nervous	
Self-efficacy	SE1	I believe I can use conversational AI	(Fang et al., 2024)
	SE2	Conversational AI is relatively simple and easy to use	
	SE3	I don't need others to help me use conversational AI	
Outcome Expectation	OE1	I believe conversational AI can help me obtain needed information more effectively	(Chen et al., 2022)
	OE2	Using conversational AI may make me feel better connected with the outside world	
	OE3	I expect conversational AI to help me better manage daily life	
	OE4	Using conversational AI might help me solve problems more smoothly	
Intention to Use	IU1	I plan to continue using conversational AI in the future	(Sun & Li, 2023)
	IU2	I expect to use conversational AI frequently in the future	
	IU3	I am willing to use conversational AI as my daily assistive tool	
	IU4	When encountering related problems or needs, I will prioritize using conversational AI	

Table 1. Variable measurement items.

Data collection

According to the Chinese age standard, this study targeted elderly users aged 60 and above who have actual experience using conversational AI. Considering that online surveys often struggle to reach older adults with lower technological proficiency, this study employed an offline fixed-point recruitment method, distributing paper questionnaires in locations where older adults tend to congregate, such as community activity centres and senior universities.

Based on the participants' needs and preferences, the questionnaire was administered in two ways. 1) Self-administered. Completed independently by participants who were literate and comfortable doing so, with research assistants present throughout to answer clarifying questions without influencing responses. 2) Assisted administration. For participants with visual impairments, reading or writing difficulties, or those who preferred verbal communication, research assistants read each question aloud from the questionnaire, used standardised neutral language to explain when necessary, and recorded the answers on their behalf.

To ensure the inclusivity and validity of the survey, we implemented various support measures during the administration process. For visual support, large-print versions of the questionnaire (18-point font) were provided for participants who needed them. For cognitive support, research

assistants received specialised training on how to explain questions using simple, concrete language, allow participants ample time to think, repeat questions when necessary, and avoid any leading or suggestive expressions.

Prior to the survey, all participants received a standardised explanation and examples of *conversational AI*, which included: 1) providing an operational definition, describing conversational AI as 'an application or smart device that supports user interaction through voice or text, and responds to user inquiries or assists in completing tasks in a conversational manner'. 2) listing representative application examples familiar to Chinese older adults, including built-in voice assistants in smartphones (such as Siri and Xiao Ai), smart speakers (such as Tmall Genie and Xiaomi Smart Speaker), and mainstream conversational AI applications (such as DeepSeek and Doubao). 3) finally, based on participants' needs, conducting on-site functional demonstrations of typical interaction scenarios, such as weather inquiries, reminder settings, or storytelling. Through this standardised explanation process, we ensured that all participants had a basic understanding of conversational AI, thereby guaranteeing the validity of subsequent measurements.

To ensure questionnaire quality, attention-check items were embedded to identify invalid responses. The survey was conducted from January to July 2025. Initially, 378 questionnaires were collected. After excluding 37 questionnaires from respondents without conversational AI experience and 19 questionnaires from respondents aged <60 years (including 5 that also failed to meet the usage experience criterion), and an additional 21 questionnaires that failed the attention-check items, the final valid sample size was 306. According to the sample size principle for structural equation modelling proposed by Westland (2012), the number of valid questionnaires in this study meets the requirements. Details are provided in Table 2.

Variable	Item	Frequency	Percentage
Gender	Male	161	52.6%
	Female	145	47.4%
Education	Primary school and below	25	8.2%
	Junior high school	46	15.0%
	High school	99	32.4%
	Associate degree	42	13.7%
	Undergraduate	83	27.1%
	Master's degree or above	11	3.6%
Duration of using conversational AI	≤ 3 months	23	7.5%
	>3 months and <1 year	107	35.0%
	≥ 1 year	176	57.5%

Table 2. Demographic information of respondents (N=306).

Research findings

Measurement model

This study employed partial least squares structural equation modelling for hypothesis testing, based primarily on three methodological considerations. 1. Data distribution characteristics. The sample data exhibited non-normal distribution characteristics upon skewness and kurtosis testing, and PLS-SEM does not rely on strict normality assumptions (Dash & Paul, 2021). 2. Model complexity and predictive orientation. The research framework includes multi-level moderating paths, with the primary goal being suitability for predictive application scenarios. PLS-SEM is more appropriate for exploratory causal-predictive analysis (Hair et al., 2020). 3. Sample size limitations. Although the effective sample size (N=306) met the minimum requirements for statistical power, it was lower than the typical sample standard for covariance-based structural equation modelling (Hair et al., 2020).

This study used SmartPls3 software to validate the measurement model (see Table 3). Following the recommendations of Bagozzi and Yi (1988), the Cronbach's alpha coefficients and composite reliability values for all constructs exceeded the threshold of 0.7, indicating good scale reliability. Convergent validity was assessed through factor loadings and average variance extracted, where factor loadings should be greater than 0.7 and average variance extracted should exceed 0.5 (Hair et al., 2020). As shown in Table 3, the standardised Cronbach's alpha, composite reliability, average variance extracted, and factor loading values all fell within acceptable ranges, demonstrating sufficient convergent validity for the construct measurements.

In terms of discriminant validity, according to the recommendations of Fornell and Larcker (1981), the model in this study meets the criterion that the square root of the average variance extracted for each construct (diagonal values) should be higher than its correlations with other constructs, indicating that the model possesses good discriminant validity (see Table 4). Using the heterotrait-monotrait ratio criterion (see Table 5), we also found no issues with discriminant validity in this study (all heterotrait-monotrait ratios were below the threshold of 0.85) (Henseler et al., 2015).

Construct		Factor loading	Cronbach's alpha	Composite reliability	Average variance extracted
Mastery Experience	ME1	0.835	0.823	0.894	0.737
	ME2	0.881			
	ME3	0.859			
Vicarious Experience	VE1	0.831	0.789	0.877	0.703
	VE2	0.837			
	VE3	0.847			
Verbal Persuasion	VP1	0.903	0.820	0.917	0.846
	VP2	0.937			
Affective Arousal	AA1	0.917	0.767	0.895	0.810
	AA2	0.883			
Self-efficacy	SE1	0.793	0.830	0.896	0.743
	SE2	0.899			
	SE3	0.890			
Outcome Expectation	OE1	0.880	0.897	0.928	0.764
	OE2	0.888			
	OE3	0.868			
	OE4	0.861			
Intention to Use	IU1	0.875	0.862	0.906	0.707
	IU2	0.842			
	IU3	0.827			
	IU4	0.817			

Table 3. Results of convergent validity.

Additionally, the variance inflation factor for all constructs ranged between 1.038 and 2.173, well below the critical value of 3.3 (Latan & Noonan, 2017, pp. 253-254), suggesting that common method bias did not significantly affect the results.

	AA	IU	OE	ME	SE	VE	VP
Affective Arousal (AA)	0.900						
Intention to Use (IU)	0.707	0.841					
Outcome Expectation (OE)	0.618	0.662	0.874				
Mastery Experience (ME)	0.344	0.448	0.458	0.859			
Self-efficacy (SE)	0.294	0.340	0.512	0.374	0.862		
Vicarious experience (VE)	0.590	0.655	0.553	0.436	0.231	0.839	
Verbal Persuasion (VP)	0.525	0.531	0.505	0.394	0.146	0.662	0.920

Table 4. Results of discriminant validity.

	AA	IU	OE	ME	SE	VE	VP
Affective Arousal (AA)							
Intention to Use (IU)	0.841						
Outcome Expectation (OE)	0.742	0.750					
Mastery Experience (ME)	0.423	0.519	0.526				
Self-efficacy (SE)	0.351	0.392	0.566	0.444			
Vicarious Experience (VE)	0.754	0.792	0.657	0.538	0.268		
Verbal Persuasion (VP)	0.653	0.625	0.584	0.475	0.157	0.812	

Table 5. Heterotrait-monotrait ratio.

Structural model

The study examined the path coefficients and significance levels for each hypothesis. The model fit and explanatory power are as follows: the explained variance (R^2) for the key dependent variable, *intention to use conversational AI*, reached 44.3%, indicating good predictive power for the model (see Figure 2). The standardised root mean square residual (SRMR = 0.055) was significantly below the threshold of 0.08, demonstrating an acceptable fit between the model and the data. Furthermore, the control variables (age, education level, gender, etc.) had no significant effect on usage intention ($p > 0.1$).

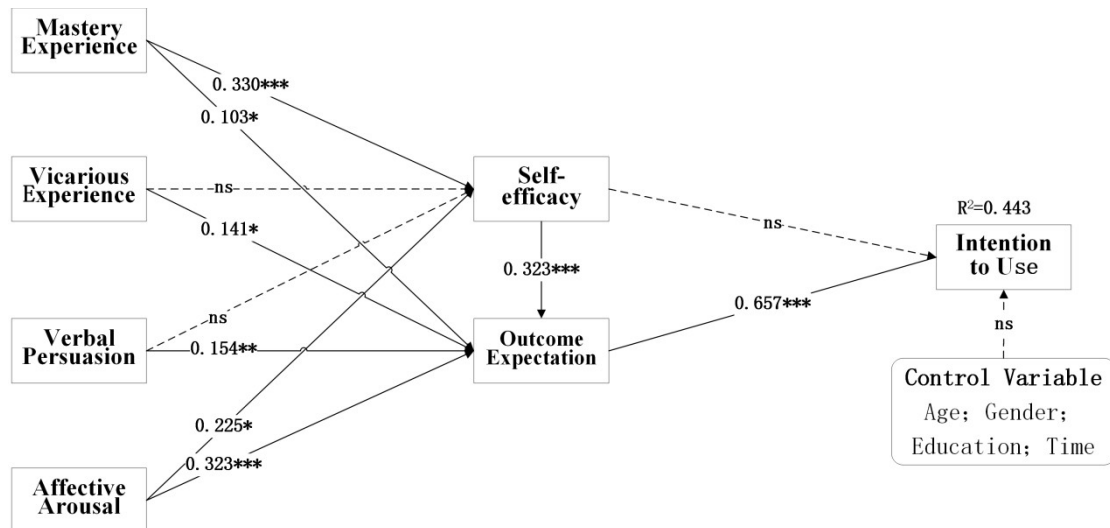


Figure 2. Path coefficients and significance

(Note. ns: not significant; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$)

The hypothesis test results are summarised in Table 6. The results indicate that mastery experiences and affective arousal have significant positive effects on self-efficacy, supporting hypotheses H1a and H4a. Furthermore, mastery experiences, vicarious experiences, verbal persuasion, and affective arousal all have significant positive effects on outcome expectations, thus supporting hypotheses H1b, H2b, H3b, and H4b.

Hypothesis		Path coefficient	Standard Error	T-value	Significance	Total Effect	Significance of Total Effect	Results
H1a	ME → SE	0.330	0.061	5.432	***	0.330	***	Supported
H1b	ME → OE	0.103	0.048	2.154	*	0.103	*	Supported
H2a	VE → SE	0.039	0.068	0.575	ns	0.039	ns	Not Supported
H2b	VE → OE	0.141	0.058	2.438	*	0.141	*	Supported
H3a	VP → SE	-0.129	0.090	1.436	ns	-0.129	ns	Not Supported
H3b	VP → OE	0.154	0.052	2.947	**	0.154	**	Supported
H4a	AA → SE	0.225	0.088	2.555	*	0.225	*	Supported
H4b	AA → OE	0.323	0.054	5.982	***	0.323	***	Supported
H5	SE → OE	0.323	0.047	6.860	***	0.323	***	Supported
H6	SE → IU	0.005	0.057	0.082	ns	0.217	***	Not Supported
H7	OE → IU	0.657	0.052	12.750	***	0.657	***	Supported

Table 6. Hypothesis testing

(Note. ns: not significant; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$).

The effects of vicarious experiences and verbal persuasion on self-efficacy did not reach a significant level, therefore, hypotheses H2a and H3a were not supported. This finding differs from the classical propositions of social cognitive theory. This study indicates that although

vicarious experiences and verbal persuasion are considered key sources of efficacy beliefs in social cognitive theory, in the context of conversational AI use, observational learning and verbal encouragement from others may not effectively translate into older adults' confidence in their own abilities. This result suggests that there may be certain boundary conditions when applying social cognitive theory to the conversational AI context, potentially including the influence of factors such as the technical characteristics of conversational AI, the specific traits of the older adult population, and the unique socio-cultural environment of China.

The results show that self-efficacy has a positive impact on outcome expectations, supporting hypothesis H5. Outcome expectations have a positive impact on usage intention, so hypothesis H7 is supported. However, the direct effect of self-efficacy on usage intention did not reach a significant level, and thus hypothesis H6 was not supported. Nevertheless, as shown in Table 6, the total effect of self-efficacy on usage intention is significant (0.217, $p < 0.001$), indicating that there is an indirect transmission relationship between the two, rather than no effect.

Alternative Model Testing

To verify the rationality of the original model specification and rule out the possibility that insignificant paths were caused by model misspecification, this study constructed an alternative model for comparative testing. The alternative model removed the insignificant direct paths (VE→SE, VP→SE, SE→IU) from the original model, retaining only the paths that were confirmed significant. The superiority of the models was judged by comparing the core fit indices between the original model and the alternative model (see Table 7), where smaller values of the Akaike information criterion (AIC) and Bayesian information criterion (BIC) indicate better model fit.

	R ²	SRMR	AIC	BIC
Original Model	0.443	0.055	-165.958	-139.893
Alternative Model	0.443	0.055	-167.954	-145.613

Table 7. Alternative model test results.

The comparison results show that the R² for usage intention in the original model (44.3%) is equal to that in the alternative model (44.3%). The SRMR values for both models are within the acceptable threshold of 0.08 (Original model SRMR = 0.055, Alternative model SRMR = 0.055). Furthermore, the AIC (-167.954) and BIC (-145.613) of the alternative model are both smaller than those of the original model (AIC = -165.958, BIC = -139.893). According to the core criteria for AIC and BIC, the alternative model demonstrates a better fit, indicating that the insignificant paths in the original model are redundant. The simplified model structure aligns more closely with the characteristics of this study's data, further validating the non-necessity of the insignificant paths in the original model. This echoes the earlier technical diagnostic conclusions of the model (ruling out technical factors such as collinearity as causes for the insignificant paths). Considering theoretical completeness, we retained the original model as the basis for reporting, but all interpretations are made with reference to the alternative model.

Mediation Effect Test

This study employed the bias-corrected bootstrapping method to test the mediating effect of the path Self-Efficacy (SE) → Outcome Expectations (OE) → Intention to Use (IU). The test results are shown in Table 8.

Intermediate path	Path coefficient	Standard Error	T-value	Bootstrap 95% CIs (Lower, Upper)	
SE→IU	0.000 ^{ns}	0.057	0.004	-0.108	0.109
SE→OE→IU	0.342***	0.044	7.855	0.267	0.434
Total effects	0.343***	0.056	6.157	0.231	0.451

Table 8. Mediation effect test results

(Note. ns: not significant; *** $p < 0.001$).

The results show that the direct effect of self-efficacy on usage intention is not significant; the mediating effect of the path Self-Efficacy → Outcome Expectations → Usage Intention is significant; and the total effect of self-efficacy on usage intention is significant. In summary, outcome expectations play a fully mediating role between self-efficacy and continuance intention (Zhao et al., 2010). The findings of this study indicate that, in the context of conversational AI, older adults' confidence in using the technology (self-efficacy) operates primarily through a cognitive mediator (outcome expectations) rather than as a direct driving factor. This finding suggests that the interpretation proposed by traditional social cognitive theory—that self-efficacy and outcome expectations jointly constitute direct influencing factors of behavioural intention—has applicability boundaries within the specific context of conversational AI. It further illustrates that, in the absence of reinforcement from positive outcome expectations, older adults' confidence in their own abilities alone may not be sufficient to effectively stimulate their intention to continue using conversational AI.

Discussion

Key findings

This study employs social cognitive theory as the core analytical framework, focusing on Chinese older adult users with experience in using conversational AI, and systematically examines the formation mechanism of continuance intention to use conversational AI. The study clarified the relationships among self-efficacy, outcome expectations, and usage intention, while also identifying the differentiated antecedent pathways for self-efficacy and outcome expectations. This study did not fully validate all theoretical assumptions of social cognitive theory in the context of conversational AI for aging, but rather discovered that the mechanisms of social cognitive theory exhibit contextual boundary characteristics within this research setting. Self-efficacy and outcome expectations remain core cognitive variables for predicting older adults' intention to use conversational AI. However, differing from the theoretical premise in the classical social cognitive theory framework that both jointly constitute direct antecedents of behavioural intention, this study found that their mode of action manifests as a chain mediation mechanism of Self-Efficacy → Outcome Expectations → Usage Intention. Meanwhile, among the four antecedents of self-efficacy proposed by social cognitive theory (mastery experiences, vicarious experiences, verbal persuasion, affective arousal), only mastery experiences and affective arousal showed significant positive effects, while the effects of vicarious experiences and verbal persuasion did not reach a significant level. However, all four types of antecedents demonstrated significant positive effects on outcome expectations. This result reveals the unique patterns of action arising from the combination of conversational AI, a novel natural language interaction technology, with the cognitive characteristics and usage context of the elderly population.

After technical diagnostic checks of the model and validation through an alternative model, ruling out technical factors and model misspecification, this study found that self-efficacy has no

direct positive effect on usage intention, although its total effect is significant (0.140, $p < 0.05$). Outcome expectations play a fully mediating role between the two. This finding differs from the classical assumptions of social cognitive theory, which posits that self-efficacy, as an individual's core belief in their own capabilities, directly drives the formation of behavioural intention (Bandura, 1977). However, in the context of conversational AI use in this study, older adults' self-efficacy could only indirectly translate into usage intention by enhancing their perception of the technology's value (outcome expectations). This finding suggests that, among the Chinese elderly user group, the adoption process of conversational AI may exhibit a cognitive logic characterised by a pragmatism orientation, their acceptance of the technology depends not only on the capability belief of 'I can operate it', but also, and more importantly, on the outcome judgement that 'operating it is valuable'. Therefore, the behavioural driving effect of self-efficacy needs to be transmitted through the value perception of outcome expectations. A similar pattern has also been observed in a study on older adults' health information-seeking behaviour (Fang et al., 2024).

Notably, this study found that the antecedents of self-efficacy among the elderly exhibit specific contextual screening characteristics. Among the four experiential sources proposed by social cognitive theory, only mastery experiences and affective arousal had a significant positive impact on it. Mastery experiences emerged as an important source of self-efficacy for older adults, a finding consistent with prior research (Bleicher & Lindgren, 2005). As Bandura (1977) pointed out, mastery experiences are most effective in enhancing self-efficacy because they allow individuals to strengthen it through repeated practise. Evidence suggests that older adults with richer mastery experiences are more inclined to perceive online health information seeking as easy (Fang et al., 2024). In the context of this study, when older adults successfully use conversational AI to complete tasks through their own efforts, their self-efficacy regarding their ability to complete similar tasks in the future is significantly enhanced. Furthermore, affective arousal is crucial for enhancing self-efficacy. Evidence indicates that the elderly are prone to negative emotions such as anxiety and fear towards digital technology (Hu et al., 2024; Yoon & Joo, 2021), and such negative emotions (e.g., technophobia) can significantly reduce an individual's self-efficacy (Yoon & Joo, 2021), thereby weakening older adults' intention to use digital technology (An et al., 2024; Jeng et al., 2022). Conversely, positive affective states can stimulate older adults' intrinsic motivation (Lent et al., 2017), making them more composed when facing technological challenges and more confident in their ability to overcome difficulties and achieve success.

The finding that vicarious experiences and verbal persuasion did not have a significant impact on self-efficacy deviates from the classical expectations of social cognitive theory. In response, we believe a careful reflection is needed from two dimensions—measurement operationalisation and the research context. First, the sample composition, predominantly urban elderly (with data mainly collected from senior universities and communities), might mask the heterogeneous effects of the urban-rural digital divide on the formation of self-efficacy. Second, the measurement of verbal persuasion focussed on its presence or absence but did not deeply assess moderating factors such as the credibility of its source and the quality of its content, which could influence its actual persuasive effect. Third, the operationalisation of vicarious experiences in this study focussed on general observational behaviour and failed to precisely capture key mechanisms in the observational learning process (such as the similarity of role models and the clarity of behavioural demonstrations). This may account for its weak predictive power.

It is important to emphasise that the findings above do not imply a rejection of the generalisability of the classical social cognitive theory framework. A more plausible interpretation is that the application of this theory to the context of conversational AI for aging, within the Chinese socio-cultural context, exhibits noteworthy specific boundaries. Based on a comprehensive analysis of existing literature, we preliminarily suggest that the interplay of factors such as institutions, family, and culture may, at certain levels, reshape the pathways

among the classic social cognitive theory variables. First, at the institutional level, although China's aging-friendly policies provide legitimacy and embedded scenarios for the elderly to use AI, this top-down rapid digital transformation can easily engender feelings of passive adaptation and frustration among older adults, who may feel 'technology iterates too fast for them to keep up', thereby exacerbating their technophobia (Charness & Boot, 2009). Under such macro-level pressure, it becomes difficult for the elderly to form effective vicarious experiences through observational learning, thus undermining the foundation for building self-efficacy. Secondly, at the family level, digital feedback, as the core form of intergenerational support in China, is characterised by a high degree of emotional attachment. Encouragement from children, rooted in Chinese filial piety culture, carries a vastly different psychological weight compared to generalised persuasion from the community or peers (Lam & Chan, 2017). Without targeted persuasion from authoritative sources (such as one's children), generalised verbal information often struggles to translate into stable self-efficacy due to a lack of credibility. More profoundly, at the cultural level, Chinese collectivism and the family-based tradition endow technology use with social meaning that transcends individual utility (Yao, 2026). For the elderly, the continued use of conversational AI carries the emotional expectation of maintaining participation in family discourse and avoiding social marginalisation due to digital lagging. This relationship maintenance oriented outcome expectation may be a more direct driver of behavioural intention than mere capability confidence (self-efficacy), potentially explaining why self-efficacy in this study needed to operate entirely through outcome expectations. Future research could further quantify the moderating effects of these contextual variables to deepen the understanding of the localised applicability boundaries of social cognitive theory and the specificities of conversational AI applications for aging.

Furthermore, differing from the screening characteristics of the antecedents of self-efficacy, mastery experiences, vicarious experiences, verbal persuasion, and affective arousal all demonstrated significant positive effects on outcome expectations. This result aligns with the theoretical assumptions of social cognitive theory (Bandura, 1977; Chen et al., 2022) and also reflects the inclusiveness of the antecedents of outcome expectations as a value perception variable. Specifically, the positive effect of mastery experiences is consistent with findings from studies by Bleicher and Lindgren (2005) and Chen et al. (2022), indicating that familiarity with similar tasks and multiple successful experiences can significantly enhance older adults' confidence in achieving beneficial outcomes. The significant impact of vicarious experiences on outcome expectations is further supported by research from Warner et al. (2011), suggesting that observing others successfully complete tasks can effectively elevate older adults' expectations of achieving similar positive results. Verbal persuasion reinforces older adults' perception of the technology's value through the transmission of external information (Clark & Nothwehr, 1999). The facilitating role of affective arousal aligns with the findings of Lent et al. (2017), which showed that it enhances older adults' positive expectations regarding the outcomes of using conversational AI by improving cognitive appraisals, among other mechanisms.

Theoretical contributions

This study further expands the application boundaries of social cognitive theory in aging-friendly scenarios. The research confirms that the core constructs of social cognitive theory (self-efficacy, outcome expectations) remain central cognitive variables for predicting the older adults' intention to use digital technology. However, within this study's context, the impact of self-efficacy on usage intention is completely mediated by outcome expectations. This finding does not negate the classic social cognitive theory conclusion that self-efficacy and outcome expectations jointly influence user behavioural intention but rather adds an important contextual boundary condition. That is, in the context of using conversational AI, older adults may adopt a more cautious decision-making logic, only translating self-efficacy into actual usage intention after confirming that the technology can bring tangible value (positive outcome expectations).

Secondly, this study reveals the relative differences among the multiple sources of experience in social cognitive theory within a specific context. The findings indicate that in the context of using conversational AI, direct mastery experiences and immediate affective arousal are the dominant antecedents shaping older adults' self-efficacy, while the direct effects of vicarious experiences and verbal persuasion did not manifest. This result does not negate the theoretical value of the latter two but rather suggests that for a relatively intuitive technology form emphasising personal experience, like natural language interaction, older adults' confidence construction relies more on the direct feedback from doing it themselves and the emotional reactions during use, rather than on observing others' behaviour or general social persuasion. Furthermore, the study confirms that mastery experiences, vicarious experiences, verbal persuasion, and affective arousal constitute the core sources of older adults' outcome expectations, a conclusion that resonates with the findings of researchers like Fang et al. (2024) and Chen et al. (2022).

Practical implications

This study constructs a four-dimensional intervention system for age-friendly conversational AI, aiming to provide actionable practical pathways for mitigating digital inequality and enhancing the digital participation of older adults.

First, the mastery of successful experiences holds significant practical value in enhancing the self-efficacy and outcome expectations of older adults regarding the continued use of conversational AI. (1) Establish regular 'Conversational AI Technology Workshops'. Spearheaded by neighbourhood or community committees, these workshops should collaborate with local senior universities, university volunteer organisations (e.g., sociology departments), technology companies, and community health centres to form a standing organisation. The community provides venues and organisational support, senior universities contribute teaching expertise, universities supply young volunteers, companies offer equipment and technical support, and health centres provide health-related content. This collaborative approach addresses the resource limitations of single institutions and ensures sustainable operation. (2) Develop a progressive standardised curriculum. Start with basic functions such as emergency calls and voice assistants to spark interest. Gradually transition to scenario-based practical training—for instance, in daily life scenarios, teaching how to use Xiaomi's Xiao Ai, Siri, or similar tools to play Peking opera, tell stories, set alarms, etc.—to reinforce outcome expectations of technology use. Considering the cognitive characteristics of older adults, training sessions should include review and Q&A segments. For example, 15-minute technical practice sessions and establishing learning progress tracking charts can enhance repetitive operational memory. This could boost their sense of control and accomplishment.

Second, vicarious experiences play a critical role in enhancing older adults' outcome expectations. A dual-mode approach of live demonstrations and visual tutorials can intuitively showcase the operational processes and positive outcomes of conversational AI. Specifically, a conversational AI technology workshop can be established, taking the lead in creating short video tutorials for different scenarios, complemented by hands-on demonstration sessions. The focus should be on how to use speech to get AI to complete tasks, lowering the cognitive barrier to technology. Additionally, a peer-assisted learning platform should be established. From each cohort of workshop graduates, select older adults with strong learning abilities, high enthusiasm, and a willingness to help others, appointing them as *silver-age digital tutors* to assist in subsequent workshops. Encouraging older adults to observe and learn from their peers' technical mastery and application outcomes can transform them from observers to participants, thereby enhancing their intention to use the technology.

Third, verbal persuasion is an effective means of enhancing older adults' outcome expectations. It is recommended that communities regularly organise family-oriented *Family Digital Day* events, inviting adult children to participate together with their parents. Design tasks that

require collaboration between grandparents and grandchildren or parents and children (such as using a voice assistant together to find a recipe). By guiding children to convey the value of technology to their parents through patient communication and intuitive hands-on experiences, the credibility and acceptance of the persuasion are enhanced. This not only creates opportunities for verbal persuasion and vicarious experiences but also establishes a support system within the family, extending learning beyond the classroom.

Fourth, positive affective arousal plays an undeniable role in enhancing older adults' technological self-efficacy and outcome expectations. During the technology learning process, a milestone-based incentive mechanism should be established. When older adults reach learning milestones, such as mastering basic functions or completing complex task operations, timely positive feedback and encouragement should be provided to reinforce their sense of achievement. Simultaneously, build an inclusive emotional support system. For example, place a small 'Help Me' card on a table at the workshop. If any older adult encounters frustration or feels discouraged while practicing on their own, they simply need to raise the card, and a volunteer will immediately provide one-on-one emotional and technical support, preventing the accumulation of negative emotions.

Limitations and future research

This study has certain limitations. First, the research focussed on the four core sources of expectancy beliefs but did not systematically examine the impact of older adults' heterogeneous characteristics on belief formation. Specifically, the participants in this study were all recruited from urban community environments and senior universities in China and already had experience using conversational AI. Therefore, the findings of this study are primarily applicable to the mechanisms of continued engagement among older adults who have already initially adopted the technology. However, they cannot directly explain the barriers that prevent older adults from initially adopting the technology, nor are they easily applicable to older adults who are completely excluded from it. Furthermore, demographic variables such as age stratification (e.g., younger-old vs. older-old), differences in Sino-Western social environments, and digital literacy levels may also moderate the formation mechanisms of self-efficacy and outcome expectations, but these dimensions were not incorporated into the analytical framework of this study. Second, this study employed a cross-sectional data design, making it difficult to capture the dynamic causal relationships among self-efficacy, outcome expectations, and technology usage intention. How personal characteristic variables (e.g., cognitive ability) influence belief formation over time, and the lagged effects of belief changes on technology usage intention, could not be verified through longitudinal data.

Based on the above limitations, future research can be further deepened in the following directions. First, conduct more nuanced heterogeneity analyses to systematically examine the differences in social cognitive pathways among different subgroups of older adults (e.g., those with different educational backgrounds, differences in Sino-Western social environments, urban-rural differences, different levels of social support, etc.). This would help construct a more comprehensive theory of digital inclusion and provide an empirical basis for precision empowerment. Second, adopt a longitudinal tracking design to capture the dynamic evolutionary relationship between older adults' cognitive beliefs and technology usage intention. Combine this with mixed-methods research; based on quantitative research, embed qualitative interviews to deeply explore the key life events and psychological transition processes that influence older adults' belief formation, thereby making the research conclusions more profound and explanatory.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors upon request.

Ethical approval

This study has been performed in accordance with the Declaration of Helsinki. Approval was granted by the Academic Committee of Library at Southeast University on December 20, 2024, and the study complied with ethical standards. The Academic Committee reviewed and approved the study protocol, involving research design and methods, eligibility criteria for participants, data collection and privacy protection, and informed consent. All questionnaires were obtained by considering the informed consent of the respondents, and all respondents completed it voluntarily and anonymously.

Informed consent

The study was conducted from January to July 2025. All participants provided informed consent before completing the formal questionnaire. At the beginning of each questionnaire, they were apprised of the study's objectives, procedures, the confidentiality of their responses, and that the data collected would be used solely for academic research. Furthermore, it was made clear that any personal information would be presented anonymously, and that they retained the right to withdraw from the study at any point. All participants agreed to participate, to the use of their data for research purposes, and to the publication of anonymised findings.

Conflicts of interest

The authors declare no conflicts of interest.

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