



Title	Empowering Elderly Language Services with Artificial Intelligence : Research on Theoretical Construction and Practical Paths
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Citation	The University of Osaka – Tongji University Joint International and Interdisciplinary Forum: Toward the Integration of Society and Knowledge Official Forum Proceedings. 2026, p. 101-117
Version Type	VoR
URL	<a href="https://doi.org/10.18910/104127">https://doi.org/10.18910/104127</a>
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*Empowering Elderly Language Services with Artificial Intelligence: Research on  
Theoretical Construction and Practical Paths*

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The University of Osaka - Tongji University  
Joint International and Interdisciplinary Forum:  
Toward the Integration of Society and Knowledge  
Official Forum Proceedings

**Abstract**

China has entered a new era characterized by the deep integration of artificial intelligence and population aging. As of 2024, the population aged 60 and above has exceeded 300 million, with internet penetration reaching 78.0%. However, 62.0% of non-internet users are elderly individuals. The intertwined digital divide and language barriers have become core bottlenecks constraining the social integration of elderly groups. Language, as the most important communication tool and information carrier for humanity, serves as a crucial bridge for elderly people to connect with the world and integrate into society. Faced with the physiological degradation of elderly language abilities and the rapid development of artificial intelligence technology, constructing an AI-enabled elderly language service system has become a critical issue in the national strategy for actively responding to population aging.

Based on the technological transformation background of the AI era, this study systematically analyzes the theoretical foundations and practical needs of elderly language services, constructs a "technology-data-service" three-dimensional empowerment framework, and proposes a precision model and construction path for AI-enabled elderly language services. The findings reveal: First, elderly language services possess multiple attributes including language welfare, language rights, and social assistance, requiring a content system constructed from three dimensions: supporting elderly care, ensuring medical access, and promoting social participation. Second, AI technologies provide novel solutions for elderly language services. Third, text analysis of 144 elderly-related policies indicates insufficient support from China's policy system for AI-enabled elderly language services, with problems including missing specialized planning and weak standard constraints. Fourth, empirical studies using government portals and mobile applications as cases demonstrate that current aging-friendly

transformations face "superficial" and "homogenized" dilemmas. Fifth, a precision model for AI-enabled elderly language services is constructed, comprising three types of subjects, two major elements, and four-stage management processes, with systematic construction proposals from five dimensions: institution, resources, products, technology, and ecology.

This study represents the first systematic exploration of the theoretical framework and practical paths for AI-enabled elderly language services, offering important reference value for promoting intelligent upgrading of elderly language services and facilitating digital integration of elderly groups.

Keywords: artificial intelligence; elderly language services; digital divide; information accessibility; precision services

## Introduction

Population aging represents a major trend in human social development during the 21st century. Since entering an aging society in 2000, China has witnessed continuous growth in both the scale and proportion of its elderly population. By the end of 2024, the national population aged 60 and above reached 310.31 million, exceeding 300 million for the first time, accounting for 22.0% of the total population; those aged 65 and above numbered 220.23 million, representing 15.6%, indicating entry into a deeply aging society. This demographic transformation exhibits notable characteristics including large numbers, rapid growth, significant regional disparities, and aging before affluence, posing severe challenges to high-quality economic and social development.

Meanwhile, new-generation information technologies represented by artificial intelligence have developed rapidly, profoundly reshaping social production and lifestyles. In the first half of 2024, the 54th Statistical Report on Internet Development in China released by the China Internet Network Information Center (CNNIC) showed that China's internet user base approached 1.1 billion, with internet penetration reaching 78.0%. However, individuals aged 60 and above account for 62.0% of non-internet users. Most elderly people struggle to directly access online information due to low technology acceptance and high operational complexity, facing risks of "digital incapacity" forming a "digital divide" and even becoming "digital refugees."

Language is humanity's most important information carrier and communication tool. Due to physiological aging or pathological decline, elderly groups commonly face issues such as language organ degeneration, weakened cognitive functions, and psychological state changes, manifesting as vague language expression, delayed information reception, and word retrieval difficulties. In the AI era, these language barriers overlap with digital technology usage obstacles, making elderly groups a typical "dual-vulnerable group of language and technology." How to empower elderly language services through AI technology, help elderly people overcome language barriers and digital divides, protect their language rights, and promote social integration has become an important issue in the national strategy for actively responding to population aging.

This study focuses on the development of elderly language services in the AI era, following the logic of "posing questions—analyzing questions—solving questions."

Research contents include: (1) systematic analysis of theoretical foundations and practical needs for AI-enabled elderly language services; (2) using policy tool analysis to parse language service needs implied in 144 elderly-related policies since 2000; (3) evaluating the current

application of AI technology in elderly language services using government portals and mobile applications as cases; (4) constructing a precision model for AI-enabled elderly language services; (5) proposing systematic construction paths.

Research methods include: (1) text analysis for systematic collection and content analysis of elderly-related policies; (2) case analysis for examining aging-friendly transformation practices of typical internet applications; (3) systematic analysis for constructing theoretical frameworks and construction dimensions.

## **I. Theoretical Foundations and Practical Needs of AI-Enabled Elderly Language Services**

Elderly language services constitute an important branch of language service research. Academia has provided rich interpretations of its connotation from different perspectives:

First, the language welfare perspective. Elderly language services represent the realization form of elderly language welfare, including four aspects: language learning, language assistance, language rehabilitation, and language comfort, encompassing both free services funded by government and low-cost public welfare services. Second, the language rights perspective. Elderly language services are professional services provided to elderly groups using all language derivatives including language, language knowledge, language technology, and language products, ensuring elderly people's freedom and rights to choose and use different types of languages and language derivatives. Third, the language life perspective. Elderly language services are targeted services provided based on elderly people's physiological, cognitive, psychological, and linguistic characteristics, satisfying elderly language life needs. Fourth, the social practice perspective. Elderly language services encompass all behaviors and practices that address various physiological, psychological, and social problems of elderly groups and the aging process through language and language-related derivatives.

Synthesizing the above perspectives, this study defines elderly language services as: various professional services provided to elderly people based on their physiological, cognitive, psychological, and linguistic characteristics, using all language derivatives including language, language knowledge, language technology, and language products, to satisfy multi-level language needs of different types of elderly people and ensure barrier-free daily life and information communication.

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AI-enabled elderly language services emphasize intelligent transformation of language interaction systems through AI technology on this basis, to meet special needs arising from elderly people's physiological function decline, cognitive function differences, and technology usage habits, help them overcome language barriers and digital divides, improve quality of life, and ensure equal rights to participate in digital society.

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Research methods include: First, text analysis for systematic collection and content analysis of elderly-related policies; Second, case analysis for examining aging-friendly transformation

practices of typical internet applications; Third, systematic analysis for constructing theoretical frameworks and construction dimensions.

This study collected and organized 144 normative elderly-related policies promulgated by China's central government and its constituent departments between 2000 and 2024 from the Pkulaw database and official government websites, using keywords such as "elderly," "pension," "aging," "silver hair," "aging-friendly," and "accessibility." Using Rothwell and Zegveld's three-category policy tool classification, policies were divided into supply-oriented, demand-oriented, and environment-oriented types to analyze implied needs for AI-enabled language services.

Among the 144 policies, 118 were pension policies and 26 were accessibility policies. By tool type, there were 75 supply-oriented policies (64 pension, 11 accessibility), 46 demand-oriented policies (38 pension, 8 accessibility), and 75 environment-oriented policies (57 pension, 18 accessibility).

Supply-oriented policies strengthen service capacity through direct resource investment, with language service needs mainly manifested in: 1. Language Services in Facility Construction Accessibility renovations of elderly care facilities require equipping intelligent speech broadcasters, large-font high-contrast signage, and access control systems with dialect voice feedback. Smart elderly care platform construction needs to develop aging-friendly voice interaction interfaces supporting multilingual services. 2. Language Services in Talent Cultivation. Elderly care service talent cultivation needs to incorporate teaching content such as dialect communication skills, hearing barrier communication strategies, and language cognitive barrier response, with language ability included in professional assessment standards. Elderly psychological care projects require enhancing service personnel's language comfort capabilities. 3. Language Services in Technical Support Application of information platforms and smart elderly care technologies requires adapting to elderly people's language cognitive characteristics, adopting simple and intuitive interface designs and easy-to-understand language expressions, supporting multilingual services including Mandarin and dialects, and developing functions such as voice alarm and intelligent voice interaction.

Policy publicity needs to convey core information through simplified terminology and dialect explanations, provide dialect communication training for grassroots handling personnel, establish elderly consultation service hotlines, and provide assistive services such as hearing aids and sign language interpretation for special elderly people. Elderly education needs to incorporate language teaching content such as Mandarin popularization and dialect protection; medical institutions need to provide simple oral explanations, large-font medical records, and

language comfort services; internet application aging-friendly transformations require optimizing interface interaction, content reading, operation prompts, and voice assistance functions. Door-to-door services require dialect communication training, service standard documents need to be compiled in simple language with case illustrations to assist understanding; public transportation needs to provide dialect voice broadcasting and large-font signage; elderly education courses need to develop dialect-dubbed videos and multilingual teaching materials.

## **II. Practical Investigation of AI-Enabled Elderly Language Services**

This study examined the first batch of 31 provincial-level government portals and 41 mobile applications required by the Ministry of Industry and Information Technology to undergo aging-friendly transformation, evaluating the current application of AI technology in elderly language services from three dimensions: perceptibility, comprehensibility, and operability.

Text enlargement functions have been basically popularized, but with limited intelligence. Speech service functions are unevenly developed: voice search is only equipped on Shanghai and Beijing government portals (6.45%); voice screen reading functions cover 16 portals (51.61%), supporting refined settings such as automatic broadcasting, selected reading, and speed adjustment; customer service functions cover 16 portals (51.61%), basically in intelligent Q&A form, with some supporting Mandarin voice input.

Picture-text combination functions are implemented on 13 portals, reducing comprehension difficulty through elderly-friendly background images and section indicator icons. Information processing functions are implemented on 13 portals, improving information acquisition efficiency through establishing special service sections for elderly people, streamlining page information, and simplifying section naming.

Advertising and induced button cleaning has been basically completed, but operational simplification services are positively correlated with comprehensibility service optimization, with problems of excessive simplification leading to insufficient service effectiveness.

Text enlargement functions are fully popularized, with some enterprises developing independent aging-friendly APP versions. Voice search functions cover 20 APPs (48.78%), with some providing keyword search examples and operation step prompts. Voice screen reading functions are only equipped on 5 APPs (12.20%), mainly telecommunications APPs. Customer service functions cover 31 APPs (75.61%), with "one-click direct call to customer

service" becoming a highlight, and some APPs implementing three customer service methods: telephone, online, and video (including sign language).

### **III. Main Conclusions from Practical Investigation**

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Picture-text combination functions are implemented in nearly half of APPs, optimizing visual experience through elderly-friendly background images and section indicator icons. Information processing functions are prominent, with more than half of APPs completing elderly information integration and simplified language expression, such as the Bank of China APP integrating high-frequency services to the homepage, naming categories with single characters such as "medical," "food," "housing," and "transportation," and integrating quality resources such as "Bank of China Elderly University."

78.05% of APPs improve operational convenience by filtering redundant information, retaining core functions, and simplifying interaction processes. For example, the Ele.me APP aging-friendly mode only retains three core functions: ordering food, shopping at supermarkets, and buying medicine, with only three controls at the bottom: homepage, orders, and personal center. Incomplete aging-friendly transformation, with three APPs including Toutiao, Youku, and Sogou not completing transformation; "superficial" AI application, mostly limited to basic voice interaction, lacking deep personalized services; excessive simplification of aging-friendly mode, failing to consider differentiated needs of elderly people of different ages, education levels, and urban-rural backgrounds, limiting usage experience for some elderly people.

First, basic aging-friendly transformation has achieved remarkable results, but deep AI application is insufficient. Basic functions such as text enlargement, voice broadcasting, and one-click customer service are widely popularized, but core AI technologies such as dialect recognition, emotion computing, intelligent recommendation, and multi-turn dialogue have limited application, with service intelligence levels needing improvement.

Second, service homogenization is serious, with precision and personalization lacking. Most products make simple adjustments according to general design specifications, failing to fully consider differentiated needs within elderly groups, and "one-size-fits-all" simplification strategies are difficult to meet diverse needs.

Third, technology and humanities integration is insufficient, with emotional warmth missing. Over-reliance on technology implementation neglects the emotional comfort function of language services, with insufficient attention to humanistic dimensions such as cultural semantics of dialects and emotional resonance in interaction.

## **V. Construction of Precision Model for AI-Enabled Elderly Language Services**

Based on the above analysis, this study constructs a precision model for AI-enabled elderly language services, comprising three types of constituent subjects, two supporting elements, and four-stage management processes.

Significant internal differences exist within elderly groups, requiring establishment of hierarchical classification demand identification mechanisms. By language ability dimension: normal aging type, mild attrition type, moderate barrier type, and severe aphasia type. By technology usage dimension: digital fear type, and digital proficient type. By service scenario dimension: home living type, institutional pension type, and social participation type. By cultural characteristic dimension: dialect-dependent type, Mandarin-dominant type, and bilingual mixed type. Differentiated AI language service solutions are configured for different types of groups.

Government guides third-party institutions to conduct standardized evaluations, establishing multi-dimensional indicator systems covering functional adaptability, technical inclusiveness, cultural appropriateness, and social effectiveness. Evaluation results are incorporated into enterprise credit evaluation assessments, driving service improvement through effectiveness evaluation, achieving win-win of efficiency and fairness.

Government leads inclusive services, using language data as planning orientation, big data technology as management tools, and cross-departmental collaboration as decision-making guarantee, protecting elderly language rights. Enterprises promote technological innovation, identifying long-tail needs through market mechanisms, bridging availability and accessibility gaps through technology iteration, and solving single-subject limitations through cross-boundary resource integration. Communities fill the "last mile" gap, undertaking demand collection response and resource adaptation transformation functions. Families provide personalized support, undertaking basic language communication and emotional companionship functions.

Construct elderly language data resource libraries, including language use and language ability data, which involves systematically collecting Mandarin, dialect, and foreign language use abilities and learning years to master language attrition phenomena; language demand data, which identifies language barriers and service needs in daily communication through active investigation and passive capture; language characteristic data, which integrates gerontolinguistics research results to establish multi-dimensional characteristic libraries covering phonetics, vocabulary, syntax, semantics, and pragmatics; and corpus data, which constructs text and speech corpora to support AI model training.

Research and develop core technologies adapted to elderly language characteristics, including speech interaction technology—encompassing speech amplification, speech conversion, speech recognition, speech synthesis, and dialect recognition; multimodal interaction technology, which integrates multi-channel information such as voice, expression, and gesture; natural language processing technology, which achieves semantic understanding, context awareness, emotion computing, and intelligent recommendation; and machine translation and transcription technology, which supports automatic conversion between dialects and Mandarin, as well as between spoken and written language.

The Four-Stage Management Processes include Demand Management: From Identification to Prediction, which identifies language needs through passive data capture (intelligent device behavior analysis) and active data production (visual demand labeling), achieves demand stratification through "grouping by similarity" (scenario classification) and "classifying by people" (group clustering), and achieves forward demand governance through dynamic monitoring, long-term prediction, and advance deployment.

Supply Design: From Configuration to Adaptation, which breaks through traditional static allocation models to achieve spatial resource adaptation (dynamic deployment in high-demand scenarios), group resource matching (deep learning recommendation systems), and human-

machine collaborative configuration (intelligent processing of routine needs, manual handling of complex needs), while emphasizing multi-method satisfaction (technology adaptation and manual service connection), multi-scenario coverage (medical, government affairs, community, culture, etc.), and multi-stakeholder collaboration (government, enterprise, community, family linkage).

Supply-Demand Matching: From Technology to Humanities, which avoids technology-dominated "pseudo-precision" and "superficial understanding" by establishing cultural semantic libraries through collecting local multimodal data and embedding them in dialect recognition technology, judges deep needs through micro-expression recognition and voice emotion analysis, and achieves a leap from "technically audible" to "psychologically understandable" by explaining professional terminology with dialect idioms and using dialects for emotional comfort.

Effectiveness Evaluation: From Assessment to Improvement, which establishes multi-dimensional evaluation indicator systems—such as decomposing language emotion transmission effectiveness into communication normativity (speed and tone detection), empathy ability assessment (situation simulation testing), and basic dialect expression (recognition accuracy testing)—incorporates evaluation results into industry-level assessments, invites linguistics experts to participate in standard revision, and forms "assessment—feedback—optimization" closed-loop mechanisms. Construct a multi-stakeholder collaboration pattern of "government + enterprise + community + family." Incorporate evaluation results into industry level assessments, invite linguistics experts to participate in standard revision, forming "assessment—feedback—optimization" closed-loop mechanisms.

## **VI. Construction Dimensions of AI-Enabled Elderly Language Services**

Based on a whole-society participation perspective, this study proposes construction paths for AI-enabled elderly language services from five dimensions: institution, resources, products, technology, and ecology.

### **1. Improving Policies and Regulations**

Conduct national elderly language use surveys, establish dynamically updated elderly language databases, providing scientific basis for policy formulation; incorporate elderly language services as an independent dimension in elderly care service evaluation, increasing specialized policy and regulation protection; increase special financial investment, supporting language rehabilitation equipment R&D, dialect culture database construction, and gerontolinguistics interdisciplinary discipline construction; on the basis of improving basic communication

accessibility, promote the active aging strategy from "being cared for" to "being useful" through developing elderly language education courses, developing dialect culture inheritance projects, and promoting intelligent technology aging-friendly transformation.

## 2. Strengthening Standards and Norms

Formulate specialized service standards for common elderly language pathological problems such as cognitive barriers, aphasia, and articulation disorders; conduct assessment work and establish intervention mechanisms for elderly language ability decline; clarify responsibilities of medical institutions and elderly community centers in such services, forming quantifiable assessment indicators; formulate specialized norms for language comfort in end-of-life care and emergencies. Upgrade core provisions of information accessibility standards to mandatory national standards, promote formation of unified cross-domain frameworks, and formulate AI application ethics norms and data security standards.

## 3. Language Service Talent Library

Construct research teams (gerontolinguistics research, textbook compilation, technology R&D, interdisciplinary research talents) and service teams (professional practitioners and social service personnel). Promote industry-research integration between language application research and language service enterprises, promoting professional and vocational cultivation of language application talents; emphasize interdisciplinary linguistics talent cultivation, covering pathological, psychological, and social dimensions; establish mature and efficient volunteer team cultivation systems, strengthening emergency language service volunteer team construction.

## 4. Language Data Resource Library

Systematically collect language use and language ability data, with key coverage of rural areas; combine active collection and passive capture to obtain language demand data; integrate research results to establish language characteristic data; construct text and speech corpora. Utilize natural language processing, machine learning and other technologies to improve data collection and analysis efficiency, exploring construction of hierarchically open elderly language data resource platforms.

## 5. Language Culture Resource Library

Excavate and organize elderly commonly used corpora of various local dialects and ethnic languages, constructing translation corpora classified by life scenarios, medical scenarios, and emergency scenarios; collect elderly oral histories, dialect folk songs, local operas and other cultural resources; construct elderly-friendly language landscape resources, including standardized signage design and emotional space creation.

Product Dimension includes: Develop aging-friendly dictionaries, dialect-Mandarin comparison manuals, professional terminology picture-text comparison cards, etc.; research and develop sensory assistive devices such as intelligent hearing aids, voice amplifiers, and AR subtitle glasses; construct voice interaction platforms, intelligent translation systems, and multilingual customer service systems. Produce audio books (dialect storytelling, folk tales, etc.), large-font printed materials, and voice-synchronized readers; develop vivid and interesting language learning materials (life-oriented English textbooks, dialect scenario play scripts, etc.); compile professional terminology manuals with simplified language. Develop language art products such as dialect folk songs and ethnic language songs, opera lyrics and local dramas, quyi and performing arts; create calligraphy and text art works; convert through technology empowerment into converged media products, serving special elderly groups such as those living alone, suffering from depression, and Alzheimer's disease. Research and develop visual assistance products (multi-function handwriting input, AR subtitle glasses, etc.), auditory enhancement products (intelligent voice assistants, dialect recognition input systems, etc.), and language translation products (pocket translators, instant translation software, etc.); develop products with different carriers and manifestation forms (converged media forms, web versions, WeChat versions, short video versions, etc.).

This framework addresses elderly language needs through three interconnected dimensions: Product, Technology, and Ecology. Product Dimension focuses on developing practical tools (e.g., aging-friendly dictionaries, dialect-Mandarin manuals, sensory assistive devices like AR subtitle glasses) and content (e.g., dialect audio books, simplified terminology guides, language learning materials). It also includes cultural products (dialect folk songs, opera adaptations) and multi-carrier solutions (converged media, web/WeChat/short video versions) to serve diverse elderly groups, including those with Alzheimer's or living alone.

Technology Dimension emphasizes accessibility and interaction: interface optimization (large fonts, high contrast), speech recognition/conversion (dialect/ethnic language support), voice assistants, and companion interaction. It integrates diagnostic tools (language screening via speech analysis) and scenario simulation for immersive training, combining local cultural characteristics with aging-friendly tech.

Ecology Dimension prioritizes inclusive design (large line spacing, semantic simplification, icon support) and respectful language norms (avoiding "old/weak" labels, using positive terms like "seniors"). It fosters intergenerational communication (family dialect learning, community exchanges), public multilingual services, and digital tools to bridge generational language gaps, while promoting language civilization across families, communities, and media.

Technology Dimension includes: Provide interface optimization technology (large fonts, high contrast, simplified layout, etc.); provide speech recognition and speech-to-text technology, supporting dialect and ethnic language recognition and conversion; provide voice assistants and auxiliary memory tools, helping record important information and boosting confidence in using digital devices. Provide speech recognition and feedback technology, giving immediate feedback on language usage and helping correct errors; provide companion language interaction technology, improving memory, comprehension, and language organization abilities through multi-turn dialogue repeated stimulation. Provide intelligent language screening and diagnosis technology, analyzing speech rate, pauses, vocabulary volume and other characteristics through machine learning to detect abnormalities as early as possible; provide scenario dialogue simulation technology, simulating life scenarios for immersive dialogue training, improving vocabulary volume, expression fluency, and semantic comprehension. Include speech enhancement and conversion, accessibility interaction, multimodal information conversion, machine translation, and other technologies; develop aging-friendly language technologies combining specific application scenarios and local cultural characteristics.

Ecological Dimension includes: Reflect elderly-friendliness in information function by setting large line spacing, bold large fonts, high contrast color schemes, and illuminated signage; reasonably arrange information layout, adopt hierarchical progressive style, avoid complex sentences, emphasize semantic simplification, and cooperate with icons to strengthen understanding. Reflect elderly-friendliness in symbolic function through naming strategies to create respectful and inclusive social atmospheres, avoiding labeling expressions such as "old, weak, sick, and disabled," and adopting positive appellations such as "seniors" and "silver-haired." Elderly people themselves actively avoid language violence, control emotional fluctuations, respect diverse values, and set examples of language civilization for younger generations; service personnel follow language civilization norms, improving professional competence through standardized training, with key attention to communication needs of special elderly groups such as relocated, depressed, and empty-nest elderly; online media strengthen language civilization responsibilities, eliminating negative reporting methods, breaking stereotypes, and focusing on presenting positive role narratives of elderly people. In family domains, encourage younger generations to learn basic dialect expressions and understand elderly language habits; in community domains, organize intergenerational language exchange activities, promoting benign interaction between dialect inheritance and Mandarin popularization; in public domains, establish multilingual service windows, respecting elderly people's language choice rights; in digital domains, develop

intergenerational communication auxiliary tools, helping elderly people understand internet neologisms and younger people understand dialectal old expressions.

## **Conclusion**

AI-enabled elderly language services constitute an important component of the national strategy for actively responding to population aging, and also represent a frontier topic in language service research in the digital era. This study systematically analyzed the theoretical foundations, policy needs, and practical status of AI-enabled elderly language services, constructed a precision model of "three types of subjects, two major elements, and four stages," and proposed construction paths from five dimensions: institution, resources, products, technology, and ecology. By integrating interdisciplinary insights from linguistics, gerontology, and artificial intelligence, the research aims to bridge the digital divide faced by older adults, enhance their access to inclusive and personalized language support, and provide actionable guidance for policymakers, tech developers, and service providers to advance equitable and sustainable elderly care solutions in the digital age.

The study found that China's elderly language service construction has achieved remarkable progress, with basic aging-friendly transformation widely popularized, but deep application of AI technology remains insufficient, with problems including missing specialized planning, weak standard constraints, serious service homogenization, and insufficient technology-humanities integration. Future efforts should focus on: first, strengthening top-level design, formulating specialized planning for AI-enabled elderly language services; second, deepening technology application, promoting innovative application of core technologies such as speech recognition, natural language processing, and multimodal interaction in elderly language services; third, strengthening standard leadership, establishing standard and norm systems covering full processes and full scenarios; fourth, promoting ecological co-construction, forming good patterns of government, enterprise, community, family, and academia collaborative advancement.

This study is only a preliminary exploration. The theoretical deepening, technological innovation, and practical optimization of AI-enabled elderly language services require joint participation of more researchers and practitioners, to build intelligent language service systems with warmth, precision, and depth for 300 million elderly people, assisting in realizing the beautiful vision of supporting elderly care, ensuring medical access, and promoting social participation.

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