AGING-CENTERED FOCUS IN INTERACTION DESIGN DEVELOPMENT: VALUE EVOLUTION, GLOBAL TRENDS, AND CHINA'S GROWING INFLUENCE

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ABSTRACT
This study investigates the evolution of aging-centered focus in interaction design by comparing global and Chinese research trajectories to understand shifts in value orientation and China's growing influence in the field. Literature was retrieved from Web of Science (WOS) and China National Knowledge Infrastructure (CNKI), and analyzed using CiteSpace-based natural language processing and bibliometric techniques. Country–institution networks, keyword clusters, and developmental cycle curves were generated to reveal structural patterns and temporal dynamics. Results show that international research emerged earlier, driven by humanistic care and value-sensitive priorities, whereas Chinese research initially emphasized usability and functional improvements aligned with rapid technological development. Over time, both contexts have gradually shifted from functionality-focused perspectives toward more complex, experience-driven and emotionally supportive design values. Since 2018, China's research investment and industrial innovation have accelerated significantly, leading to a visible rise in scholarly output, collaboration networks, and agenda-setting capacity in global discourse. Overall, aging-centered interaction design is undergoing a value transition from solving practical barriers to enhancing emotional, social, and inclusive experiences. The convergence of domestic and international developments highlights not only China's narrowing academic gap but also its growing role as an influential contributor shaping the next phase of aging-friendly design innovation.

Keywords: Aging-Centered, Interaction Design, Developmental-Cycle, Bibliometric Analysis, Cross-Cultural Comparison

1 INTRODUCTION

Most countries worldwide are entering an irreversible stage of population aging, and the rapid growth of the elderly population has become a global consensus. Consequently, design disciplines are increasingly attentive to the needs of older users [1–3]. Against this backdrop, the notion of Aging-Centered Interaction Design has drawn scholarly attention since the late 20th century. For example, Morris (1994) emphasized the necessity of incorporating the specific needs of older users into interaction design considerations [4].

Since the 1960s, with the proliferation of computers, explorations around Human-Computer Interaction (HCI) began to emerge and gradually became institutionalized during the 1980s, forming a core domain of interaction design development [5]. Its primary aim was to bridge the interaction gap between digital technologies and human users, assisting users in understanding computational logics while ensuring effective reception and feedback of user commands. For a long time, research focused mainly on task-oriented usability issues [6]. Within this process, aging-centered interaction design came to be regarded as a more user-appropriate practice for older adults, encompassing interactive digital products, environments, systems, and services [7]. Its original intention was to bridge the functional and usability gaps between older users and digital technologies, given the early characteristics of high complexity and semantic inconsistency that often hindered smooth interaction for the elderly [8,9].

In recent years, with the deep integration of digital technologies and design disciplines, along with advances in user behavior prediction and detection, the research paradigm of aging-centered interaction design has undergone transformation. The research focus has expanded from functional value—emphasizing usability and efficiency—to emotional value, with greater attention to meaning-making, embodied cognition, and affective experience [10]. This value shift not only reflects the disciplinary evolution of interaction design but also resonates with broader changes in global sociocultural contexts. In China, although research on aging-centered interaction design started relatively late, explorations and practices have emerged at multiple levels. However, existing studies still exhibit gaps in developmental logic, value evolution, and international comparison, lacking systematic and comprehensive analysis. Examining the evolution of aging-centered concerns from the perspective of interaction design development, alongside cross-national comparisons, can help clarify research logics and trends. Moreover, such comparisons reveal domestic limitations and potential breakthroughs, while also highlighting China's growing influence within global technological and design discourses. Through this process of comparison and reflection, the study not only provides a theoretical basis for understanding the current state of aging-centered interaction design but also broadens research paradigms and methodological approaches, offering new insights for future research and practice.

2 AGING-CENTERED CONCERNS IN THE DEVELOPMENT OF INTERACTION DESIGN: CONTEXT AND RESEARCH APPROACH

2.1 Historical Trajectory and Value Evolution of Aging-Centered Concerns

Compared with younger users, older adults show distinct differences in physical and cognitive abilities, with considerable interindividual variability. This makes supportive interaction design particularly critical when they engage with digital technologies [29]. Early approaches to aging-centered interaction design primarily emphasized functional value, focusing on usability and comprehensibility. Morris (1994) argued that design for older adults should improve usability and intelligibility to enable them to meet daily needs and remain socially active [4]. Such ideas align with the early notion of Barrier-Free Design, which stressed equity and usability [12,13].

In recent years, research has increasingly shifted toward interpersonal communication and social interaction mediated by digital technologies, emphasizing user behavior from a human-centered perspective and addressing multilayered user needs [7]. Within the developmental trajectory of interaction design, the evolution of aging-centered concerns illustrates a shift from functional value to a multidimensional orientation dominated by emotional value. Hassenzahl's (2008) user experience model distinguishes between two complementary dimensions of design quality: pragmatic quality and hedonic quality [31]. Pragmatic quality concerns efficiency and effectiveness in task completion, whereas hedonic quality emphasizes enjoyment and satisfaction during use. The model suggests that successful interaction design should not only meet older users' basic functional needs but also enrich their emotional experiences, thereby enhancing overall satisfaction.

Similarly, Norman (2007) proposed that design should address three levels of emotional response: visceral, behavioral, and reflective [32]. For older adults, interaction design must simultaneously address behavioral usability and foster reflective resonance, including identity and social recognition. Such multidimensional support encourages active participation, sustained use, and deeper emotional engagement.

Overall, the trajectory of aging-centered interaction design reflects a transition from functionality-dominated goals to a broader concern with emotional and social dimensions. This value evolution highlights the discipline's responsiveness to changing sociocultural contexts while also pointing to the growing need for inclusive design frameworks. Future research should advance integrative approaches that balance functional, emotional, and social values, enabling interaction design to address the increasingly diverse and complex demands of aging users.

2.2 Research Approach and Framework

To systematically clarify the conceptual evolution and research landscape of aging-centered concerns within the development of interaction design, this study selected the two most authoritative databases, Web of Science (WOS) Core Collection and China National Knowledge Infrastructure (CNKI), as primary data sources. Highly relevant academic papers were extracted as research samples, providing a

comprehensive basis for analyzing research dynamics and knowledge structures in the field. Bibliometric methods were employed in combination with information visualization and natural language processing (NLP) techniques to reveal the value orientations, global trends, and technological influence of aging-centered interaction design, particularly in the Chinese context.

Methodologically, CiteSpace was adopted as the core analytic tool. Building on co-citation analysis and bibliometric techniques, its visualization functions enable not only an overview of research status and developmental trends in the field, but also in-depth multidimensional analysis across countries, institutions, and keywords. Specifically, this study applies CiteSpace to explore the distribution of publications, institutional collaboration networks, and keyword clustering within aging-centered interaction design. Semantic clustering of textual corpora was further conducted to extract core thematic labels, thereby uncovering the knowledge base and theoretical trajectory of the field.

On this basis, a developmental cycle framework of aging-centered interaction design was constructed, visually mapping its progression, structural relationships, and evolutionary pathways. The framework illustrates the value shift from functionality to emotion while highlighting the similarities and differences between domestic and international studies in terms of early trajectories, thematic foci, and eventual convergence. In doing so, it provides both theoretical grounding and empirical evidence for understanding global trends and China's technological influence within the broader development of interaction design (see Figure 1 for the research framework).

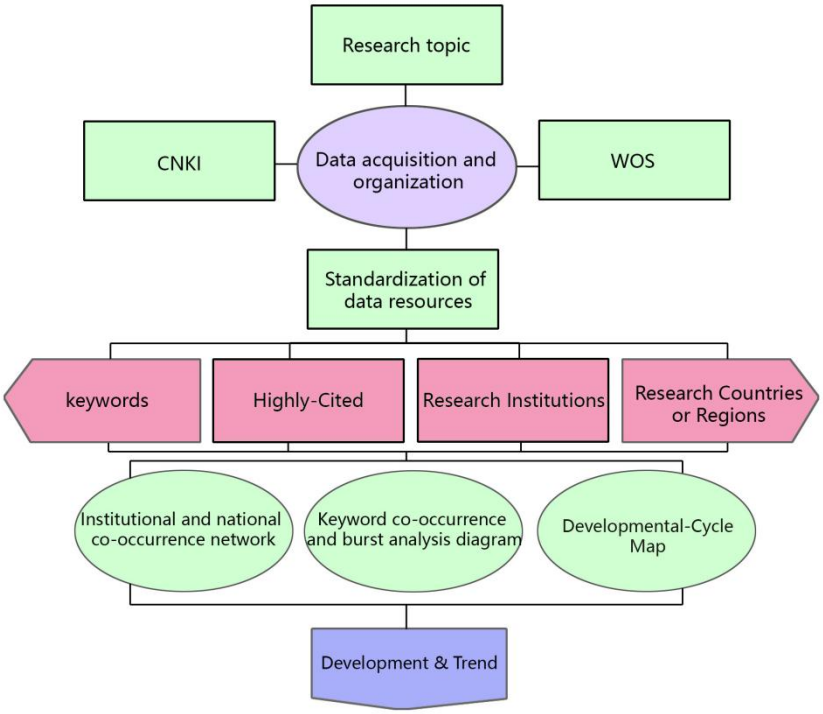

Figure 1. Research method flow chart

3 RESEARCH STATUS AND EVOLUTION OF AGING-CENTERED DESIGN WITHIN THE PERSPECTIVE OF INTERACTION DESIGN DEVELOPMENT

3.1 Publication Output and Shifts in Research Intensity

To provide a comprehensive analysis of the research dynamics in aging-centered interaction design, publications indexed in the core databases of WOS and CNKI were systematically collected and analyzed. The final retrieval date was set as October 25, 2024. Given that searches using the dual keywords "Aging-Centered" and "Interaction Design" in CNKI yielded relatively few results with delayed publication years, the advanced Chinese search was refined with the thematic terms "Interaction Design" and "Elderly." This strategy identified 784 records. After excluding patents, newspapers, and

conference papers, and conducting manual screening to eliminate studies of low relevance, 373 valid documents were retained.

For English publications, multiple retrieval strategies were tested to ensure accuracy and validity. The final WOS query adopted “Interaction Design” and “Elderly” as thematic terms, producing 3,211 records. After excluding patents, newspapers, and conference proceedings, and further manual filtering of marginally relevant documents, 145 valid publications were obtained.

Statistical analysis reveals that scholarly output in aging-centered interaction design has demonstrated a sustained upward trajectory over time, reflecting the increasing academic and societal attention to this domain (see Figure 2).

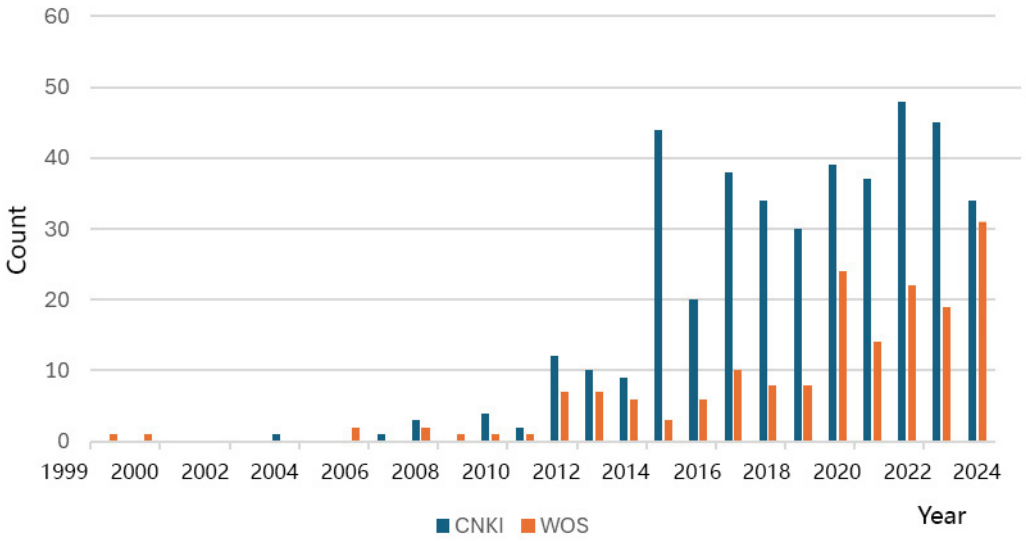

Figure 2. Related Articles in WOS and CNKI include Statistical Charts

From Figure 2, it can be observed that the WOS was the first database to index publications on aging-centered interaction design, with the earliest record dating back to 1999. Overall, the field has shown a steady upward trajectory, peaking in 2020. Although publication numbers in recent years remain near this peak, they no longer exhibit significant growth. In contrast, the CNKI began indexing relevant studies later, with the earliest article published in 2004. Since 2012, however, the number of publications has surged, demonstrating a stable upward trend. Notably, after 2010, CNKI consistently recorded more publications than WOS, suggesting that aging-centered interaction design has gained increasing scholarly attention in China.

Chronologically, publications in WOS can be divided into two distinct stages: the Initiation Phase (1999 – 2011), during which only sporadic studies appeared, indicating that aging-centered interaction design had just entered the academic discourse; and the Development Phase (2012 – 2023), characterized by a substantial increase in output, reflecting the rising international visibility of the field. Similarly, publications in CNKI also present three phases: the Incubation Phase (2004 – 2011), with very limited contributions from a small number of institutions and scholars; the Growth Phase (2012 – 2014), marked by a gradual increase in attention and output; and the Breakthrough Phase (2015 – 2023), during which publication volumes grew explosively, confirming that aging-centered interaction design had become a research hotspot in China.

3.2 Global and Domestic Research Landscape

Within the broader trajectory of interaction design, global attention to aging-centered research reveals significant differences in regional distribution and collaborative networks. Visualization of the WOS core database indicates that, to date, research outputs in this field have been published by institutions across 39 countries and regions (Figure 3), highlighting its inherently interdisciplinary and international character. As shown in Figure 4, Mainland China ranks first with a distinct lead, followed by Taiwan, the United Kingdom, the United States, and Italy. Together, these top five regions account for 80

publications, or 55.17% of the total, underscoring the concentration of research efforts in a few influential hubs. This pattern suggests that the value orientation of aging-centered interaction design is evolving from localized concern toward global consensus, with China emerging as a key actor in shaping the international research agenda.

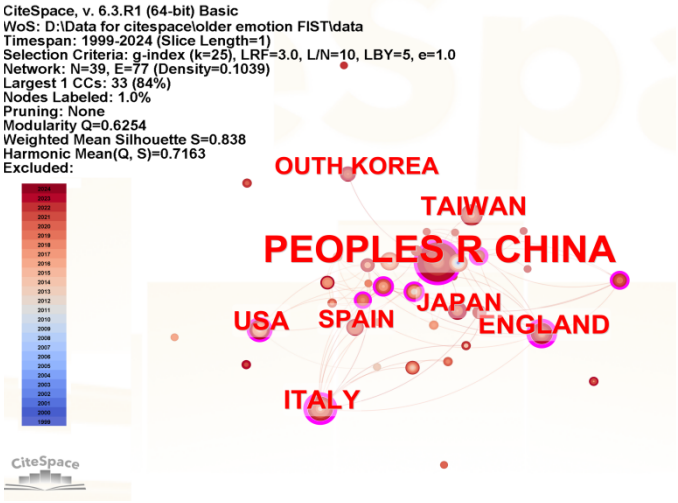

Figure 3. Map of core country publication network of WOS

Figure 4. Number of core country publication network of WOS

From a global perspective, Mainland China has demonstrated significant research influence in the field of aging-centered interaction design. Data indicate that Mainland China has published 36 relevant papers in international journals, accounting for 24.82% of the total and ranking first worldwide. This reflects the strong commitment and sustained investment of domestic research institutions in this domain. In terms of institutional contributions, Tongji University and Nanjing Forestry University stand out with active research outputs on the international stage. Within the domestic academic system, Jiangnan University (8 papers), Tianjin University of Technology (7 papers), Southwest Jiaotong University (7 papers), Jiangsu Normal University (6 papers), and Wuhan University of Technology (6 papers) constitute the primary research forces.

As shown in Figure 5, the collaboration network comprises 106 nodes and 141 links, with an overall density of only 0.025. This suggests that cooperative ties among Chinese research institutions remain relatively weak, and research practices tend to rely more on individual or intra-institutional efforts. Overall, while China has already secured a leading position globally in both the volume and impact of its scholarly output, further advancement in international discourse power and technological influence will depend on strengthening inter-institutional and cross-border collaboration networks. Such developments are essential to driving the value evolution of aging-centered interaction design and advancing its consolidation as a global research consensus.

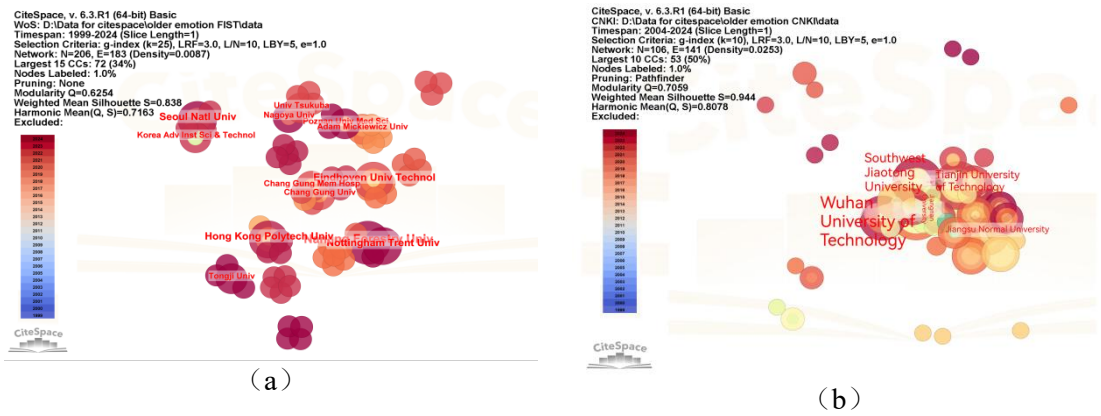

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Figure 5. Co-occurrence Map of WOS and CNKI Age-friendly Interaction Design Research Institutions

(a) Databases from WOS ; (b) Database from CNKI

3.3 Keyword Clustering and Thematic Structure

3.3.1 Keyword Clustering and Analysis

Based on the keyword co-occurrence mapping of publications indexed in the Web of Science (WOS) core collection and China National Knowledge Infrastructure (CNKI), the clustering process primarily compares citation frequencies of relevant keywords to determine their relative influence within the field. To ensure analytical precision, common descriptors were excluded. In Chinese-language sources, general terms such as “Aging-Centered (Age-Friendly),” “Elderly,” and “Interaction Design” were removed; similarly, in English-language sources, terms such as “Interaction Design,” “Elderly,” and “Old People” were excluded. The remaining keywords were then ranked in descending order of frequency (see Table 1).

These high-frequency keywords constitute the foundational thematic framework of the aging-centered interaction design domain, both internationally and within the Chinese research context. They not only reveal the core conceptual categories underpinning scholarly inquiry but also provide an empirical basis for identifying the structural evolution of research themes in this interdisciplinary field.

Table 1. High-frequency keywords for WOS and CNKI

	WOS		CNKI	
1	Technology	25	User Experience - UX	130
2	Care	18	Interface Design	106
3	Health	13	Product Design	41
4	Acceptance	12	Interactive Interface	26
5	Human-robot interaction	11	Human-Computer Interaction	25
6	Design	11	Smart Products	19
7	Age	11	Usability	13
8	Smart home	9	Design Strategy	12
9	Behavior	9	Interaction Experience	11
10	Quality of life	7	Flow Theory	8

The development of Aging-Centered Interaction Design exhibits marked differences between international and domestic research contexts. In the keyword co-occurrence mapping of WOS core collection, the network density is 0.026, comprising 269 nodes and 948 connections, presenting a highly decentralized structure. The most frequently co-occurring keywords are “technology,” “acceptance,” “care,” and “health,” whose associations extend across diverse domains, including design studies, medicine, psychology, and sociology. This suggests that, in the international research discourse, Aging-Centered Interaction Design is framed not only as an issue of technological and product optimization

but also as one intrinsically tied to healthcare, social acceptance, and the evolution of cross-disciplinary value systems.

By contrast, the keyword co-occurrence network in CNKI exhibits a density of 0.027, with 191 nodes and 502 connections, likewise reflecting a relatively decentralized structure. However, the domestic research focus is more discipline-specific, with high-frequency keywords including “User Experience (UX),” “Interface Design,” “Product Design,” and “Interactive Interface.” This pattern indicates that Chinese scholarship emphasizes technical optimization at the product and interaction levels, while comparatively underexploring interdisciplinary themes related to health, psychology, and social value.

Overall, WOS data highlight the pluralistic orientation and evolving value dimensions of Aging-Centered Interaction Design within the international academic community, whereas CNKI data foreground China’s strengths in technical and application-driven aspects of design studies. This divergence underscores not only the cross-disciplinary convergence shaping the global trend but also the direction for China’s future research agenda: consolidating disciplinary expertise in design while fostering interdisciplinary collaboration to extend Aging-Centered Interaction Design from a technological focus toward broader societal and value-based impacts.

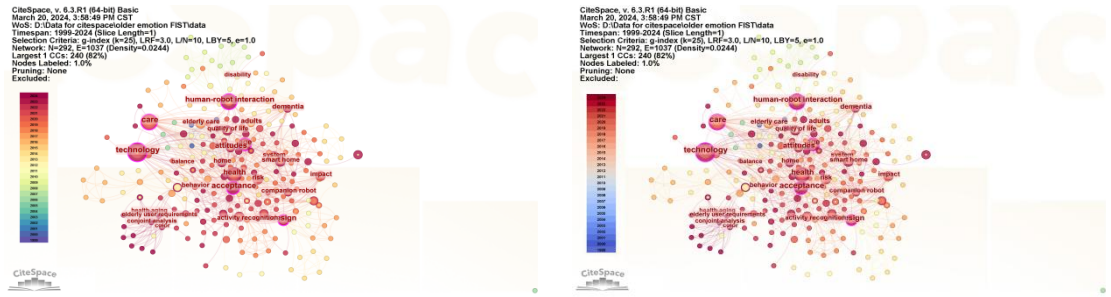

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Figure 6. Keyword Co-occurrence Diagram of WOS and CNKI

(a) Web of Science databases; (b) CNKI database; The upper left corner of the graph is the basic parameter, and the lower left corner is the time partition legend. The node size in the graph represents the keyword frequency, and the width and color of the node concentric circles correspond to the number of papers and the time partition

Through the content analysis of high-frequency keywords, two primary value orientations can be identified: Functional Value and Emotional Value (see Table 2). Within the WOS dataset, keywords predominantly emphasize the relationship between older adults and interaction carriers, highlighting the role of interaction design in improving daily life and health outcomes. For instance, terms such as “Care,” “Design,” and “Behavior” are closely associated with “Quality of Life” and “Health,” indicating that international research places greater emphasis on the contributions of interaction design to human-centered care and health enhancement. This orientation not only reflects the core principle of “human-centeredness” in interaction design but also reveals that the global academic community is increasingly embedding Aging-Centered issues within interdisciplinary value frameworks.

By contrast, high-frequency keywords in the CNKI dataset are concentrated on terms such as “User,” “Experience,” “Interface,” “Interaction,” “Design,” “Product,” and “Usability.” This pattern suggests that domestic research continues to follow the traditional paradigm of interaction design, with stronger focus on technological implementation, interface optimization, and user experience. At the same time, however, it is gradually expanding into non-material dimensions of interaction, encompassing social and emotional values. This transition reflects how Chinese scholarship on Aging-Centered Interaction Design is evolving from a purely function-oriented orientation toward a more composite orientation that integrates emotional and social considerations.

Further insights can be drawn from the clustering analysis illustrated in Figure 6, which demonstrates that the development of Aging-Centered Interaction Design, both internationally and domestically, has been closely shaped by the evolution of information technologies and interaction media. For example, the emergence of adaptive robotic intervention architectures has enabled personalized interaction, making it possible to tailor “guided interaction” and “behavioral control” models to older adults with

varying health and cognitive conditions [22]. Within this process, multimodal interaction methods have been increasingly reinforced, enhancing not only the functionality and usability of interaction design but also endowing it with deeper layers of emotional value [23, 24].

In summary, international research advances value evolution through interdisciplinary integration, whereas Chinese research leverages concentrated strengths in design studies to progressively extend toward emotional and social dimensions. This divergence underscores distinct academic pathways while also pointing to China's potential trajectory for strengthening its technological influence in the global Aging-Centered Interaction Design field: namely, consolidating expertise in interface and experience optimization while further promoting interdisciplinary integration and value expansion, thereby enhancing its leadership capacity within the global research discourse.

Tab 2. Classification of high-frequency keywords

	WOS		CNKI	
1	Technology	Functional value	User Experience	Emotional value
2	Care	Functional value	Interface Design	-
3	Health	-	Product Design	-
4	Acceptance	Emotional value	Interactive Interface	-
5	Human-robot interaction	-	Human-Computer Interaction	-
6	Design	-	Smart Products	-
7	Age	-	Usability	Functional value
8	Smart home	-	Design Strategy	-
9	Behavior	-	Interaction Experience	Emotional value
10	Quality of life	Emotional value	Flow Theory	-

3.3.2 Emergent Keywords and Relational Analysis

To gain an in-depth understanding of the evolutionary trajectory of keywords in the field of Aging-Centered Interaction Design, this study conducts a co-occurrence network analysis and traces the temporal dynamics of high-impact keywords. Emergent terms reflect the rapid rise and frequency shifts of research hotspots within specific periods; thus, the Bursts function in CiteSpace is employed to identify and categorize such emergent keywords. This approach enables a clear mapping of the frontier research domains and their dynamic transitions across different stages of Aging-Centered Interaction Design. By integrating statistical results from the two core databases, WOS and CNKI, this study synthesizes and highlights the ten strongest emergent keywords. From the perspective of temporal distribution, 2018 emerges as a critical turning point, marking the entry of Aging-Centered Interaction Design into a new developmental phase within both domestic and international academic discourses (see Fig. 7).

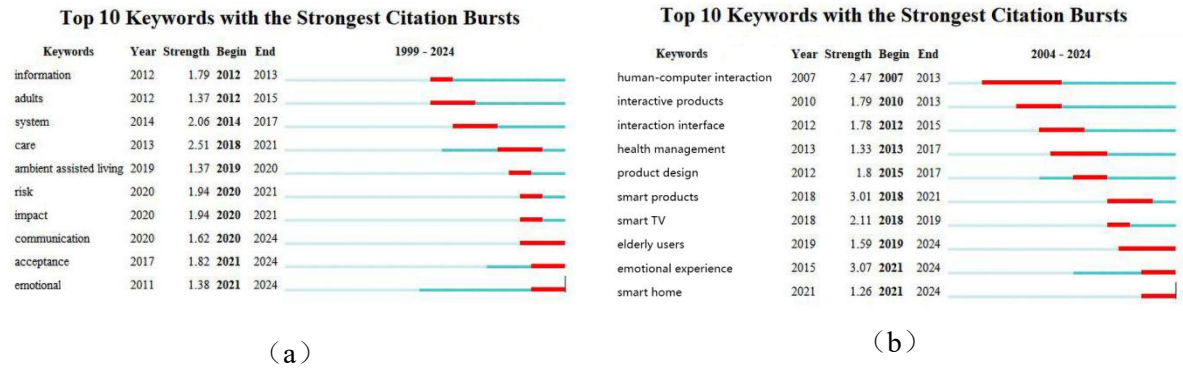

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Figure 7. Keywords with the Strongest Citation Bursts of age-appropriate interaction design research of WOS and CNKI

(a) Web of Science databases；(b) CNKI database

In the WOS emergent keyword mapping, terms between 2007 and 2017 such as “information”, “adults”, and “system” reflected a functional and task-oriented focus on digital technologies. From 2018 to 2023, emergent terms like “communication” and “emotional” indicated a shift toward human-centered care and emotional experience, illustrating the evolution of interaction design values from functional to emotional.

Similarly, the CNKI mapping revealed early emphases (2004–2017) on “human–computer interaction”, “interactive product”, and “health management”, underscoring functional orientation and health-support needs. After 2018, keywords such as “smart products”, “smart home”, and “emotional experience” emerged, showing a move beyond traditional interaction devices toward the exploration of emotional value in intelligent environments.

Both datasets thus highlight 2018 as a watershed in Aging-Centered Interaction Design: earlier stages were dominated by functional values, while later research increasingly foregrounded emotional and humanistic concerns. A key divergence lies in emphasis: WOS focuses on older users’ acceptance and usage behaviors, while CNKI approaches Aging-Centered needs through design methods and technological strategies, aiming to address these demands via intelligent systems and innovation. Together, these trajectories reveal the international depth in user experience studies and China’s breakthroughs in intelligent, design-driven pathways, underscoring China’s emerging technological influence in the global evolution of Aging-Centered Interaction Design.

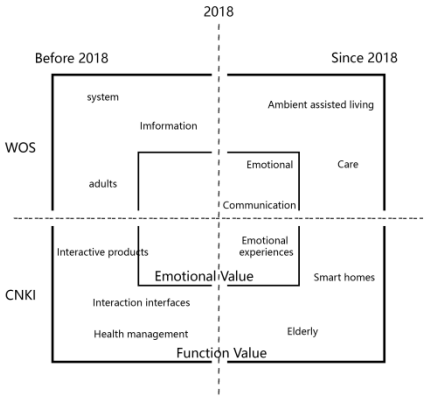

Figure 8. Relationship map of hotspot emerging keywords in WOS and CNKI

4. RESEARCH HOTSPOT EVOLUTION AND DEVELOPMENT CYCLES

4.1 Developmental Cycle and Stage Characteristics of Aging-Centered Interaction Design Research

Based on the visualization of Aging-Centered studies within the lens of interaction design, it is evident that research hotspots have undergone distinct shifts across different phases. However, the preliminary comparison between WOS and CNKI reveals that the overall trends and developmental patterns have not yet been fully elucidated. To further quantify and deepen this evolutionary process, this study employs CiteSpace to conduct timeline visualizations of keywords in both databases. By calculating keyword co-occurrence and burst strength, CiteSpace generates time-based evolutionary maps that illustrate the distribution of research hotspots across different stages. On this basis, the timelines were reorganized to trace the dynamic trajectory of research hotspots through the stages of Exploration—Development—Maturity. Drawing on development cycle theory, the study categorizes the research process into these three stages, and integrates bilingual keyword trends to compare international and domestic research orientations. This approach allows for a more intuitive representation of the overall transformation in Aging-Centered Interaction Design, particularly its transition from functional value toward emotional value and intelligentization (see Figure. 9).

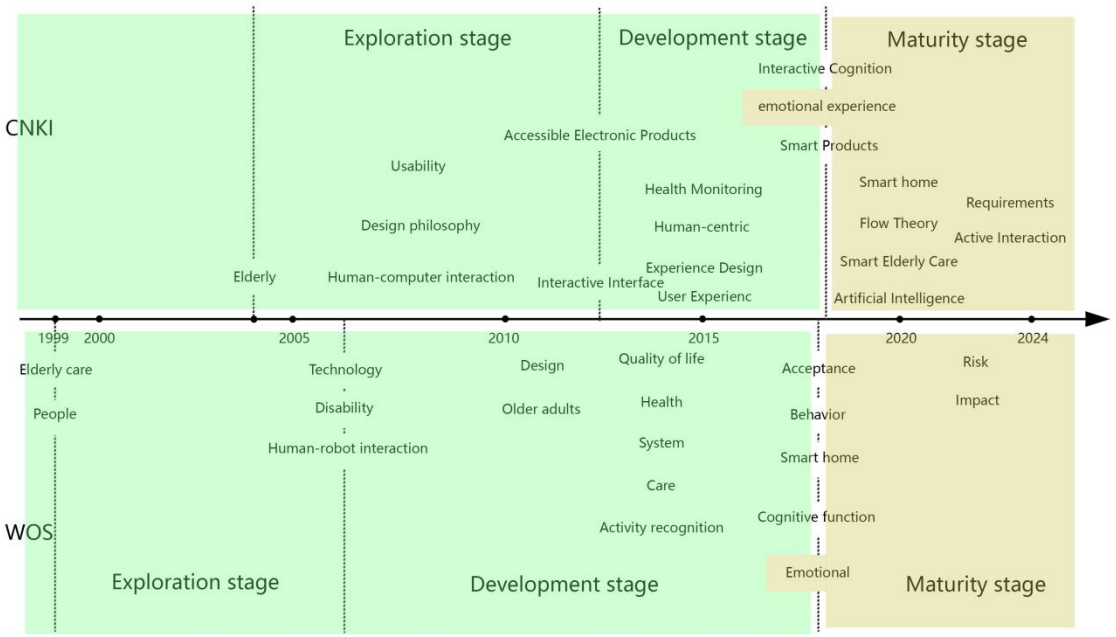

Figure 9. A Developmental Cycle Map of Ageing-Oriented Research within the Paradigm of Interaction Design

During the Exploration stage, WOS (1999–2006) concentrated on fundamental functional issues in Aging-Centered Interaction Design, tending to address meta-level questions within the field. By contrast, CNKI's exploration period (2004–2012) was anchored in "Usability," with greater emphasis on design ontology, highlighting the academic value of a function-oriented paradigm.

In the Development stage, WOS (2007–2018) gradually extended beyond basic functional satisfaction, shifting toward humanistic care centered on the intrinsic needs of older adults. This reflects the value transition from "functional efficiency" to "human experience." Meanwhile, CNKI (2013–2018) focused on themes such as "User Experience," "Experience Design," "Humanization," and "Health Monitoring." While still aimed at enhancing the functional value of interaction design, these studies increasingly emphasized user-centered adaptability, reflecting the Chinese academic community's explorations in technical pathways and methodological approaches.

In the Maturity stage, both WOS and CNKI entered a period of rapid development after 2019. With the rise of artificial intelligence and smart products, Aging-Centered Interaction Design research began to transcend conventional frameworks, gradually shifting toward holistic human–environment–technology interactions. This stage foregrounded the agency of older users and emphasized emotional value. Consequently, Aging-Centered Interaction Design was no longer limited to efficiency and functional optimization but increasingly highlighted human care, emotional experience, and social value, revealing a convergence of international and Chinese research agendas.

Overall, the three-stage evolution demonstrates areas of overlap between WOS and CNKI. Notably, around 2018, the focus of Aging-Centered Interaction Design shifted globally from functional value to emotional value. This turning point not only reflects a broader value transformation within the international academic community but also suggests that, as barriers to academic exchange and technological development gradually diminish, China is aligning its research influence with global trends while contributing localized strengths in technology and design methodologies.

4.2 Value Transition and Driving Forces in the Development of Aging-Centered Interaction Design

Nevertheless, Figure 9 further underscores that the evolution of Aging-Centered Interaction Design within the lens of interaction design is not driven by a single factor. Instead, it emerges from the combined influence of demand-driven, product-driven, technology-driven, and policy-driven forces. These drivers both reflect the profound impact of societal issues on lifestyles and continuously stimulate new research topics and practical directions. To more intuitively illustrate the shifting value orientations

and research logics across stages, Figure 10 was developed based on the classification framework in Table 2. In this figure, color differentiation is applied: light blue represents keyword clusters focused on functional implementation and operability, while light orange represents clusters oriented toward subjective experience and multidimensional values centered on emotions. Through this layered color coding, the study clarifies the evolutionary logic, namely the progression from functional value toward multidimensional, emotion-centered value.

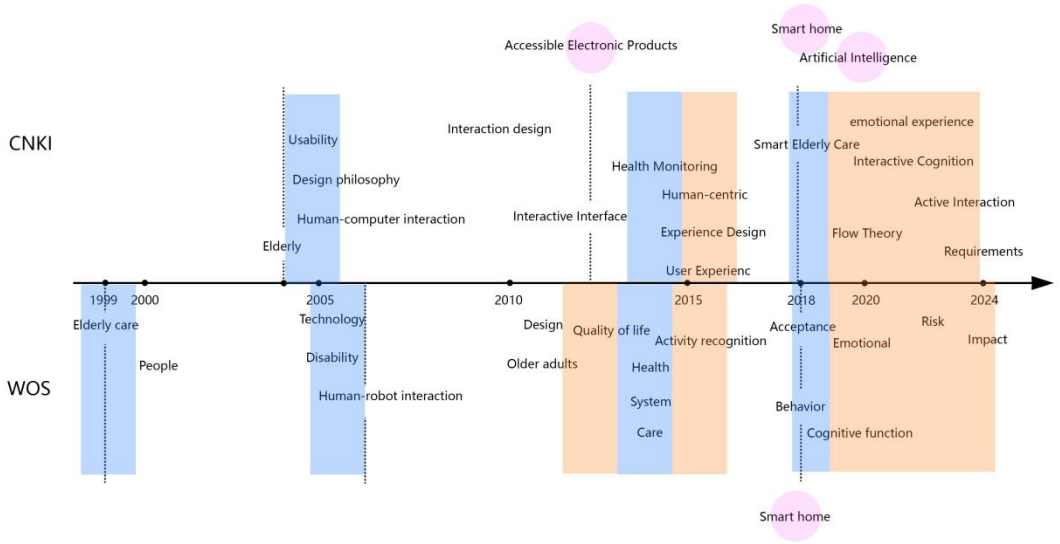

Figure 10. Development Path Diagram of Ageing-Oriented Research within the Paradigm of Interaction Design

In both the WOS and CNKI databases, early Aging-Centered studies in interaction design were predominantly oriented toward "functional value," with emphasis on technical usability and system implementation. As the field matured, particularly from the mid-2010s onward, emerging keywords such as emotion, user experience, and acceptance reflected a growing concern with users' subjective perceptions. This shift became more pronounced around 2018 with the surge of concepts such as smart home and artificial intelligence, indicating a research transition from a purely functional focus toward multi-dimensional value frameworks encompassing emotional experience. This trajectory echoes Norman's (2007) classical proposition that product development should move beyond functional utility to address emotional needs [32].

It is noteworthy that the year 2018 marks a conspicuous paradigm shift in the development trajectory of aging-centered interaction design. This turning point is reflected not only in the significant changes in research volume and thematic focus, but also in its close association with technological advancements and evolving sociocultural contexts. A review of field reports and literature indicates a representative external driving force: the transition of intelligent interaction technologies into a more emotionally oriented stage, which broadened the core concerns of design.

Since 2018, intelligent voice interaction systems, exemplified by Google Duplex, have demonstrated a more advanced level of natural conversation, enabling machines to convey politeness, emotional responses, and social cues such as tone and pauses—thus breaking away from the traditional command-based interaction paradigm [33]. Meanwhile, augmented reality platforms such as Apple ARKit 2 have facilitated more immersive, contextually grounded, and narrative-driven interactive experiences [34], shifting interface design from mere "task execution" toward "emotional resonance" and "experience shaping." For older adults, these enhanced emotional expression capabilities significantly improve interaction comfort and foster stronger trust in technology, making emotional care an increasingly essential dimension of aging-centered design.

While the mapping provides clear evidence of research evolution, its limitations must be acknowledged. Differences in database coverage reduce cross-disciplinary comparability; synonym inconsistencies may generate noise; and CiteSpace's burst-detection remains sensitive to time-slice settings, suggesting that turning points (e.g., 2018) require triangulation with multiple indicators. Consequently, the present

discussion emphasizes overall trends and value evolution, rather than absolute assertions tied to a single temporal marker.

5. CONCLUSION AND PROSPECTS

Drawing on the core databases of WOS and CNKI, this study employed CiteSpace to conduct a visualization analysis of Aging-Centered interaction design across four dimensions: publication volume, research institutions, research hotspots, and developmental cycles. The findings reveal a clear trajectory of value evolution in the field, shifting from a function-oriented paradigm toward a multi-dimensional framework emphasizing emotional value. This transformation highlights the underlying logic of value transition in interaction design under the conditions of an aging society.

International research tends to address the intrinsic challenges faced by older users, placing stronger emphasis on humanistic care, dignity, and user experience. Such approaches have led to thematically diverse and conceptually coherent research agendas. In contrast, although Chinese scholarship entered this domain later, it has rapidly gained momentum, achieving advantages in both publication volume and citation frequency. This progress not only narrows the gap with global scholarship but also begins to shape the international discourse system. However, Chinese research remains largely characterized by a "technology – design driven" model, with a strong focus on methods and technological solutions, while relatively underexploring dimensions of humanistic value and social participation. This imbalance risks constraining the broader developmental trajectory of the field.

To move forward, Aging-Centered interaction design in China must return to fundamental questions of human dignity, emotional well-being, and social integration, balancing technological innovation with user-centered values. Such a reorientation requires shifting beyond efficiency and functionality to embrace holistic concerns of care, respect, and empowerment. By aligning intelligent innovation with humanistic and sustainable design principles, Chinese scholarship holds the potential to exert a more leading influence in shaping the global paradigm of intelligent and sustainable design, offering both theoretical insights and practical guidance for addressing the challenges of population aging and for fostering a more inclusive society.

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