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Factors Influencing the Implementation of Computerized Cognitive Training in Chinese Community-Dwelling Elderly: A Qualitative Study

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Abstract

Background: Computerized cognitive training (CCT) has shown potential in preserving cognitive function among older adults. However, its implementation in Chinese community settings remains limited, and little is known about the experiences and perceptions of community-dwelling elderly regarding difficulty-adaptive CCT.

Objective: To characterize factors influencing the implementation of difficulty-adaptive computerized cognitive training in Chinese community-dwelling elderly.

Methods: A descriptive phenomenological qualitative study was conducted using semi-structured interviews with 14 community-dwelling elderly who had completed a 6-week difficulty-adaptive CCT program at four communities in Beijing between June 2017 and January 2018. Data were analyzed using Colaizzi's seven-step phenomenological analysis method. Two researchers independently coded the transcripts, with disagreements resolved through discussion with a qualitative research expert. Member checking was conducted with four participants to verify the accuracy of findings.

Results: Four main themes were extracted: (1) Positive experiences, including perceived improvement in cognitive function and mood; (2) Facilitators and barriers to training participation, with facilitators comprising dementia care experience, higher educational attainment, and availability of free time, and barriers including unfamiliarity with computer operation, low awareness of cognitive training, and lengthy training sessions; (3) Training content preferences, reflecting a desire for both relaxed, engaging content and professional guidance; and (4) Practical dilemmas and suggestions, including difficulties in understanding task instructions and complex login procedures, with recommendations for detailed task descriptions and simplified procedures.

Conclusion: Community-dwelling Chinese elderly showed good acceptance of difficulty-adaptive CCT, particularly those with higher educational levels. To facilitate broader implementation, training systems should optimize task instructions, simplify login procedures, enrich training content, and accommodate the diverse needs and circumstances of older adults. The findings provide practical insights for the design and delivery of community-based cognitive interventions in China.

Background

Population aging is a global public health challenge, and maintaining cognitive function in later life is central to healthy aging. Cognitive decline in older adulthood is associated with loss of independence, reduced quality of life, and increased burden on families and healthcare systems [1, 2]. Computerized cognitive training (CCT) has emerged as a promising non-pharmacological approach for preserving cognitive function and delaying age-related cognitive decline [3, 4]. Among various CCT paradigms, difficulty-adaptive training—which adjusts task difficulty in real time based on individual performance—has attracted growing research attention because it provides appropriately calibrated cognitive challenge [5, 6].

Despite evidence supporting the potential benefits of difficulty-adaptive CCT for cognitive health, its adoption in community settings in China has historically been limited. Several factors may contribute to this gap: under-recognition of Alzheimer's disease and cognitive impairment among the general public; most existing CCT systems in China are designed for individuals with cognitive impairment or are imported from abroad, with few mature systems tailored to cognitively healthy community-dwelling elderly; and computer use remains insufficiently widespread among older adults in many communities, creating practical barriers to CCT implementation.

The CCT system used in this study was developed by overseas brain scientists and clinicians in collaboration with Chinese partners. It is a professional brain cognitive training system that integrates findings from cognitive neuroscience research on brain functional and structural networks, as well as clinical research on patients with various cognitive disorders. The system incorporates internet and big data technology, enabling real-time online personalized adaptive training based on the individual profile of each user, and is suitable for use in community and home settings.

To date, research on CCT in China has focused predominantly on quantitative studies of intervention effects [7–9], while qualitative studies exploring the lived experiences, perceptions, and practical challenges of older adults using CCT are scarce. Understanding the subjective experiences of end users is essential for identifying barriers to implementation and optimizing training systems for broader community uptake. Therefore, this study employed qualitative research methods and semi-structured interviews to explore the experiences of community-dwelling elderly using difficulty-adaptive CCT, with the aim of providing evidence for the design and implementation of effective cognitive interventions in Chinese community settings.

Methods

Study design

This study employed a descriptive phenomenological qualitative design using face-to-face semi-structured interviews. Phenomenology seeks to understand the lived experience of individuals regarding a specific phenomenon—in this case, the experience of using difficulty-adaptive CCT among community-dwelling elderly. The study was reported in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist [10].

Participants and setting

Participants were recruited between June 2017 and January 2018 from four communities in Beijing using convenience sampling. Eligible participants were aged 60 years or older, had completed a 6-week difficulty-adaptive CCT program, and were able to communicate effectively. Inclusion criteria were: (1) age ≥ 60 years; (2) cognitively intact, defined as Montreal Cognitive Assessment (MoCA, Beijing version) score ≥ 26 for those with > 12 years of education, or ≥ 25 for those with ≤ 12 years of education; (3) good

communication and expression skills; (4) access to internet-enabled electronic devices (desktop computer, laptop, or tablet) at home, in the community, or in an elderly apartment; (5) stable health status in the past three months with independent activities of daily living; and (6) voluntary participation with written informed consent. Exclusion criteria were: (1) history of neurological or psychiatric illness; (2) severe visual or hearing impairment; (3) use of medications affecting cognitive function; and (4) serious physical illness preventing continued participation in training.

Sample size was determined by information saturation—the point at which no new themes or concepts emerged from subsequent interviews. Saturation was achieved after the 12th interview, and two additional interviews were conducted to confirm saturation, yielding a final sample of 14 participants.A total of 14 participants were enrolled in this study, with a mean age of 71.35 years old. Demographic characteristics of participants are presented in Table 1.

Table 1
General information about interviewees(n = 14)

ID	Age	Gender	Education	Marital status	Residence status
A	69	female	15	married	community
B	67	female	15	married	community
C	73	female	12	married	community
D	81	female	12	widow	apartment
E	66	female	9	married	community
F	69	female	15	divorce	apartment
G	66	male	15	married	community
H	76	female	15	married	community
I	72	male	15	widower	community
J	62	male	15	married	community
K	79	female	9	widow	apartment
L	68	male	12	married	community
M	80	female	15	married	community
N	71	female	15	divorce	apartment

Researcher reflexivity

The research team consisted of seven members: one qualitative research specialist (PhD, Professor), three qualitative research specialists (Master's degree, Associate Professor), and three nursing graduate

students who had completed one year of qualitative research coursework. The primary interviewer was a female nursing graduate student with training in qualitative interviewing methods. The interviewer had no prior relationship with the participants before the study and maintained a neutral, non-judgmental stance throughout the interviews. The interviewer's disciplinary background in nursing and prior coursework in gerontological nursing informed the development of the interview guide and the interpretation of findings, while regular team discussions and peer debriefing helped mitigate individual bias. Field notes documenting non-verbal cues, contextual observations, and the interviewer's reflective comments were recorded during and after each interview.

Interview guide

A semi-structured interview guide was developed based on the research objectives and a review of relevant domestic and international literature. The initial guide was reviewed and refined through discussion by the research team. The main questions were: (1) Do you feel that the computerized cognitive training system you used during this period has been helpful to you? (2) What changes do you think cognitive training has brought to your life? (3) What difficulties have you encountered in using the training system, and how did you resolve them? (4) What do you think should be done to further promote this system among the elderly population in Chinese communities? Probes and follow-up questions were used flexibly to explore participants' responses in depth.The detailed interview guide is presented in Additional file 1.

Data collection

Before each interview, the purpose, significance, methods, and potential benefits and risks of the study were explained in detail to each participant. Participants were informed of the principles of voluntariness and confidentiality, and that they could withdraw from the study at any time without penalty. Written informed consent was obtained from all participants prior to the interview. Interviews were conducted in a quiet, private interview room at a time mutually agreed upon with the participant. During the interview, participants were encouraged to fully express their feelings and ideas. The interviewer maintained a neutral attitude throughout, observed and recorded participants' tone, movements, expressions, and facial expressions in real time, and audio-recorded the entire interview with permission. Each interview lasted 20 to 30 minutes.

Data analysis

Interviews were transcribed verbatim within 24 hours by the interviewer. Transcripts were checked by a second investigator to ensure accuracy and completeness. Data were analyzed using Colaizzi's seven-step phenomenological analysis method [11]: (1) reading and re-reading all interview materials to gain a sense of the whole; (2) extracting significant statements that pertain to the phenomenon under study; (3) formulating meanings from the significant statements; (4) organizing formulated meanings into clusters

of themes, theme groups, and categories; (5) providing an exhaustive description of the phenomenon, linking themes back to the research question; (6) describing the fundamental essential structure of the phenomenon; and (7) returning the results to participants to verify the authenticity and accuracy of the content (member checking).

Two researchers independently analyzed and coded the interview transcripts. Disagreements were discussed and resolved with the assistance of a qualitative research expert. Member checking was conducted with four participants, who confirmed that the findings accurately reflected their experiences. No qualitative analysis software was used; coding and theme development were conducted manually, with all codes and thematic structures documented in written form for audit purposes.

Rigor and trustworthiness

The trustworthiness of the findings was established using Lincoln and Guba's four criteria [12]: (1) Credibility was enhanced through prolonged engagement, persistent observation, triangulation of two independent coders, peer debriefing among the research team, and member checking with four participants; (2) Transferability was supported by thick description of the study context, participant characteristics, and findings, enabling readers to assess the applicability of results to other settings; (3) Dependability was ensured through an audit trail documenting all analytical decisions, coding structures, and team discussions; and (4) Confirmability was promoted by bracketing researcher assumptions through reflexive journaling and by grounding all interpretations in participants' own words.

Ethical considerations

This study was approved by the Biomedical Ethics Committee of Peking University (approval number: 17045). All participants provided written informed consent prior to participation. Audio recordings and transcripts were stored securely and de-identified to protect participant confidentiality. Participants were assigned alphabetical codes (A through N) in all transcripts and publications.

Results

Fourteen community-dwelling cognitively healthy elderly who had completed a 6-week computerized cognitive training program participated in semi-structured interviews. Data analysis using Colaizzi's seven-step method yielded four main themes and multiple sub-themes. The essential structure of the phenomenon—community-dwelling elderly's experience of using difficulty-adaptive CCT—can be described as follows: older adults approach CCT with varying levels of awareness and digital literacy; those who engage with it perceive benefits in cognitive function and emotional well-being; their sustained participation is shaped by personal motivation (dementia care experience, education, free time) and practical barriers (computer skills, task comprehension, time constraints); and they desire

training that is simultaneously engaging and professionally grounded, with simplified operational procedures. This essential structure integrates the four themes described below.

Theme 1: Positive experiences

Sub-theme 1.1: Perceived improvement in cognitive function

Participants who experienced the benefits of training expressed greater willingness to persist. Perceived cognitive improvements included faster reaction times, a more flexible mind, improved concentration, better memory, and enhanced hand-brain coordination. Participant L stated: "I think doing this exercise can train the brain; my brain reacts faster than before, not as wooden as it used to be." Participant J remarked: "It's helpful, very helpful. I just enjoy doing it. The games require the combination of hand, eye, and brain; you have to concentrate. It's good for the brain. I sometimes do it for more than an hour each time."

Sub-theme 1.2: Improvement in mood

Participants noted that cognitive decline could bring about adverse emotional reactions such as anxiety and depression, and that CCT helped alleviate such negative emotions. Participant D shared: "This training system makes a lot of sense. I feel my memory is fading, and when I think about it, I feel bad. This training makes me feel better because I have a goal every day." Participant F said: "I used to live a retired life, just watching my children do housework at home, with no chance to use my brain. Now I have this training system; I do it every day, it's become a habit. I'm focused and I'm in a good mood."

Theme 2: Facilitators and barriers to training participation

Sub-theme 2.1: Facilitating factors

Dementia care experience. Participants who had relatives or friends with dementia, or who had cared for individuals with dementia, or who had seen media reports about dementia, were more acutely aware of the burden that the disease imposes on individuals, families, and society. They were therefore more motivated to seek preventive measures. Participant A stated: "My mother had Alzheimer's disease. In the last few years, we took turns caring for her. It was really hard for her and for us. I'm worried that I'll become like that in the future. I don't want that. I want to improve my memory through training." Participant E said: "A friend of mine in his 60s no longer recognizes people—it's terrifying. Just a few years ago he was only a little forgetful, intermittent, sometimes fine. I didn't expect this. I can't accept being like that, and I have to prevent it. That's the main purpose of this training; I want to exercise my brain."

Higher educational attainment. Participants with higher education pursued a higher quality of life and were more attuned to changes in their own cognitive function. They noticed cognitive changes earlier

and sought ways to address them through knowledge. Their educational background also enabled them to accept new cognitive training methods and concepts more readily. Participant M noted: "I paid attention to cognitive decline quite early. Before, I insisted on brain training every day using my own methods. Now that you've provided me with such a good platform, I'll make good use of it and live up to the expectations of the research team." Participant G said: "Now that science and technology have advanced, it's possible to do cognitive exercise without leaving home. Thank you for this new method. I've practiced every day during this period, and now I still want to continue exercising my brain."

Availability of free time. Participants with sufficient free time were generally more willing to participate in cognitive training. Participant F stated: "I'm retired here, with nothing to do, living alone. There's plenty of free time. If you're old and idle, doing this really exercises the brain." Participant K remarked: "My purpose for doing this is very simple. What could happen if I stayed in this elderly apartment? Three meals, noon nap, and so much time for other activities with nothing to do. It would be nice to do this as a way to find something to do."

Sub-theme 2.2: Barrier factors

Unfamiliarity with computer operation. Low frequency of computer use among older adults led to insufficient operational skills, affecting the fluency of training. Participant A shared: "I didn't use the computer often before. I didn't know there were so many advertisements on the computer now. I remember just starting the first task, and something popped up—you couldn't close it, you had to wait for it to disappear, several minutes. I got impatient and didn't want to persist." Participant D said: "It also has to do with your computer equipment. My computer is older, it's just slow. So I click and it doesn't respond. I'm not skilled, and it responds slowly—then you say there's no point."

Low awareness of cognitive training. Some participants had a limited understanding of cognitive training, regarding it more as a game or pastime rather than recognizing its importance. Participant G stated: "I just take it as a task, play it every day, and then it's over." Participant M remarked: "I thought it was a game. I thought it was a game anyway."

Lengthy training sessions. As people age, attention span tends to shorten. Additionally, some participants undertook household responsibilities and could not dedicate concentrated time to training. Participant H said: "I don't have a whole block of time. Sometimes there are so many things, I really don't have that long to practice. Several times a day, each within 10 minutes, is possible." Participant J noted: "It takes up too much time. I have to pick up my child and do housework. I can't finish housework every day."

Theme 3: Training content preferences

Sub-theme 3.1: Relaxed and engaging

Participants appreciated the vivid colors, appropriate text size, accompanying music, reward mechanisms for good performance, and life-related, relaxed training content. These design elements

increased their interest in continuing participation. Participant B stated: "Doing this training is like playing a game—it's easy, a pastime. Every time I get a high score, there are fireworks. It's fun." Participant N said: "I'm over 70 years old. I want to do easy and simple training. Training that's too complicated to understand becomes a burden, and I don't want to bother with it."

Sub-theme 3.2: Professional

Participants reported a lack of reliable ways to improve cognitive function in daily life and concerns about being deceived. When professional training guidance was available, they were more willing to participate. Participant H noted: "The training program was interesting, well designed, more professional than the games I used to play. It allowed us to train in relaxed games, enjoy doing it, never miss a day—and if we didn't do it, we felt like we'd lost something." Participant C stated: "Because you are professional and have professional equipment, I am willing to participate. After you get used to it, you want to do it every day; if you don't, you feel uncomfortable."

Theme 4: Practical dilemmas and suggestions for improvement

Sub-theme 4.1: Difficult-to-understand task instructions and need for detailed descriptions

Participants reported that age-related decline in comprehension led to errors during training, confusion, and wasted time and energy. They suggested refining task requirement descriptions to save time and improve efficiency. Participant K shared: "Simple games can be understood at the beginning, but complicated game instructions are not understood—I almost gave up. As we get older, our understanding isn't what it used to be. Some slightly more complicated topics can't be understood. I suggest that the task requirements be more detailed or add voice explanations." Participant I said: "I can't understand some of the questions, such as the 'eastern family banquet' game. There are other games that I try to play a few times to figure out the pattern. But if I keep making mistakes, it's a little frustrating. I hope the system will reinforce that."

Sub-theme 4.2: Complex login procedures and need for simplification

Participants reported that the login procedure was somewhat complex, requiring entering a web address first, after which a login page with account number and password would pop up automatically. Although electronic devices can store the web address, the 4-digit account number and password were difficult for some participants to remember. Participant F stated: "Most of the time, I still forget the login number and password. Sometimes I need to use WeChat to ask you whether the login procedure can be simplified. Old people are afraid of trouble. Every time having to enter those numbers is too troublesome to remember. Can you log in once and not have to log in again, directly entering?" Participant C remarked: "Although the number and password were recorded at that time, the paper record can't be remembered

anywhere. Old, can't remember anything. Can you consider the real situation of elderly people at my stage and set up a simpler procedure?"

Discussion

This qualitative study explored the experiences of community-dwelling Chinese elderly using difficulty-adaptive CCT and identified factors influencing its implementation. Four main themes emerged: positive experiences (cognitive and emotional benefits), facilitators and barriers to participation, training content preferences, and practical dilemmas with improvement suggestions. The findings suggest that community-dwelling elderly generally have good acceptance of difficulty-adaptive CCT, particularly those with higher educational attainment, but that several practical and systemic factors need to be addressed to facilitate broader implementation.

Positive experiences: cognitive and emotional benefits

Participants in this study reported perceived improvements in cognitive function, including faster reaction times, improved concentration, better memory, and enhanced hand-brain coordination. These subjective reports are consistent with quantitative evidence from previous studies showing that CCT can improve cognitive performance in community-dwelling older adults [5, 13, 14]. The perception of cognitive benefit appeared to be an important motivator for continued participation, consistent with the principle that perceived self-efficacy and outcome expectations influence health behavior adherence [15].

Participants also reported improvements in mood, including reduced anxiety and depression and an increased sense of purpose. This finding aligns with previous research suggesting that CCT can have beneficial effects on emotional well-being in older adults [16, 17]. The relationship between cognitive function and mood is bidirectional: cognitive decline can lead to negative emotions, while improved mood may in turn support cognitive engagement and function [18]. The daily structure and goal-oriented nature of CCT may also contribute to emotional well-being by providing a sense of routine and achievement, particularly for participants living alone or with limited social engagement.

Facilitators and barriers: a multi-level perspective

The facilitators identified in this study—dementia care experience, higher educational attainment, and availability of free time—highlight the role of personal motivation, health literacy, and opportunity in shaping participation. Participants with dementia care experience demonstrated a particularly strong preventive orientation, consistent with the Health Belief Model, in which perceived susceptibility and severity of a health condition motivate preventive action [19]. Higher educational attainment was associated with greater awareness of cognitive decline and willingness to adopt new technologies, consistent with the well-documented relationship between education and cognitive reserve [20].

The barriers identified—unfamiliarity with computer operation, low awareness of cognitive training, and lengthy training sessions—point to practical and educational challenges that must be addressed for broader implementation. Digital literacy remains a significant barrier for many older adults in China, particularly those with lower education or limited prior computer experience [21]. The finding that some participants regarded CCT as merely a game underscores the need for targeted health education to communicate the purpose and value of cognitive training. The preference for shorter, more flexible training sessions has practical implications for program design, particularly for community-dwelling elderly with household responsibilities. Previous research has suggested that training dose matters for cognitive benefit [22, 23], and future programs should explore flexible scheduling options—such as multiple short sessions per day—that accommodate participants' lifestyles while maintaining adequate training dose.

It is noteworthy that participants' living arrangements (community dwelling versus elderly apartment) influenced their available time and training patterns. This finding suggests that implementation strategies should be tailored to the specific living contexts of older adults, rather than adopting a one-size-fits-all approach.

Training content preferences: balancing engagement and professionalism

Participants expressed a desire for training content that was simultaneously relaxed/engaging and professional. This apparent duality reflects the need for CCT systems to be both motivating (through game-like elements, rewards, and enjoyable content) and credible (through professional design, evidence-based tasks, and clear linkage to cognitive health). This finding is consistent with the concept of "serious games"—games designed for purposes beyond entertainment—which have shown promise in health behavior change and cognitive training [24]. The challenge for developers is to maintain professional rigor while ensuring that the user experience is accessible and enjoyable for older adults with varying levels of digital literacy and cognitive function.

Practical dilemmas: task comprehension and login procedures

The difficulties participants encountered with task instruction comprehension and login procedures are concrete, modifiable barriers that directly affect training adherence. Age-related declines in processing speed, working memory, and comprehension can make written instructions difficult to follow, particularly for complex or novel tasks [25]. The suggestion to add voice explanations is particularly relevant, as older adults often benefit from multi-modal information presentation. The complexity of login procedures—including remembering account numbers and passwords—represents a fundamental usability issue that can create frustration and dropout before training even begins. Simplified login options, such as biometric authentication, one-click access, or caregiver-assisted setup, should be explored in future system iterations.

These practical barriers are particularly important because they are amenable to intervention through system design and user support. Unlike factors such as educational attainment or prior dementia care experience—which are difficult to modify—task instruction clarity and login simplicity can be directly improved by developers and implementers. Addressing these issues may be one of the most cost-effective ways to improve CCT uptake and adherence in community settings.

Limitations

Several limitations of this study should be acknowledged. First, convenience sampling was used, and all participants were recruited from four communities in Beijing, which may limit the transferability of findings to other regions of China, particularly rural areas or smaller cities where computer access and digital literacy may differ. Second, the sample comprised participants who had completed a 6-week CCT program; individuals who dropped out of training were not interviewed, which may have resulted in an overrepresentation of positive experiences and an underrepresentation of barriers that led to dropout. Future studies should include the perspectives of dropouts to gain a more complete understanding of implementation challenges.

Third, the sample was relatively small (n = 14) and comprised predominantly participants with higher educational attainment, which may limit the generalizability of findings to older adults with lower education or limited digital literacy. Fourth, as a cross-sectional qualitative study conducted after training completion, the findings reflect participants' retrospective perceptions and may be subject to recall bias. A longitudinal qualitative design capturing experiences during training could provide richer, more nuanced insights.

Fifth, while member checking was conducted with four participants, the relatively small number of participants involved in verification may limit the confirmability of findings. Sixth, the primary interviewer was a graduate student, and while trained in qualitative methods, the depth of probing and rapport-building may have differed from that of an experienced qualitative researcher. Finally, the study did not explore the perspectives of family members, caregivers, or community workers, whose roles in supporting CCT implementation may be significant. Future research should adopt a multi-stakeholder approach to gain a more comprehensive understanding of implementation factors.

Conclusion

This qualitative study explored the experiences of 14 community-dwelling Chinese elderly using difficulty-adaptive CCT and identified four main themes: positive experiences (cognitive and emotional benefits), facilitators and barriers to participation, training content preferences, and practical dilemmas with improvement suggestions. Community-dwelling elderly showed good acceptance of difficulty-adaptive CCT, particularly those with higher educational levels. To facilitate broader implementation in Chinese community settings, training systems should optimize task instructions (including voice explanations), simplify login procedures, enrich and diversify training content, and accommodate the diverse needs, digital literacy levels, and lifestyle circumstances of older adults. The findings provide

practical insights for the design, refinement, and delivery of community-based cognitive interventions, and underscore the importance of user-centered design in making CCT accessible and effective for a growing elderly population.

Declarations

Ethics approval and consent to participate

This study was approved by the Biomedical Ethics Committee of Peking University (approval number: 17045). All participants provided written informed consent prior to enrolment. The study was performed in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

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Author Contribution

GY.HJ conceived and designed the study, conducted semi-structured interviews, performed qualitative data analysis and drafted the manuscript; F.W. and MM.S. participated in data collection and data coding; M.W. supervised the whole research process and critically revised the manuscript. All authors read and approved the final manuscript.

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Data Availability

The raw interview transcripts contain identifiable personal information of participants. Therefore, the raw qualitative data cannot be publicly shared in order to protect participants' confidentiality and privacy. Reasonable requests for partial de-identified data may be addressed to the corresponding author upon valid request.

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Supplementary Files

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