Voice Assistants to Deliver Cognitive Stimulation Therapy for Persons Living with Dementia

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Abstract

Dementia is a global public health concern, with approximately 55 million individuals worldwide currently living with it. Individual cognitive stimulation therapy (iCST) has been shown to improve quality of life for persons living with dementia (PLwDs). However, providing iCST at scale remains a serious challenge, specifically as it can add considerable burden on care partners. This project focuses on a voice assistant (VA) to support care partners in delivering iCST. We developed a VA prototype and conducted a qualitative study with care partners (N=5). Our preliminary findings show that using a VA to deliver iCST is feasible and acceptable. We have also identified design requirements for the VA to effectively provide iCST, including need for personalization reflecting dementia severity and individual interests, collaboration between care partners and PLwDs, and accessible interactions to minimize frustration and distress. These findings can inform the future design of inclusive and accessible VAs.

CCS Concepts

• **Human-centered computing** → **Empirical studies in collaborative and social computing**; • **Applied computing** → **Health informatics**.

Keywords

Dementia, voice assistant, cognitive stimulation therapy, LLMs

ACM Reference Format:

Ling Qiu, Ita Daryanti Saragih, Donna Marie Fick, S. Shyam Sundar, and Saeed Abdullah. 2025. Voice Assistants to Deliver Cognitive Stimulation Therapy for Persons Living with Dementia. In *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems (CHI EA '25), April 26–May 01, 2025, Yokohama, Japan.* ACM, New York, NY, USA, 7 pages. https://doi.org/10.1145/3706599.3719707

CHI EA '25, Yokohama, Japan

ACM ISBN 979-8-4007-1395-8/25/04
https://doi.org/10.1145/3706599.3719707

1 Introduction

More than 55 million individuals worldwide are affected by dementia in 2024, with approximately 10 million new cases being diagnosed each year [1]. Dementia is characterized by impairments in language, memory, and cognition, as well as difficulties in completing daily activities [2]. Persons living with dementia (PLwDs) living at home benefit from varying levels of support from family caregivers to maintain their daily routines[20]. However, providing this support can be demanding for family care partners, who may experience stress, burnout, anxiety, and depression [8].

There is currently no cure for dementia. As a result, clinical treatments focus on effective management of symptoms and delaying cognitive decline. In recent years, individual Cognitive Stimulation Therapy (iCST) has emerged as a key non-pharmacological intervention to support cognitive function in PLwDs [27]. Recent work shows that iCST can improve quality of life for PLwDs as well as strengthening relationships between PLwDs and their care partners [6]. However, providing iCST to individuals in need remains challenging, as care partners must dedicate time to delivering the activities while also tailoring the content to suit individual's interests, preferences, and abilities. This can add considerable burden for care partners. Orrell et al. [15] found that only 40% of participants completed at least two iCST sessions per week, with 22% not participating at all. Such low adherence can undermine the efficacy of iCST and consequently, lead to non-optimal outcomes [15].

To address this serious public health need, this paper focuses on designing voice assistants (VAs) to deliver iCST at scale. Voice interaction is well-suited for iCST activities, as it uses interactive conversations for different activities [15]. Moreover, voice interactions can be more accessible for older adults who can be less familiar with digital tools [5, 18]. In addition, recent advances in large language models (LLMs) enable VAs to be highly adaptable and flexible, which can lead to better support for PLwDs who might struggle with communication. While prior work has focused on assistive technologies for dementia [16, 17, 24], there is a knowledge gap regarding the feasibility and acceptance of using LLM-powered VAs to support care partners for delivering iCST. We aim to address this gap by focusing on the following two research questions:

- RQ1: What is the acceptance and feasibility of using a VA to deliver iCST?
- RQ2: What are the design requirements for a VA to effectively deliver iCST while reducing care partner burden?

To explore these questions, we developed a LLM-powered prototype VA using Amazon Alexa. We conducted five semi-structured interviews with care partners of PLwDs. Participants first interacted with the prototype and then provided feedback on multiple aspects, including program content, usability for PLwDs, the role of care partners in supporting usage, and potential concerns about privacy and security. Our data show that care partners found using a VA to deliver iCST to be feasible and acceptable. They believed that VA interactions may improve PLwDs' cognitive stimulation and enhance connections between care partners and PLwDs. However, care partners also raised concerns about trustworthiness and security of VAs. They also emphasized the importance of personalizing sessions to reflect dementia severity and PLwD interests.

Care partners worried that PLwDs' cognitive impairments could hinder their ability to practice iCST alone, and suggested that collaboration between PLwDs and care partners could enhance usability, engagement, and shared quality time. They also provided suggestions for improving adoption and engagement, including making the VA more accessible, offering guidelines for care partners, ensuring that sensitive content is managed appropriately, and incorporating visual stimulation. These preliminary findings can lead to more accessible and inclusive VA design to better support PLwDs and their care partners.

2 Background

2.1 Individual Cognitive Stimulation Therapy

Dementia leads to a progressive deterioration in cognitive and functional skills, significantly affecting the wellbeing and life quality of persons living with dementia (PLwDs) and their care partners. There is no known cure for dementia. Cognitive Stimulation Therapy (CST) is recognized as one of the most effective interventions for maintaining cognitive functioning of PLwDs [21]. Individual Cognitive Stimulation Therapy (iCST) is an extension of CST that is usually done at home by a care partner. Example activities include reminiscences (e.g., discussing an old photo) and number games (e.g., matching products with their prices) [26]. Sustaining the positive effects of iCST over time requires continuous practice, engagement, and the customization of activities [15]. However, the implementation of iCST imposes a significant burden on the caregivers, which can lead to low adherence and engagement[11] and then lead to suboptimal results of iCST. A recent study found that only 40% of participants completed at least two sessions per week, and 22% did not complete any sessions at all [15].

To address these challenges, Rai et al. developed an iCST application for touchscreen tablets [19]. The iCST app is designed to facilitate conversations between PLwDs and their care partners by utilizing a variety of topics derived from traditional iCST methods. Additionally, the app incorporates multimedia stimuli aimed at targeting specific cognitive functions, including memory and language. Preliminary evaluations of the app indicated that most dyads found it engaging and enjoyable, and the majority of the content was deemed appropriate [19]. One care partner noted that the app was particularly useful in making cognitive stimulation more accessible. Despite these promising aspects, adherence to the app remained low; usability data revealed that only 11% of dyads completed two or more activities [19]. In this study, we propose that voice assistants (VAs) offer an ideal platform for delivering iCST at scale. The high adoption rate of VAs among older adults presents a unique opportunity to support PLwDs and their care partners more effectively [9]. Motivated by this potential, we conducted an exploratory study to investigate the utility of VAs in delivering iCST.

2.2 Voice Assistants to Support PLwDs and Their Care Partners

Recent research has explored the use of VAs to support PLwDs and their care partners for different purposes. Zaman et al. developed an LLM-powered VA that answers care partners' questions about their caregiving experiences, using data gathered from online peer support groups [28]. Li et al. presented a prototype VA that uses a semantic-based knowledge graph search and reasoning engine to deliver personalized daily diet recommendations for PLwDs [12]. Dixon et al.'s research revealed that individuals with mild to moderate dementia are open to using additional modalities—particularly voice-based interactions—to enhance their mobile phone user experience [4].

Recent advancements in large language models (LLMs), such as ChatGPT [23], have demonstrated their remarkable ability to generate coherent, context-aware text and their potential in healthcare applications [10, 14, 25]. Gilman et al. highlighted that individuals with mild to moderate dementia are both interested in and capable of integrating LLM-based conversational agents as assistive tools into their daily routines [7]. Treder et al. propose that LLMs can serve as therapy assistants to enhance therapeutic outcomes, either by reducing the workload of healthcare professionals or by directly engaging in an intervention [22]. In light of these findings, we aim to explore opportunities to leverage LLM-powered VAs to deliver cognitive stimulation therapy to PLwDs.

3 Methods

We conducted an exploratory interview study to identify opportunities and design requirements for LLM-powered voice assistants to facilitate iCST for PLwDs. Specifically, care partners interacted with a prototype that we developed for this purpose and offered feedback on its functionality, user experience, and suitability for PLwDs. In the following section, we first introduce the prototype and then describe our interview study design.

3.1 CSTalk: An Alexa Skill to Deliver iCST

3.1.1 System Implementation. We chose Amazon Alexa as the platform and developed an Alexa Skill—referred to as CSTalk—to deliver iCST activities. Unlike most Alexa Skills that utilize rule-based conversation flows, CSTalk integrates an LLM to support open-ended, chat-like interactions. Specifically, we employed GPT-4o (via the OpenAI API) to generate flexible, context-sensitive responses. Figure 1 provides an overview of the system architecture. Because we would like to include visual components, we chose the Amazon Echo Show device with an 8-inch touch display for deployment.

We used the Alexa Skills Kit (ASK) SDK to implement the CSTalk back-end voice interface and deploy it on AWS Lambda. Lastly, we developed the visual user interface using Alexa Presentation Language (APL).

3.1.2 Voice Assistant Design. : Because our primary goal was to explore the feasibility and potential of a VA-based iCST delivery approach, we maintained an interaction flow similar to traditional iCST sessions [26]: (1) an initial greeting from the VA; (2) a brief conversation about the day's weather; and (3) completion of an iCST activity with the VA. We first identified suitable activities from the iCST manual by Yates et al. [26] and then chose to implement the "Old Wives' Tale Quiz". This particular activity was selected on the basis of three criteria: 1. it follows a straightforward, step-by-step format; 2. its primary interaction modality is voice; 3. it does not require extensive physical movement or outdoor settings. In the "Old Wives' Tale Quiz," users discuss whether a common saying (e.g., "An apple a day keeps the doctor away") is true or false, share related personal memories, and exchange ideas with the VA.

To address the different components of the iCST session, we developed multiple LLM agents, each configured with a distinct system prompt defining its role and scope (e.g., a weather-discussion agent and an "old wives' tale" quiz agent). Lastly, because our target users are older adults, CSTalk also displays the assistant's spoken responses as on-screen text to enhance usability and accessibility.

3.2 Study Design

In this study, we conducted five semi-structured interviews with individuals in the United States who self-identified as unpaid family care partners of persons living with dementia (PLwDs). Family care partners are essential to iCST, as they actively participate in sessions and deeply understand the care recipient, making them valuable proxies. To mitigate potential risks associated with introducing novel technologies to PLwDs, this study intentionally focused on care partners. This caution was confirmed by one participant, who noted that PLwDs might become frustrated if they encountered the same interaction failure he had experienced with the prototype. We distributed study flyers through a public US university's StudyFinder and reached out to online and local dementia support groups via the Alzheimer's Association. Participants differed in their familial roles and were responsible for individuals with varying degrees of cognitive impairment and diverse living environments. Detailed demographic information about participants and their care recipients is presented in Table 1.

All interviews were conducted remotely via Zoom. Each session began with a brief three-minute introductory video that describes the traditional iCST activities, ensuring that participants had a basic understanding of the intervention. Participants then interacted with the prototype for two full iCST sessions. The Alexa smart speaker was positioned on the researcher's side, with the laptop camera adjusted to display its screen. We tested the setup to ensure that the device could accurately capture participants' utterances and respond promptly. Following these interactions, they provided feedback including the iCST content, feasibility of asking PLwDs to use the system, and potential concerns about privacy and security.

All interviews were recorded and transcribed by the first and second authors. We then performed a bottom-up thematic analysis of the interview transcripts using Braun and Clarke's approach [3]. The first and second authors independently reviewed and coded the transcripts to identify emerging themes within the responses of the participants. The two authors then collaborated to consolidate common themes and establish consistent sub-themes in key categories. Another author went through the resultant themes to unsure consistency. Discrepancies were discussed until a consensus was reached.

4 Findings

4.1 Acceptance and Feasibility of Delivering VA-based iCST

4.1.1 Acceptance and Feasibility of the System. VA-based iCST has emerged as a promising intervention to support cognitive function and quality of life in PLwDs while reducing caregiving burden. Participant feedback highlighted its benefits, with P1 stating: *"I think this program will benefit someone with severe dementia, because that's irreversible, but at least it gives them a sense of someone who they can talk to,"* highlights the potential of VA-based iCST to provide comfort and companionship and fostering connections that help individuals feel more engaged and less isolated. P1 also emphasized that VA-based iCST offers a familiar, accessible platform, preferring it over introducing new environments, stating, *"It's a simple system that they can interact with then and there that they can get comfortable with versus introducing to a new environment."* This reinforces the idea that the system could be especially beneficial for individuals who remain cognitively active and capable of engaging in stimulating activities. As VA-based iCST provides a non-intrusive and familiar means of engagement, making it a practical and accessible intervention as a stimulating activity for PLwDs. Given that stimulating activities play a crucial role in facilitating interactions, VA-based iCST offers supportive communication with PLwDs according to the care partners, as P2 stated: *"So [the smart speaker] being direct about something in a way that's supportive...wanting to understand his or her feelings, I would think that would be totally appropriate."* VA-based iCST can also initiate conversations when communication feels strained, as P5 shared: *"If you don't know what conversation to have, you just sit there... this would engage both people without having to come up with something."* P5 suggested that VA-based iCST could reduce social withdrawal in dementia care by enabling natural conversation, noting, *"People stop visiting because they don't have anything to say... this would allow natural flow."* By fostering engagement and building relationships, VA-based iCST mitigates the emotional impact of isolation, enhancing caregiving and supporting both PLwDs and care partners. Its ability to enable meaningful interactions makes it a valuable, long-term tool in dementia care.

4.1.2 Privacy and Security. Concerns regarding confidentiality and security risk associated with using VAs for delivering iCST in PLwDs are important to consider and address by adopting a secure and trustworthy design. As P2 noted, *"I think what AI is doing is generating so much more information in such a short period of time that the answers can be more comprehensive and accurate."* However, it is important to put awareness in system design given the heightened vulnerability of older adults, including those with dementia,

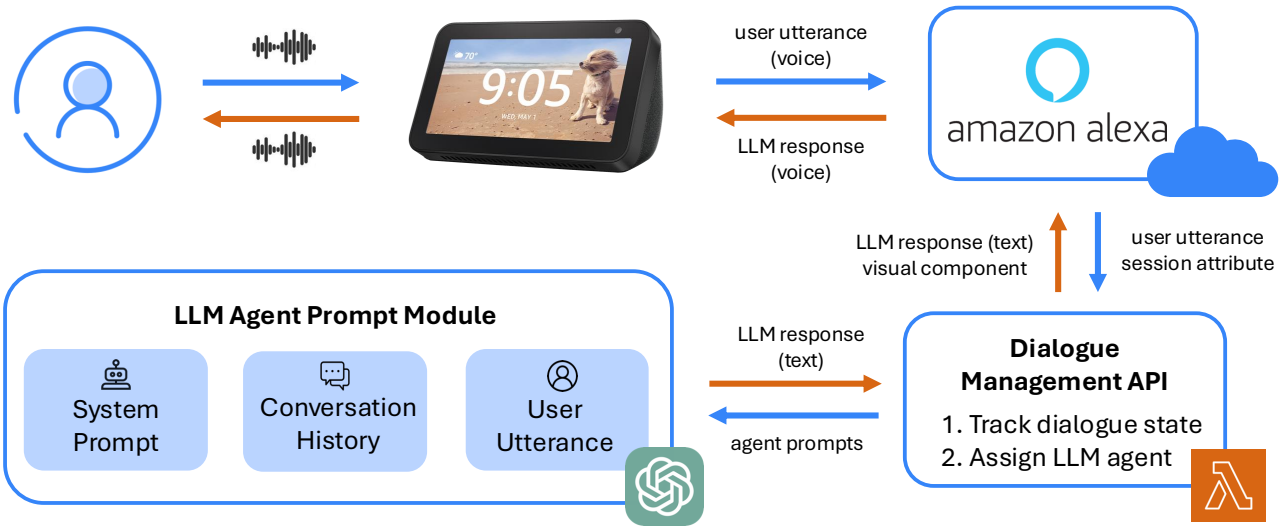

Figure 1: System architecture of CSTalk. First, the user's voice utterance is converted to text by Amazon Alexa's automated speech recognition system. Next, the text and session attributes (e.g., dialogue state) are forwarded to the Skill's backend, the dialogue management API. Based on these attributes, the dialogue management API identifies the current conversation state and selects the corresponding LLM agent to process the user's input. The generated text response is then passed back through Alexa, converted to speech, and delivered to the user.

Table 1: Characteristics of Participants and Their Care Recipients (PLwDs)

Participant	Relationship to PLwDs	Education	Cognitive Status	Years since Diagnosis	Living Place
1	Son	Graduate degree	Moderate	5	Home
2	Husband	Graduate degree	Severe	9	Care facility
3	Wife	Bachelor degree	Moderate	3	Home
4	Son	Some college	Moderate	1	Home
5	Daughter	Associate degree	Moderate	4	Home

suggesting the need to design VA-based iCST that is not only helpful but also secure. P1 expressed a personal concern, stating, *"I know the system's not trying to do this, but people with dementia are 62 and a half percent greater at risk of being victims of identity theft or scams."* This echoes the previously researched challenge of monitoring LLM usage to detect and mitigate abusive behavior [13]. P5 also recommended incorporating general questions to ensure secure conversations with the system, saying, *"Yeah, I think as long as it stayed more general, I think it would be fine. I think if it were to start asking for names like 'Can you name your best friend?' or asking for more things like that, rather than just a general memory (for example, between a sunny day and a rainy day), keeping it more that way— I mean, you never know what the person's gonna share back with it."* P4 said that their concern was minimal. When asked about privacy, they said, *"Maybe a little bit if you start thinking about the threat to privacy. [But] Not really, it's not like you're giving out anything like bank information or anything like that. So overall, I'd say no, maybe slightly but not severely."*

4.2 Need for Personalization

4.2.1 Matching Therapy to Dementia Severity. For individuals in early stages of dementia where cognitive function remains relatively intact, the use of VA to deliver iCST may offer benefits by providing meaningful engagement as P2 reflected on this point *"When the mind of a person with dementia is active, they're trying to solve problems—like puzzles, coloring and artwork—whatever their minds are alert enough to engage with, I would believe that it could have worked then."* On the other hand for those with more advanced stages of dementia, the use of technology may lead to less engagement and diminished enjoyment with the interaction. As P1 pointed out *"Who it will not help best is people with mild or people who are just getting involved with dementia, because it's just another thing that they're going to have to learn versus the people that they're interacting with daily."* This underscores the need for tailored design that aligns with individual interests to enhance the effectiveness of VA-based iCST. As dementia progresses, certain functions deteriorate; therefore, the effectiveness of VA-based iCST depends on its ability to adapt to the needs of PLwDs. Ultimately

balancing complexity of interaction with personalization could be seen as one of the aspects to maintaining engagement and promoting improvement on cognitive function and quality of life. Offering responses with not only simple but also more depth and thoughtfulness will ensure help in this regard, as P1 noted: *"Don't be so blunt and be so basic like, have a little bit more detail and depth to the questions into the responses that they're providing and maybe be mindful of who they're talking to."*

4.2.2 Personalization Based on Interest. Tailoring care and activities to the specific needs of PLwDs is vital, as these aspects can significantly affect their engagement in the implementation of VA-based iCST and enhance their overall comfort. As P1 shared: *"We have tried music therapy, but he gets very irritated with that. If it's not his specific type or genre of music, it provides a really bad sense of, how do I say this… agitation. And with that agitation, the stress builds up on him and it doesn't help. It makes the problem worse."* The importance of flexibility in intervention, including the VA-based iCST, and the consideration of personal preferences further emphasized by P2, noted, *"Some people might like to sing, some people might like to draw, and some people might want to just talk. So, you've got a lot of different circumstances you're trying to deal with."* In addition, P1 reflected the successful implementation of the art therapy solely laying on the meaning of the familiar content that can foster engagement: *"Art therapy has been very helpful for him. We kind of start small with a few pictures, and then we kind of diversify the types of pictures through American history or famous paintings, like Picasso, paintings and stuff that he's interested in."* In regards to VA-based iCST, the approach including the content of the systems should be able to leverage themes that individuals are passionate about, providing a familiar and comforting point to improve overall therapeutic experience.

4.3 Importance of Including Care Partners

4.3.1 Difficulty of Independent use by PLwDs. PLwDs experience varying degrees of cognitive impairment that could impede their ability to interact with technology. In this study, participants primarily cared for individuals with moderate to severe dementia. All participants expressed concern about the feasibility of PLwDs managing the prototype without assistance. Specifically, they highlighted that individuals with moderate to severe dementia may struggle to remember how to operate the system. For example, P1 stated *"If you think anybody with severe dementia is going to understand how to use the system, they're 10 to one times more likely to just drop it and probably break it, and not remember the next day what the heck happened."* In contrast, there was some optimism about users with mild dementia, as P1 noted, *"For mild dementia, you will probably spend less time for them to feel comfortable, and it will become part of their routine."*

In response to this challenge, participants believed care partners could play a key role in introducing the device, offering reminders, and overseeing iCST sessions. P2 remarked, *"I don't know if the guidelines [of the iCST app] would make sense to the person who has dementia but a caregiver, it could help them understand how that system could work with their charge or the person they're taking care of."* P5 further highlighted that PLwDs might forget to use the system altogether, stating, *"I think she could use it once I got it started, I think I would probably have to say: 'Are you interested or something?' Because she would forget about doing it."* Finally, P1 underlined the importance of caregivers in troubleshooting technical issues. As P1 pointed out, *"I understand it froze, and I understand who I need to ask for help. But is a person with dementia going to understand that? Probably not. They're going to get mad."* By stepping in to resolve such problems, care partners could help ensure a more positive user experience for PLwDs.

4.3.2 Practicing iCST Together. Participants highlighted that integrating care partners into iCST sessions can enhance the engagement for PLwDs. P3 shared that her husband rarely initiates activities on his own because of his personality, and that her involvement in using the system would encourage his participation. Similarly, P4 suggested that the presence of a real person during iCST sessions might increase the interest of PLwDs: *"Say my mom maybe just talking to a screen or something isn't very interesting, just kind of what am I doing here. So if there were another real person involved in the conversation, it would be helpful, more natural or normal."* These perspectives contrast with the idea that VA-based iCST could serve as a substitute for human interaction, as noted by P1 in Section 4.1.1. This difference highlights the importance of designing VA-based interventions that can flexibly support both independent participation and collaborative use with care partners, depending on the needs of the individual.

Participants emphasized that having care partners in iCST sessions can strengthen the relationship between care partners and PLwDs. P2 stated, *"If I were using any system, I would want both of us to be able to be involved in it. It really came down to helping my wife, I'd be working as a team. I'm here all the time."* P1 suggested that the system could generate conversation prompts related to the PLwD's past memories, allowing care partners to gain a deeper understanding of the PLwD's experiences and fostering shared joy. In addition, joint participation in iCST sessions may improve the mental well-being of care partners as well. As P1 noted, *"It helps alleviate the constant burden of having to care for someone around the clock and facilitates the implementation of interventions such as reciprocal conversations and art therapy."*

4.4 Ensuring Adoption and Engagement

4.4.1 Making the VA More Accessible. Participants offered several suggestions to enhance the accessibility of VAs for PLwDs. P1 recommended providing clear usage instructions, such as writing simple prompts on sticky notes to guide initial interactions: *"the first thing is to encourage that person. Maybe to write on a sticky note, as basic as it sounds, like, what to say first. Say 'Hey Alexa, respond, question.'"* P2 emphasized the importance of a positive first impression, stating that the VA must be easy to learn and understand: *"I think that's gonna be dependent upon the quality of the initial interaction. In the case of my wife, it would have to be really understandable and relatively simple and relate to what she's doing at that point in time."* Lastly, P4 suggested improving feedback mechanisms by adding verbal cues to indicate when the VA is listening or not, instead of relying solely on visual indicators like the blue bar used by Alexa: *"Like we say about the blue bar or something, if there was something else saying 'I'm listening' or 'not listening,' that might be helpful."*

4.4.2 Provision of Guidelines and Training. As mentioned previously, care partners are essential for facilitating iCST sessions. Participants emphasized the necessity of providing them with comprehensive guidelines and training to ensure smooth engagement. For example, P2 noted, *"You've got to give guidelines so people have more context. I was trying to provide myself with context and how to deal with it. The context would be helpful... So where do you start? What's the best way to start to get comfortable so that you can keep on going?"* Similarly, P1 shared that learning the system through trial and error could be challenging and advocated for a structured training approach: *"I think you have to have a 2, 3 step process of giving a nice overview of the system and then letting them demo it themselves. And by doing so, they understand and can learn how the process works... I was able to improve my use of the system the second time after you walked me through how to do it."*

4.4.3 Managing Sensitive or Triggering Topics. Participants emphasized that VAs should avoid sensitive or triggering subjects to prevent frustration and distress among PLwDs. What is considered sensitive varies among individuals. P1 highlighted that personal family matters are especially delicate. He explained that his mother passed away and, in interactions with his father, he *"tries not to use pictures of personal family like my mom to remember things the wrong way, because it makes my dad sad."*. P5 pointed out that VAs should refrain from discussing abilities lost due to cognitive impairment. P5 stated, *"I haven't met anyone with dementia who responds well to losing something like driving because it's often taken away from them rather than chosen."*. Furthermore, managing sensitive topics involves not only addressing the sensitivities of PLwDs but also ensuring that VAs can handle such topics appropriately. P1 noted that older generations grew up in different environments and might make inappropriate sexual gestures or comments toward certain groups. He expressed concern about how the VA would respond if PLwDs initiated such conversations. It is important to note that, given the small sample size of this study, these insights may not fully capture the diverse experiences of PLwDs and their care partners. Moreover, the identification of triggering subjects is highly personal. As such, designing VAs for this context requires nuanced ethical and technical considerations, recognizing that a one-size-fits-all approach may not be feasible.

4.4.4 Visual Stimulation. Two participants suggested that adding a visual component to the system could enhance engagement and enjoyment of the iCST sessions. They drew this idea from their own daily experiences, where they often look at photos together with their care recipients. As P2 explained, *"Looking at pictures and getting people to comment on them is much better than just relying on verbal activity."* Additionally, the visual component can serve as a cue to improve the voice interaction experience. P1 suggested, *"Why not add a picture of an apple when it comes up in the conversation with Alexa? Sometimes they might miss the question or get agitated, especially when they're trying to talk to the system."*

5 Conclusion

In this study, we developed a LLM-powered VA to deliver iCST to PLwDs. While our study is limited given a small sample size (N=5), our preliminary findings show the potential feasibility and acceptance of using the VA for dementia support. Our data also highlights the need for personalization, the importance of involving care partners, and strategies to enhance engagement. However, a key limitation of our study is the reliance on care partners as proxies rather than direct input from PLwDs. To address this, we plan to integrate these insights to further refine the VA design, and plan to involve PLwDs directly in the design process. Lastly, we plan to conduct a large-scale deployment study to further evaluate the system's feasibility and efficacy in delivering iCST. Through these efforts, we hope to establish an empirical understanding of the long-term viability of using VAs for delivering iCST, as well as exploring their broader use for supporting dementia care.

Acknowledgments

Research reported in this publication was supported by National Institute on Aging of the National Institutes of Health under award number R21AG085439. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. This research is supported in part by the MSIT (Ministry of Science, ICT), Korea, under the Global Scholars Invitation Program (RS-2024-00459638) administered by IITP (Institute for Information & Communication Technology Planning & Evaluation).

References

[1] Alzheimer's Association. 2024. 2024 Alzheimer's Disease Facts and Figures. *Alzheimer's & Dementia* 20 (2024), 3708–3821. https://doi.org/10.1002/alz.13809
[2] Zoe Arvanitakis, Raj C Shah, and David A Bennett. 2019. Diagnosis and management of dementia. *Jama* 322, 16 (2019), 1589–1599.
[3] Virginia Braun and Victoria Clarke. 2019. Reflecting on reflexive thematic analysis. *Qualitative research in sport, exercise and health* 11, 4 (2019), 589–597.
[4] Emma Dixon, Rain Michaels, Xiang Xiao, Yu Zhong, Patrick Clary, Ajit Narayanan, Robin N Brewer, and Amanda Lazar. 2022. Mobile phone use by people with mild to moderate dementia: uncovering challenges and identifying opportunities: mobile phone use by people with mild to moderate dementia. In *Proceedings of the 24th International ACM SIGACCESS Conference on Computers and Accessibility*. 1–16.
[5] Asbjørn Følstad and Petter Bae Brandtzæg. 2017. Chatbots and the new world of HCI. *interactions* 24, 4 (2017), 38–42.
[6] Luke Gibbor, Lycia Forde, Lauren Yates, Stavros Orfanos, Christina Komodromos, Harriet Page, Kate Harvey, and Aimee Spector. 2021. A feasibility randomised control trial of individual cognitive stimulation therapy for dementia: impact on cognition, quality of life and positive psychology. *Aging & Mental Health* 25, 6 (2021), 999–1007.
[7] Elizabeth S Gilman, Sushant Kot, Margi Engineer, and Emma Dixon. 2024. Training Adults with Mild to Moderate Dementia in ChatGPT: Exploring Best Practices. In *Companion Proceedings of the 29th International Conference on Intelligent User Interfaces*. 101–106.
[8] Dilip V Jeste, Brent Mausbach, and Ellen E Lee. 2021. Caring for caregivers/care partners of persons with dementia. *International Psychogeriatrics* 33, 4 (2021), 307–310.
[9] Sunyoung Kim and Abhishek Choudhury. 2021. Exploring older adults' perception and use of smart speaker-based voice assistants: A longitudinal study. *Computers in Human Behavior* 124 (2021), 106914.
[10] Tiffany H Kung, Morgan Cheatham, Arielle Medenilla, Czarina Sillos, Lorie De Leon, Camille Elepaño, Maria Madriaga, Rimel Aggabao, Giezel Diaz-Candido, James Maningo, et al. 2023. Performance of ChatGPT on USMLE: potential for AI-assisted medical education using large language models. *PLoS digital health* 2, 2 (2023), e0000198.
[11] Phuong Leung, Lauren Yates, Vasiliki Orgeta, Fara Hamidi, and Martin Orrell. 2017. The experiences of people with dementia and their carers participating in individual cognitive stimulation therapy. *International Journal of Geriatric Psychiatry* 32, 12 (2017), e34–e42.
[12] Juan Li, Bikesh Maharjan, Bo Xie, and Cui Tao. 2020. A personalized voice-based diet assistant for caregivers of Alzheimer disease and related dementias: system development and validation. *Journal of Medical Internet Research* 22, 9 (2020), e19897.

[13] Tianshi Li, Sauvik Das, Hao-Ping Lee, Dakuo Wang, Bingsheng Yao, and Zhiping Zhang. 2024. Human-centered privacy research in the age of large language models. In *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems*. 1–4.

[14] Amama Mahmood, Junxiang Wang, Bingsheng Yao, Dakuo Wang, and Chien-Ming Huang. 2023. LLM-Powered Conversational Voice Assistants: Interaction Patterns, Opportunities, Challenges, and Design Guidelines. *arXiv preprint arXiv:2309.13879* (2023).

[15] Martin Orrell, Lauren Yates, Phuong Leung, Sujin Kang, Zoe Hoare, Chris Whitaker, Alistair Burns, Martin Knapp, Iracema Leroi, Esme Moniz-Cook, et al. 2017. The impact of individual Cognitive Stimulation Therapy (iCST) on cognition, quality of life, caregiver health, and family relationships in dementia: A randomised controlled trial. *PLoS medicine* 14, 3 (2017), e1002269.

[16] Alessandro Pappadà, Rabih Chattat, Ilaria Chirico, Marco Valente, and Giovanni Ottoboni. 2021. Assistive technologies in dementia care: an updated analysis of the literature. *Frontiers in psychology* 12 (2021), 644587.

[17] Alisha Pradhan, James Gallier, Raymond Domjan, Emma Dixon, Robert Bao, Hanuma Teja Maddali, and Amanda Lazar. 2023. Towards a System Architecture for Connected Physical and Digital Reminders Using Embodied Objects for People with Dementia. In *Proceedings of the 25th International ACM SIGACCESS Conference on Computers and Accessibility*. 1–5.

[18] Ling Qiu, Bethany Kanski, Shawna Doerksen, Renate Winkels, Kathryn H Schmitz, and Saeed Abdullah. 2021. Nurse AMIE: using smart speakers to provide supportive care intervention for women with metastatic breast cancer. In *Extended abstracts of the 2021 CHI conference on human factors in computing systems*. 1–7.

[19] Harleen Kaur Rai, Rebecca Griffiths, Lauren Yates, Justine Schneider, and Martin Orrell. 2021. Field-testing an iCST touch-screen application with people with dementia and carers: a mixed method study. *Aging & Mental Health* 25, 6 (2021), 1008–1018.

[20] Hui Shi, Chen Mao, Jinling Tang, and Huiying Liang. 2020. Research on the health of and interventions for family caregivers of people with dementia: a bibliometric analysis of research output during 1988–2018. *BMC geriatrics* 20 (2020), 1–9.

[21] Aimee Spector, Lene Thorgrimsen, BOB Woods, Lindsay Royan, Steve Davies, Margaret Butterworth, and Martin Orrell. 2003. Efficacy of an evidence-based cognitive stimulation therapy programme for people with dementia: randomised controlled trial. *The British Journal of Psychiatry* 183, 3 (2003), 248–254.

[22] Matthias S Treder, Sojin Lee, and Kamen A Tsvetanov. 2024. Introduction to Large Language Models (LLMs) for dementia care and research. *Frontiers in Dementia* 3 (2024), 1385303.

[23] Bryan Wang, Gang Li, and Yang Li. 2023. Enabling conversational interaction with mobile ui using large language models. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–17.

[24] Anna Xygkou, Chee Siang Ang, Panote Siriaraya, Jonasz Piotr Kopecki, Alexandra Covaci, Eiman Kanjo, and Wan-Jou She. 2024. MindTalker: Navigating the Complexities of AI-Enhanced Social Engagement for People with Early-Stage Dementia. In *Proceedings of the CHI Conference on Human Factors in Computing Systems*. 1–15.

[25] Ziqi Yang, Xuhai Xu, Bingsheng Yao, Ethan Rogers, Shao Zhang, Stephen Intille, Nawar Shara, Guodong Gordon Gao, and Dakuo Wang. 2024. Talk2Care: An LLM-based Voice Assistant for Communication between Healthcare Providers and Older Adults. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 8, 2 (2024), 1–35.

[26] Lauren Yates, Martin Orrell, Phuong Leung, Aimee Spector, Bob Woods, and Vasiliki Orgeta. 2020. *Making a Difference 3: An Evidence-Based Group Programme to Offer Cognitive Stimulation Therapy (CST) to People with Dementia.* Hawker Publications, London, UK.

[27] Lauren A Yates, Phuong Leung, Vasiliki Orgeta, Aimee Spector, and Martin Orrell. 2015. The development of individual cognitive stimulation therapy (iCST) for dementia. *Clinical interventions in aging* (2015), 95–104.

[28] Kimia Tuz Zaman, Wordh Ul Hasan, Juan Li, and Cui Tao. 2023. Empowering Caregivers of Alzheimer's Disease and Related Dementias (ADRD) with a GPT-Powered Voice Assistant: Leveraging Peer Insights from Social Media. In *2023 IEEE Symposium on Computers and Communications (ISCC)*. IEEE, 1–7.