AI to Support Everyday Life for People with Dementia

Emma Dixon
eschare@g.clemson.edu

CLEMSON UNIVERSITY
What is Dementia?
DEMENTIA

Umbrella term for loss of memory and other thinking abilities severe enough to interfere with daily life.

Alzheimer's: 60-80%
Lewy Body Dementia: 5-10%
Vascular Dementia: 5-10%
Frontotemporal Dementia: 5-10%
Others: Parkinson's, Huntington's

Mixed dementia: Dementia from more than one cause

Image from the Alzheimer's Association
Stages of Dementia

Mild  Moderate  Severe
55 million

10 million new cases each year

World Health Organization
AI Imaging For Early Detection of Alzheimer
Technology also has great potential to assist people in the mild to moderate stages of dementia.
Opportunities to design human-centered technologies, with high levels of human control and high levels of automation.
1. Current AI use by people with dementia

2. Promising future directions for AI and Dementia
1. Current AI use by people living with mild to moderate dementia

Clean the carrots and cut them in small pieces.
Research Questions

In what ways do tech-savvy people with mild to moderate dementia use AI in their daily life?

Arthur’s daily routine with AI

7:00 AM

“Flash briefing”

7:30 AM

“Arthur, your tea is ready”

8:30 PM

“Arthur, your tea is ready”
Arthur’s daily routine with AI

8:20 AM
Mindful exercise to “get rid of the cobwebs”

9:00 AM

9:30 AM
“Arthur, you need to have a shower or you will smell.”

“Your bus arrives in 20 minutes.”

“so I can take Alexa out with me”
Arthur’s daily routine with AI

Arthur says he has designed a system, which “keep[s] me in that routine” that he has established to work within the context of his daily life and social relationships.
1 Current AI use by people with dementia

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Research Questions

R1: What challenges do people with mild to moderate dementia experience when using technology?

R2: How could AI systems be used to address these challenges?

Accessibility Barriers to Technology
Findings: Fluctuations in Sensory Ability Affecting Reading

8:00 AM: Font Size 14
4:00 PM: Font Size 24

“8 o'clock in the morning, I might be able to read font size 14, by 4 o'clock in the afternoon I'm up to font size 24. Now if that was on paper, I would have had to stop reading hours ago.” - P1
Findings: Fluctuations in Cognitive Ability Affecting Reading

Text-based content could be “hard to decipher” [Velma].

- Word count
- Jargon
- Changes in reading comprehension
- Specific fonts making people motion sick

“It’s not that I’m not interested… I’ll find something, and then I’ll have trouble understanding… what the words - what they’re saying… And then like, I’ll go back five or six times. And I might get to… the meaning of one word.”
- Arnold
Findings: Challenges with Traditional Keyboards

- P9 uses Alexa to record auditory journals
- Pr13 uses traditional assistive devices (Dragon Speak)
Findings: The need for audible words not sounds

To add context for notifications on his phone P1 uses “an audible word that tells me what it [the notification] is.”
Difficulty Navigating to Apps and Features

“Maneuvering through the phone... as it becomes more useful I think it can become more challenging because there's more stuff squeezed in there and finding it all and maneuvering through it all can be a challenge.”
- Thomas
Time Pressure, High Stress and Fatigue Impairing Task Execution

“[I] was very cognitively exhausted and I was waiting for a specific bus to come home... I didn’t have the cognitive wherewithal to figure anything else out.”
- Eleanor
Opportunities for AI systems – as described by Participants

- Customizable user interfaces to address challenges with navigating the phone
  - making app icon more “recognizable” - Miranda
  - Providing “less options” - Malcolm
Opportunities for AI systems – as described by Participants

- Proactive technology assistance to address challenges with re-learning task flows
  - Preston proposed his phone could identify:
    - “Hey, he really hasn't used that stylus pen. Maybe we should send him another opportunity.”
    - and then provide “a tutorial” of how to use that feature.
In what use cases is AI applicable to people with dementia?
1. Health Information Seeking!
Health Information Seeking!
On-going work

Analyzing the cognitive load and emotional responses of people with dementia and healthy older adults to 4 types of digital dementia information:

1. A medical article
2. An advocacy article
3. A blog post – written by someone with dementia
4. A pseudoscience article

https://www.realeye.io/features/online-webcam-facial-coding
Opportunity for AI: Determining Setting Changes Necessary to Make Digital Health Information More Accessible
2. People with MCI and Dementia in the Workforce

- We are able to identify dementia earlier in the progression of the condition.
- 9% of people with dementia are living with younger onset dementia – under the age of 65 at diagnosis [WHO]
- This number is projected to increase significantly in the next decade.
On-going Work: Examining Workforce Assistive Technology for People with MCI and Early-Stage Dementia

- Interviews with people with MCI/Dementia who are working
- Assistive technology toolkit development and deployment
Toolkits could include: AI Text Summarization

Abstract: While many approaches to make neural networks more fathomable have been proposed, they are restricted to interrogating the network with input data. [...] In this work, we propose neural persistence, a complexity measure for neural network architectures based on topological data analysis on weighted stratified graphs. [...] 

Intro: [...] In this work, we present the following contributions: We introduce neural persistence, a novel measure for characterizing the structural complexity of neural networks that can be efficiently computed. [...] 

Conclusion: [...] However, this did not yield an early stopping measure because it was never triggered, thereby suggesting that neural persistence captures salient information that would otherwise be hidden among all the weights of a network. [...] 

TLDR: We develop a new topological complexity measure for deep neural networks and demonstrate that it captures their salient properties.

Taken from Cachola, Lo, Cohan, and Weld, 2020
Toolkits could include: Voice-based Interaction
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emmaedixon.wordpress.com/