



University of California  
San Francisco

# Applying natural language processing/chatbot for behavior change in older adults

Yoshimi Fukuoka, PhD, RN, FAAN

Professor

Department of Physiological Nursing &

UC Berkeley and UC San Francisco Computational Precision Health Ph.D. Program

University of California, San Francisco

[Yoshimi.fukuoka@ucsf.edu](mailto:Yoshimi.fukuoka@ucsf.edu)



University of California  
San Francisco

# DISCLOSURE

I have no conflicts of interest in relation to this presentation

# Definitions

- **Natural Language Processing (NLP):** A branch of AI and the ability of computational technologies and linguistics to process human natural language
- **Chatbot:** A computer program designed to simulate conversation with humans over text or voice (e.g., Alexa, Siri)
- **Large Language Model (LLM):** A type of AI model that is trained on large amounts of text data to understand, generate, and interact using human language (e.g., GPT)

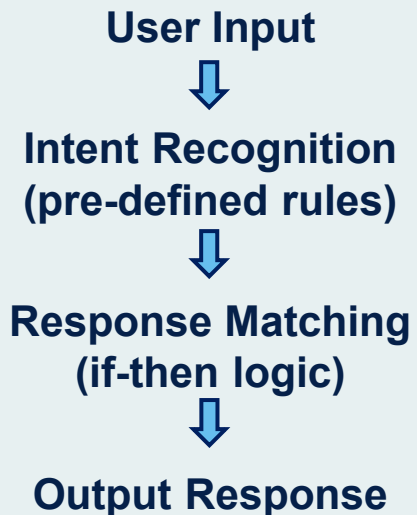


Image created by ChatGPT

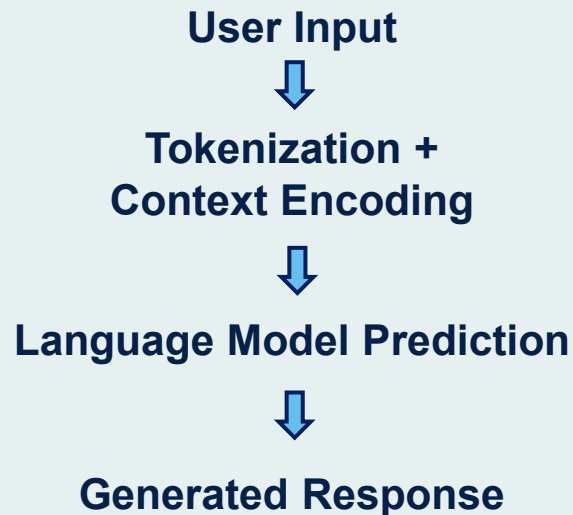
# Comparing Two Chatbot Approaches



## Rule-based Chatbot (e.g., Google Dialogflow)



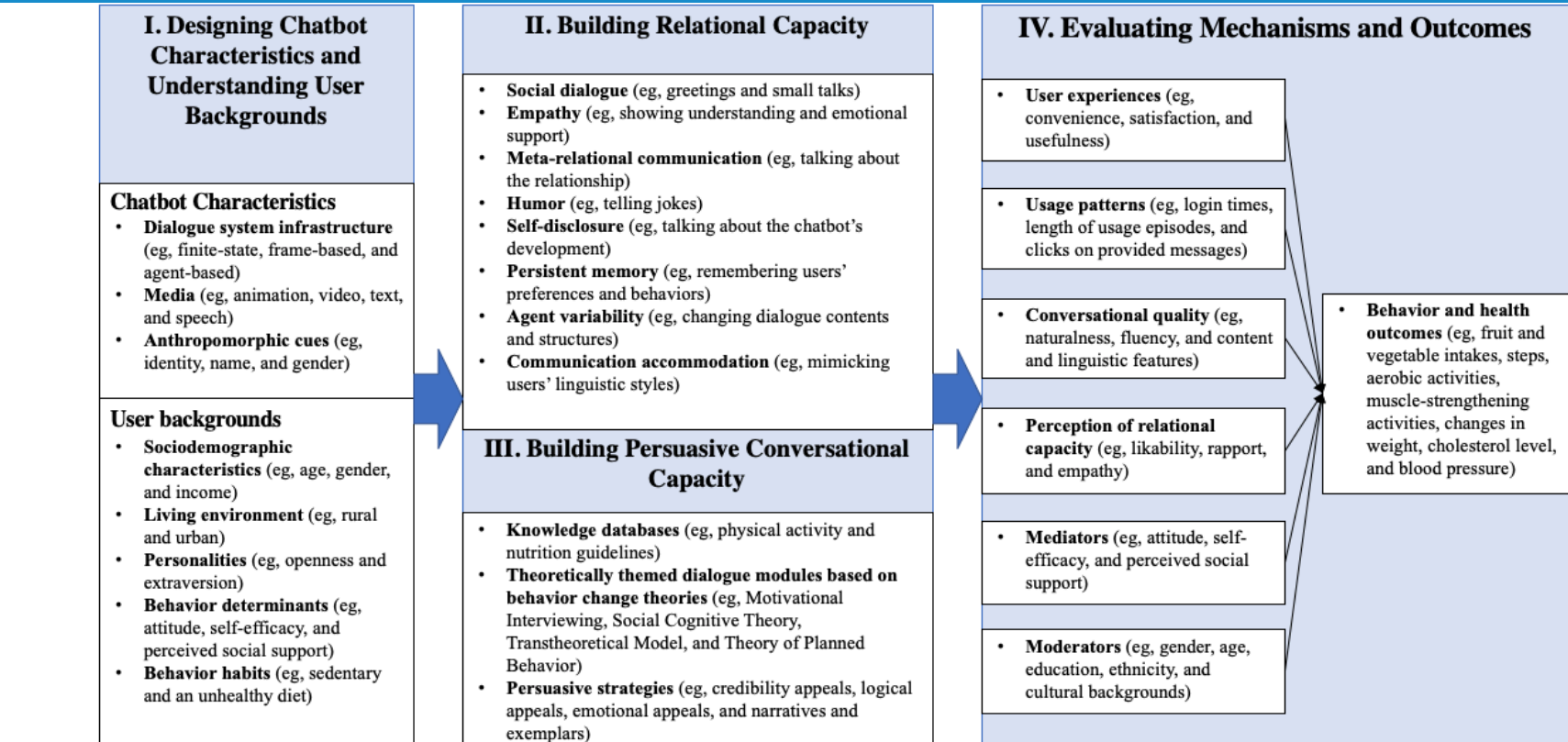
## LLM-based Chatbot (e.g., GPT)



# Pros and Cons of Chatbot Types

Rule-based Chatbot (e.g., Google Dialogflow)		LLM-based Chatbot (e.g., GPT)	
Pros	Cons	Pros	Cons
Consistent and predictable responses	<b>Rigid — struggles with unexpected input</b>	Natural, human-like conversations Application Programming Interface (API)	<b>Hallucination and inaccurate responses</b>
<b>Easy to control and monitor</b>	Requires manual updates and maintenance	<b>Handles a wide variety of inputs and topics</b>	Harder to control or predict
<b>Low cost</b>	Poor at handling complex or nuanced conversations	Understands context and user intent better	<b>Requires more resources and can be expensive</b>
Excellent for simple tasks and structured flows		Useful for creative, educational, and advisory tasks	

# AI Chatbot Behavior Change Model



# Systematic Review: Natural Language Processing Techniques for Early Detection of Cognitive Impairment

- **Aim:** Efficacy of NLP techniques in detecting early cognitive impairment through speech and language
- **Study Types:** 42 cross-sectional and 9 longitudinal (2011-2024)
- **Tasks:** Picture description (most common), spontaneous speech, story recall, AI/chatbot dialogues
- **Main Finding:** Combining linguistic and acoustic analysis has the highest detection of cognitive impairment in older adults

# Scoping Review: Role of Chatbots in Enhancing Health Care for Older Adults

- **Aim:** Role, benefits, and applications of chatbots in supporting various health conditions in older adults
- **Study Types:** 29 studies in older adults (60+) using chatbots

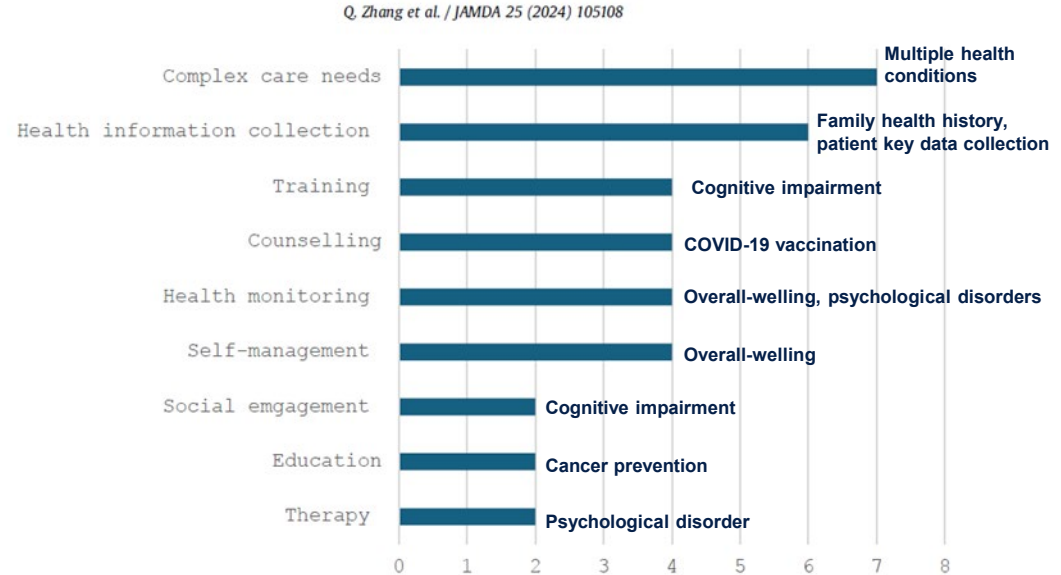


Fig. 2. Number of studies by purposes.

# Scoping Review: Role of Chatbots in Enhancing Health Care for Older Adults

**Table 2.** Summary of Chatbot Characteristics (N=29)

Characteristics	Number of Studies, % (n)
Name	
Yes	65.5 (19)
No	34.5(10)
Response generation	
Rule-based	17.2 (5)
Natural language processing	17.2 (5)
Nonspecific	65.5 (19)
Platform	
Mobile application	37.9 (11)
Web-based	17.2 (5)
Others	44.8 (13)
Input modality	
Text	57.1 (16)
Speech	28.6 (8)
Multimodalities	14.3 (4)

- Many of the studies were published after 2020
- Most chatbots were implemented in mobile applications such as LINE or Telegram
- Technical performance, user acceptability, and effectiveness of chatbots were the most collected outcomes

# Significance of Heart Disease in Women

- 314,000 women died from heart disease in the US in 2020
- The average age for a first heart attack is 72 for women
- Older women often delay seeking care during a heart attack
- Women's awareness of heart disease decreased from 65% to 44% from 2009 to 2019, despite large public campaigns

**A one-size-fits-all approach is not working**

# Rationale for HeartBot Development

- Nearly half of adults use a chatbot (e.g., Alexa, Siri, Google Assistant)
- Tailor heart disease messages to older women
- Available 24 hours a day, 7 days a week
- Collect real-time, big data for surveillance

# HeartBot Session

+

Topic	Content
1	Introduction and greetings
2	Participants' name retrieval
3	Knowledge of heart attacks
4	Symptoms of heart attacks
5	First action
6	Importance of calling 911
7	Waiting duration
8	Treatment of heart attacks
9	Action plans while waiting for 911
10	Risk factors for heart disease
11	Female-specific risk factors for heart attacks
12	Racial risk factor for heart disease
13	Multiple choice questions
14	Further questions to ask to <u>HeartBot</u>
15	Acknowledgement and conclusion of the conversation

# HeartBot Screenshots

Hello, I am HeartBot from the UCSF study. 😊

I will ask you several questions. Please answer in your own words. Don't worry about getting the answers right. This chat will take about 15 minutes.

If you are experiencing a medical emergency, please call [911](#) immediately. At the end of this session, you will be asked 2 questions and you also can ask questions.

Let's get started!

Please tell me your first name.

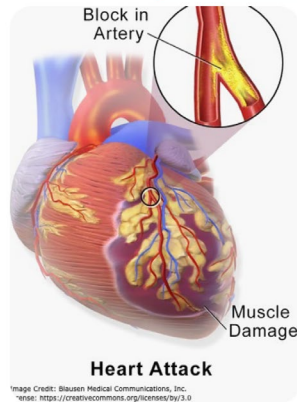
Diane

I am so glad to be talking with you today, Diane.

Please text "start over" at any point to start the conversation from the beginning.

What do you know about heart attacks? 🍷

Not much except for chest pain



Okay. Heart attack is a medical emergency. It occurs when the coronary arteries are blocked (see the image) and not providing enough oxygen to the heart and body. Your heart can stop if you don't get an immediate medical treatment.

emergency. It occurs when the coronary arteries are blocked (see the image) and not providing enough oxygen to the heart and body. Your heart can stop if you don't get an immediate medical treatment.

What are the symptoms of a heart attack?

Chest starts to hurt

There can be several symptoms of a heart attack, Diane. It's important to remember that CHEST PAIN or PRESSURE are the most common symptoms. Common symptoms in women are:

- Chest pain, pressure, or discomfort
- Pain in the shoulder, arm, or upper back pain
- Shortness of breath
- Heartburn/nausea
- Extreme fatigue

# Vision to Improve Women's Health

## Next step

- Conduct an RCT to test the AI HeartBot

## Vision

- Launch a nationwide **“HeartBot Campaign for Women”** (e.g., Place QR codes in airports, bus and train stations, and local transportation)

## Impact

- Increase women's heart disease awareness and promote early access to treatment
- Ultimately, **SAVE women's lives**

# Summary

- Large randomized controlled trials of chatbot interventions in older adults are lacking
- Long-term effects, sustainability, and scalability must be examined
- It is important to engage older adults in co-design and have a theoretical framework
- Standardized safety and privacy measures are needed



University of California  
San Francisco

# Thank you

[Yoshimi.Fukuoka@ucsf.edu](mailto:Yoshimi.Fukuoka@ucsf.edu)