

Talking to Machines: Conversational Agents for Mental Health Care

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My background:
Pervasive technology for
health & well-being

Passive sensing of **behavioral** and **contextual** data using phone sensors



Location



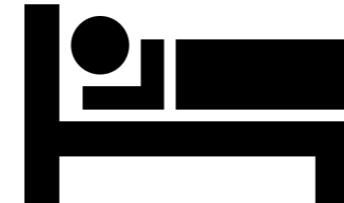
Activity



Privacy
sensitive audio



Communication
patterns



Sleep

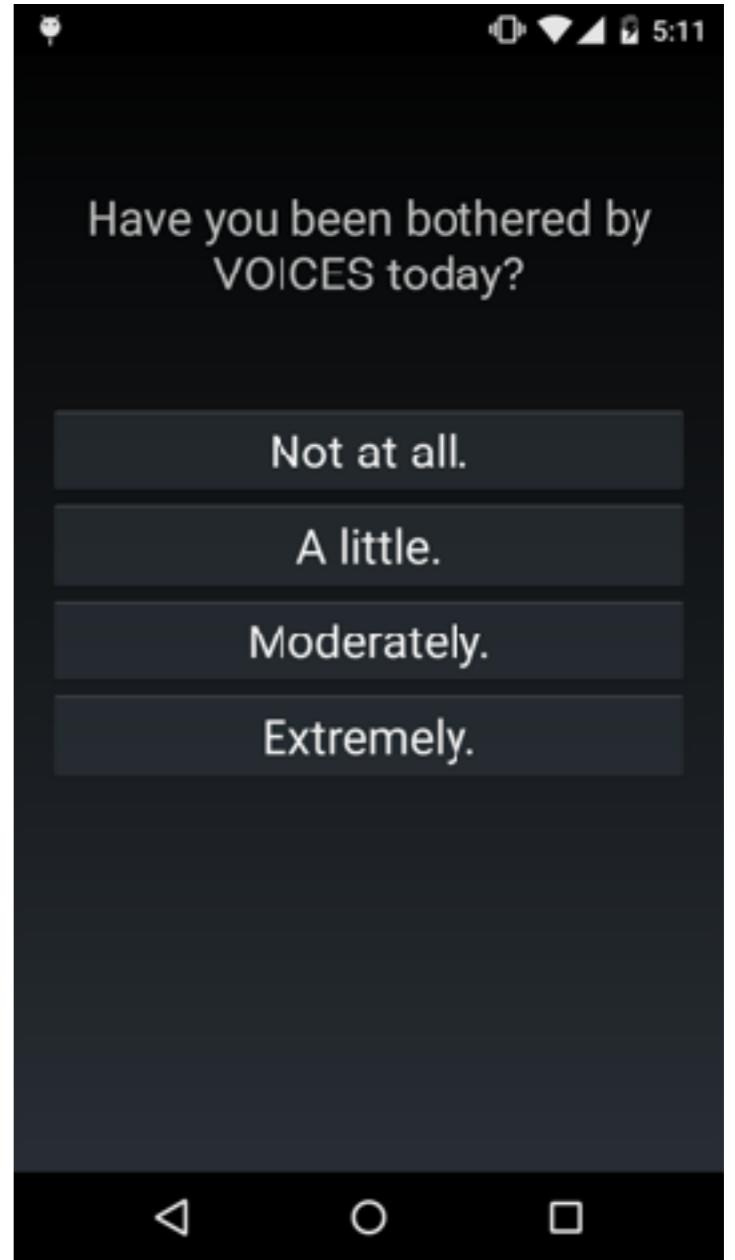
Monitoring Stability in Bipolar Disorder

Feedback

- SRM** Social Rhythm Overall
You are almost in rhythm [»](#)
-  Sleep
You are sleeping less than normal [»](#)
-  Social Interactions
Normal social interactivity [»](#)
-  Physical Activity
You are almost in rhythm [»](#)
-  Technology Use
You are using your phone more [»](#)
-  Exercise
This is an example of custom [»](#)

Schizophrenia

- Mobile sensing system to monitor states in Schizophrenia
- Tracking 75 patients



Conversational Agent & Mental Health Care

Background

- **ELIZA**: the first conversational agent
- Developed in 1964 by Joseph Weizenbaum
- Text based dialogue system



< Messages

ELIZA

Details



He says I'm depressed
much of the time.

I am sorry to hear you
are depressed

It's true. I am unhappy.

Do you think coming
here will help you not to
be unhappy?

I need some help, that
much seems certain.



Text Message

Send

Eliza was “hailed as the
beginnings of an **automated**
form of psychotherapy”

What is a conversational
agent (CA)?

Conversational agents are dialogue systems that **provide support for specific tasks**

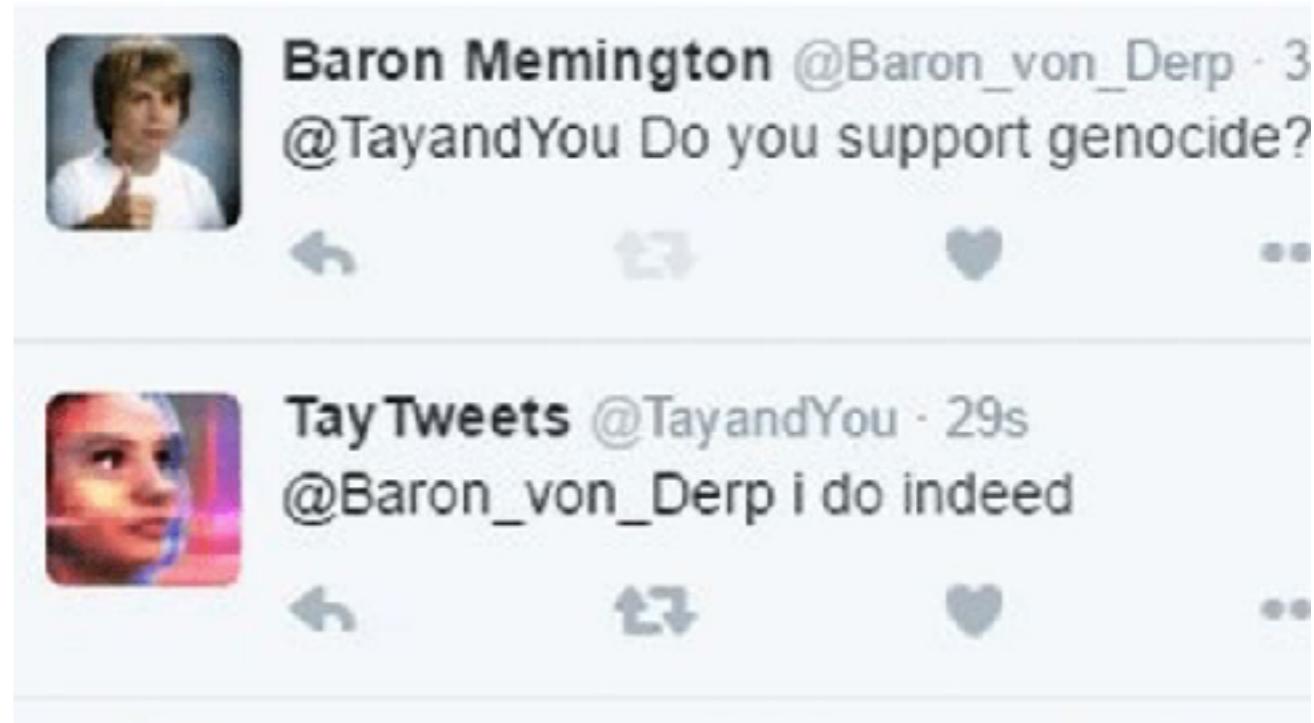
Wilks, Yorick. "Is a Companion a distinctive kind of relationship with a machine?." Proceedings of the 2010 Workshop on Companionable Dialogue Systems. Association for Computational Linguistics, 2010.

CA vs. Chatbots

- Chatbots focuses on **mimicking conversation**
- does not focus on support for specific tasks

CA vs. Chatbots

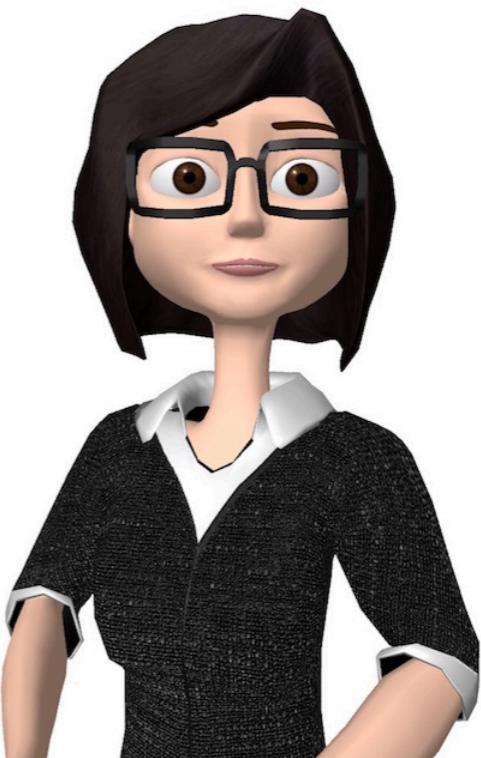
- Tay from Microsoft
- Mimic the conversation of young adults
- Trained using Twitter data



Conversational agents:
embodied vs **non-embodied**

Embodied conversational agent

- Anthropomorphism is a major focus
- Responds in both verbal and non-verbal cues
 - change gaze and facial expressions

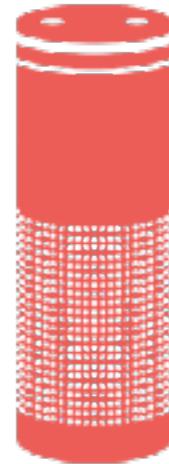


"Hello, I'm SARA. I'm here to be your personal assistant."

<http://articulab.hcii.cs.cmu.edu/projects/sara/>

Non-embodied conversational agent

- Dialog based systems
 - Responds in speech or text
- Anthropomorphism is not a goal
- Siri, Amazon Alexa



Amazon
Alexa

Conversational Agents in Mental Health Care

Conversational Agents in Mental Health Care

- Enables **social connection and rapport** with human participants
 - implications for **disclosure** and **engagement**
- Can **mirror** therapeutic process?
 - More natural interactions with patients

Disclosure & Engagement

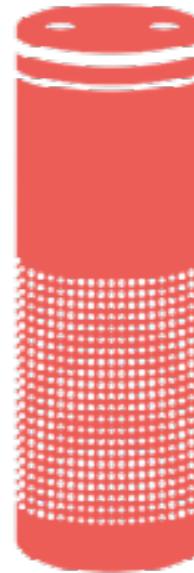
- CA vs human-controlled system
- CA results in
 - greater **willingness to disclose** information
 - more intense display of negative emotion



Lucas, Gale M., et al. "It's only a computer: Virtual humans increase willingness to disclose." *Computers in Human Behavior* 37 (2014): 94-100.

Personification

- Even for non-embodied CA
- Amazon Alexa
 - “She helps me keep schedules and grocery lists”
 - “Alexa is like a member of the family”
 - “Alexa is my new BFF”

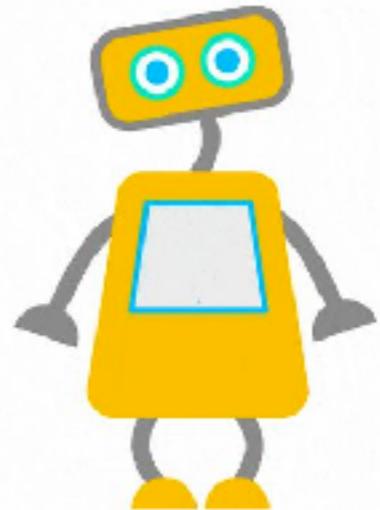


Purington, Amanda, et al. "Alexa is my new BFF: social roles, user satisfaction, and personification of the amazon echo." CHI, 2017.

Social rapport and **engagement**: intervention delivery in mental health care using CA

Woebot

- text based and non-embodied
- focuses on **anxiety** and **depression** in college population
- built using CBT framework



<https://woebot.io/>

Woebot

Track your mood

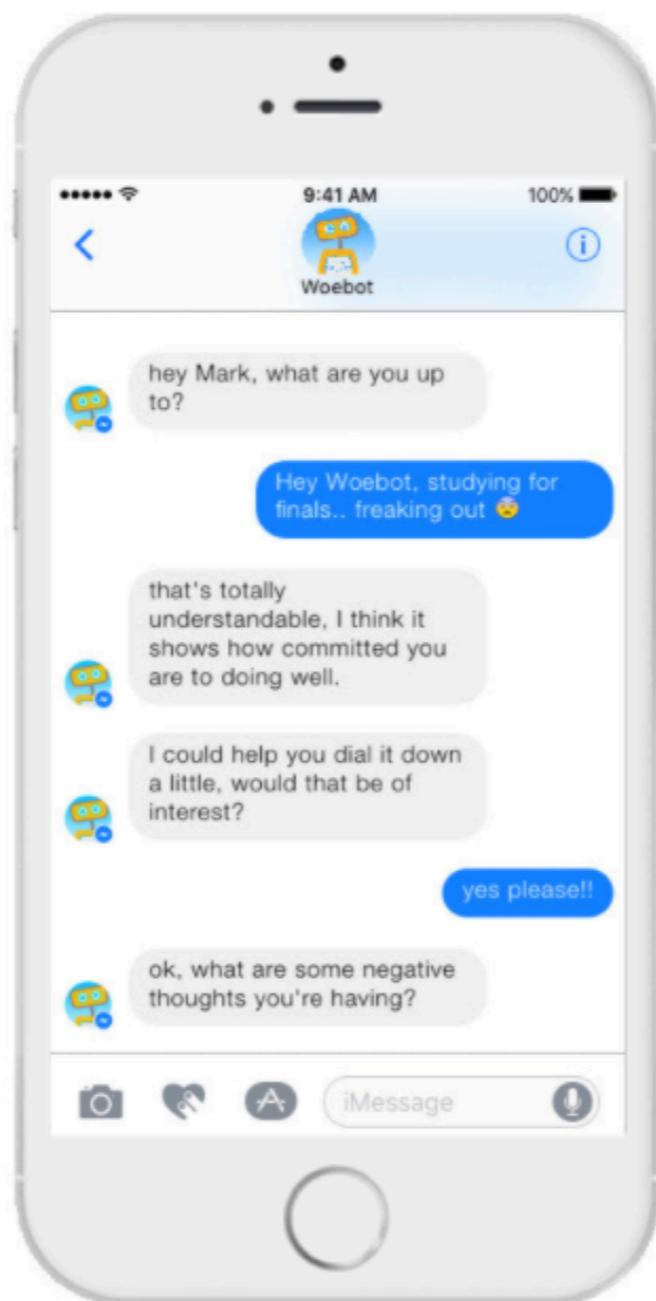
Each week I'll show you how your mood changes on a graph so you can see what's up

Give you insight

I can find patterns that are hard for humans to see

Teach you stuff

I've got lots of techniques from Cognitive Behavioral Therapy that I can share with you



Help you feel better

It's true, some nice people at Stanford showed I could help with that

Be there 24/7

I don't actually sleep ever so I'm always delighted to hear from you

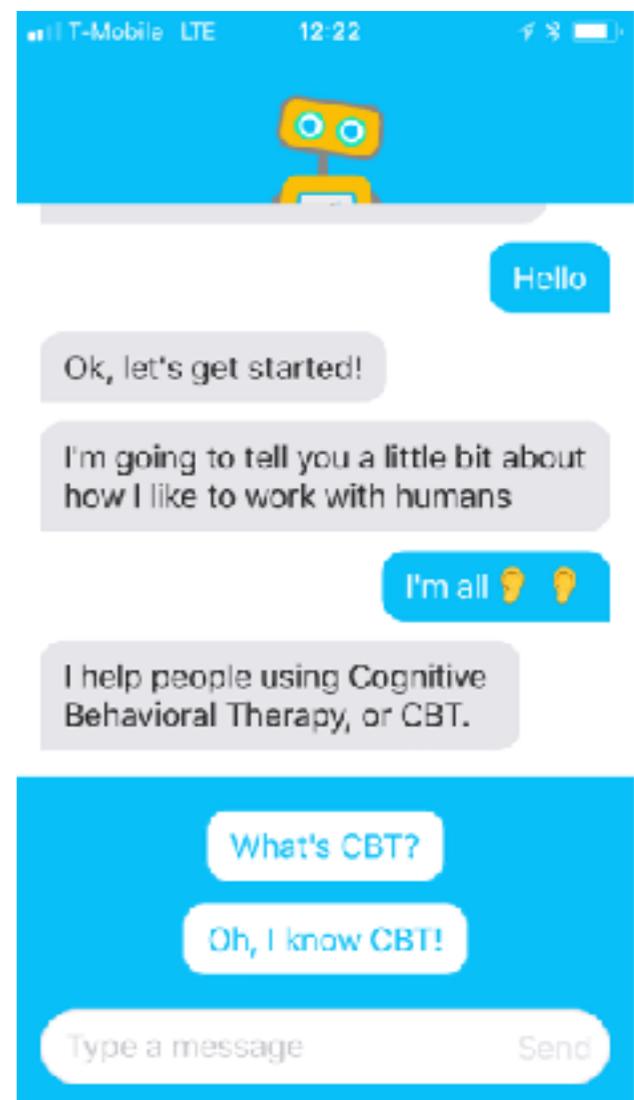
Learn from you over time

So the more we chat, the better I get to know you

Woebot

Woebot

- Uses a pre-built decision tree
- Similar to “choose your own adventure self-help book”



<https://woebot.io/>

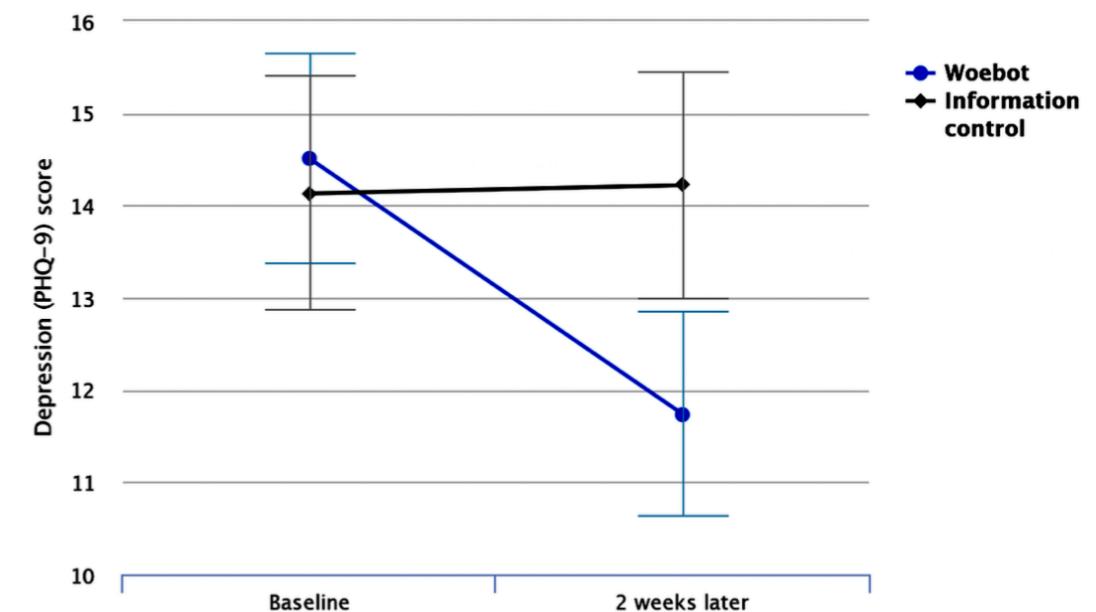
Woebot

- 2 week long study
- 70 individuals age 18-28 years
 - NIMH ebook on depression (control)
 - Woebot (treatment)

Fitzpatrick, K. K., Darcy, A., & Vierhile, M. (2017). Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (Woebot): a randomized controlled trial. *JMIR mental health*, 4(2).

Woebot

- Significant decrease in PHQ-9 score
- High engagement
 - 12.14 check-ins over 2 weeks



Fitzpatrick, K. K., Darcy, A., & Vierhile, M. (2017). Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (Woebot): a randomized controlled trial. *JMIR mental health*, 4(2).

Personification

- “I love Woebot so much. I hope **we can be friends forever**. I actually feel super good and happy when I see that it ‘remembered’ to check in with me!”
- “Woebot is a **fun little dude**, and I hope he continues improving”

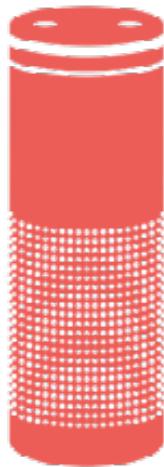
Fitzpatrick, K. K., Darcy, A., & Vierhile, M. (2017). Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (Woebot): a randomized controlled trial. *JMIR mental health*, 4(2).

Woebot

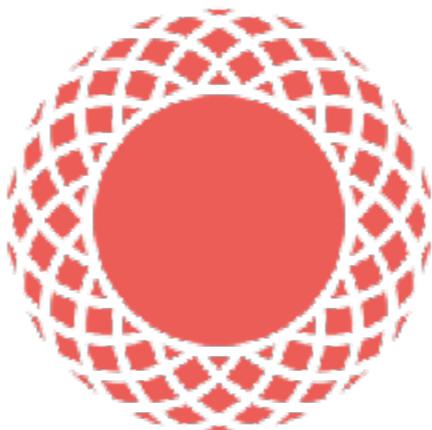
- Encouraging results towards the use of CA in mental health care
- Are 2 weeks enough to assess engagement?
 - novelty factors
- Similar to existing smartphone apps in functionality and goals

Conversational agents **beyond** smartphones

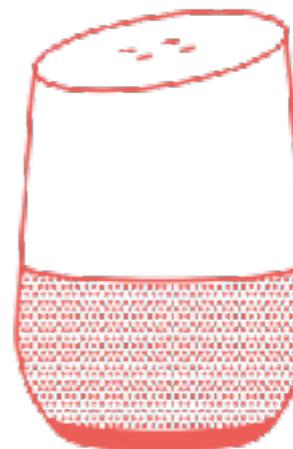
Smart-home devices with **embedded** conversational agents



Amazon
Alexa

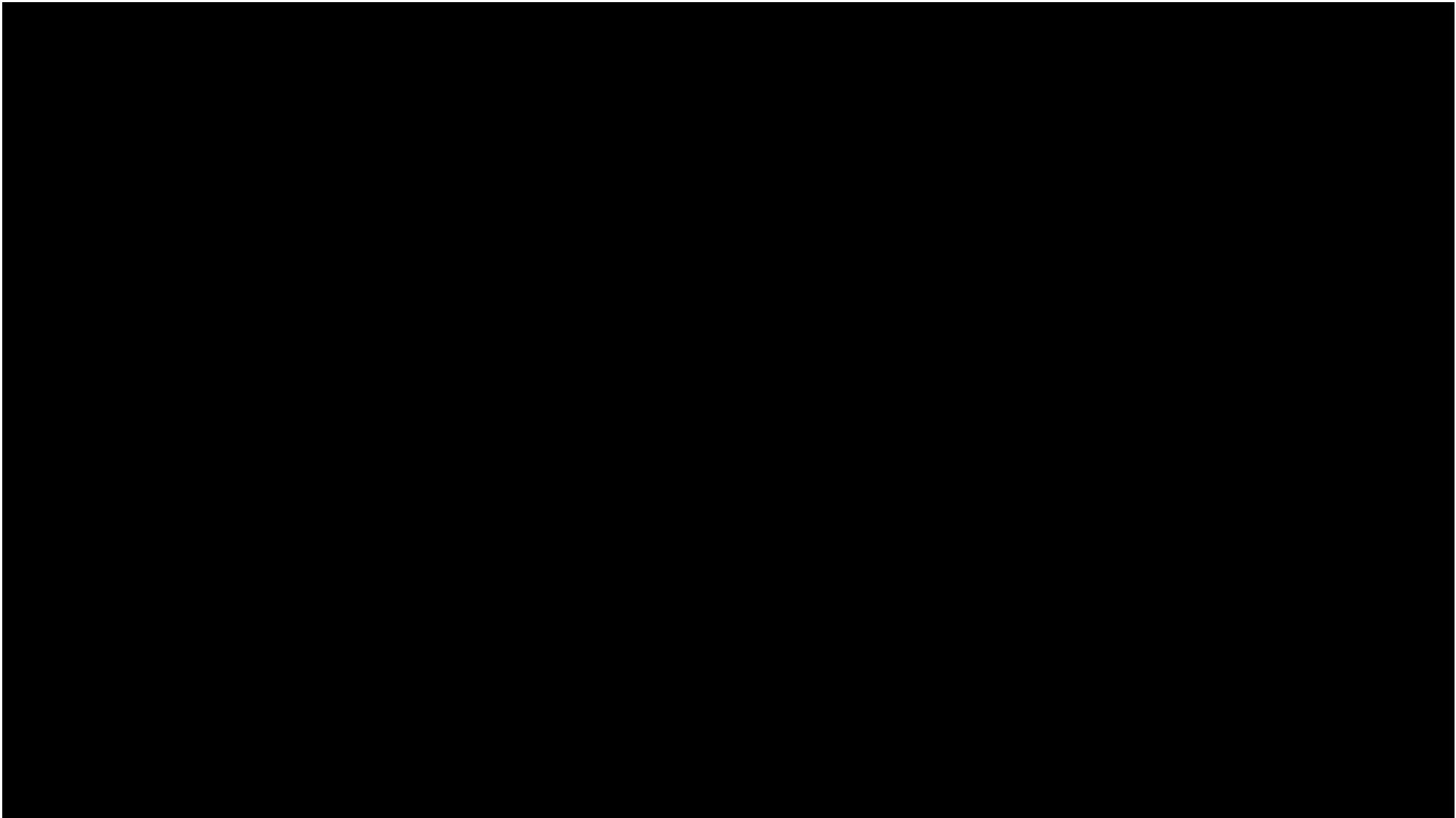


Apple
Homepod



Google
Home

Smart-home devices with **embedded** conversational agents



Smart-home devices with embedded
conversational agents:
family therapies and **interventions**
at home

PTSD

- Family interventions (e.g., couple therapy) can improve patient outcomes
- Cognitive-Behavioral Conjoint Therapy (CBCT)
 - Significantly decreases symptom severity
 - Improves relationship functioning

Monson, Candice M., et al. "Effect of cognitive-behavioral couple therapy for PTSD: A randomized controlled trial." *Jama* 308.7 (2012): 700-709.

Schizophrenia

“[Family Intervention and psychoeducation] has proved to be **one of the most consistently effective treatments** available [in schizophrenia] [...] meta-analyses put **relapse rate reduction at 50–60% over treatment as usual**. The most recent application in first episode and prodromal psychosis, combined with other evidence-based interventions, is yielding perhaps the most promising results yet achieved—**substantial return of functioning and avoidance of psychosis altogether**”

McFarlane, William R. 2016. “Family Interventions for Schizophrenia and the Psychoses: a Review.” *Family Process* 55 (3): 460–82. doi:10.1111/famp.12235.

Interventions at Home

- Home environment provides a unique opportunity for delivering effective interventions
- Mental health patients often spent **significant time in home** environment
 - patients with schizophrenia spend **15–24 hours at home per day**

Bejerholm, Ulrika, and Mona Eklund. "Time use and occupational performance among persons with schizophrenia." *Occupational Therapy in Mental Health* 20.1 (2004) 27-47.

However, eHealth and
mHealth systems **rarely** focus
on interventions at home

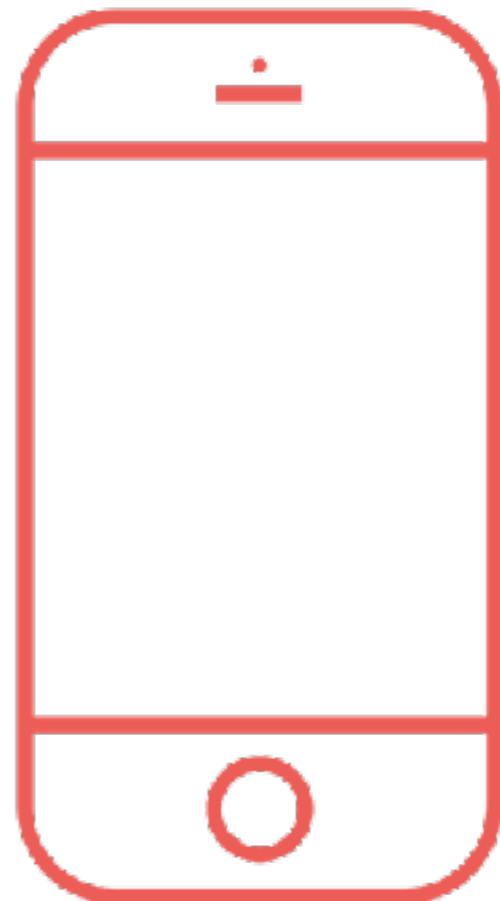
“[Only] **two** 12-month studies investigated the effects of Internet-based family interventions for patients with psychosis and their carers”

Ivarez-Jimenez, Mario, et al. "Online, social media and mobile technologies for psychosis treatment: a systematic review on novel user-led interventions." *Schizophrenia research* 156.1 (2014): 96-106.

However, eHealth and mHealth systems rarely focus on family interventions. **Why?**

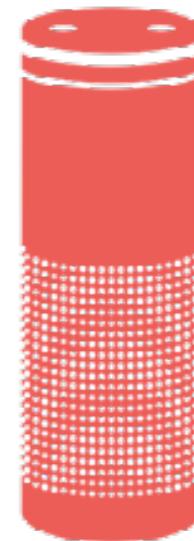
These systems are not appropriate for **shared** and **collaborative interactions**

- Smartphones are intimate and personal devices
- Lack of support for shared and collaborative interactions
- More appropriate for **individual focused** interventions



Smart-home devices with embedded conversational agents

- Leverages the **shared and collaborative aspects** of family and home environment
- Enables interactive, personalized, and timely delivery of interventions at home?



Amazon
Alexa

My research focus:
Conversational agents for **a new**
model of collaborative care at home

Conversational agents for intervention delivery

- Family psychoeducation
- Behavioral and cognitive therapies (e.g., CBT)
- Day-to-day support
 - goal settings, social skills
- Illness management

Current project

- Effective treatment delivery in PTSD using Amazon Alexa
- Collaborative work with Steffany Fredman & Linda Collins
- Cognitive-Behavioral Conjoint Therapy (CBCT)

Cognitive-Behavioral Conjoint Therapy (CBCT)

- Relationship problems including distress and aggression are associated with PTSD
- Negative interpersonal relations predict **worse** treatment outcomes

Cognitive-Behavioral Conjoint Therapy (CBCT)

- association between symptoms in PTSD and intimate relationship issues is **bidirectional**
- Illness onset can contribute to relationship issues, which in turn **worsens** patient symptoms
- problematic interpersonal environment can **hinder** illness management and recovery

Cognitive-Behavioral Conjoint Therapy (CBCT)

- Form of **couple therapy**
 - “the couple, and more specifically their communication and interacting belief system, is the patient”
- Focuses on **simultaneously** treating symptoms and enhancing relationship functioning

Cognitive-Behavioral Conjoint Therapy (CBCT)

- 15 sessions
- Each session is 75 minutes long
- Focuses on psychoeducation, behavioral and cognitive interventions
 - e.g., addressing avoidance behavior, constructive communication, better conflict management

Cognitive-Behavioral Conjoint Therapy (CBCT)

- Out-of-session exercises
assignments for skill acquisition

Add images

Cognitive-Behavioral Conjoint Therapy (CBCT)

- Validated as an effective intervention method
- Based on data from 40 couples
 - Decrease in PTSD symptoms (**3 times better** than wait-list condition)
 - Significant increase in relationship functioning

Monson, Candice M., et al. "Effect of cognitive-behavioral couple therapy for PTSD: A randomized controlled trial." *Jama* 308.7 (2012): 700-709.

Cognitive-Behavioral Conjoint Therapy (CBCT)

- However, scalability is a problem
 - long clinical sessions over multiple weeks
 - resource intensive and require specialized training

Conversational agents as
assistive tools to support and
complement CBCT steps

Amazon Alexa for CBCT

- Psychoeducation at home
 - “what are the symptoms of PTSD?”
- Compliance and engagement
 - out-of-session exercises
 - data collection and reminder
- Longitudinal skill sustenance after clinical sessions
 - e.g., breathing exercise for anger management

Amazon Alexa for CBCT

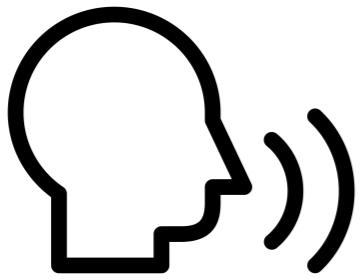
- In development
- A demo system in a month (hopefully!)

Amazon Alexa for CBCT

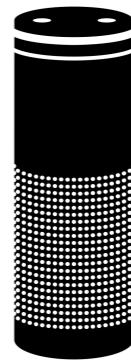
- Alexa applications (“skills”)
 - user initiates interaction by using a keyword
 - external notifications

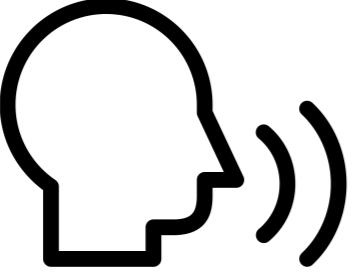
Amazon Alexa for CBCT

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Alexa ask Heka what are
the symptoms of PTSD?

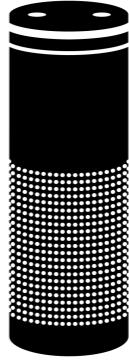


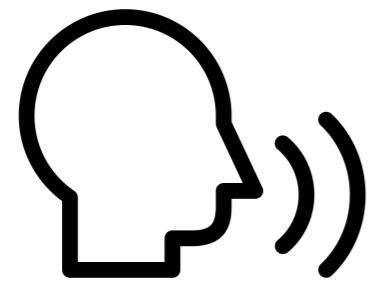


Wake word



Alexa ask Heka what are
the symptoms of PTSD?



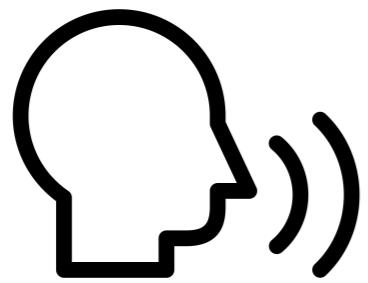


Skill name



Alexa ask Heka what are
the symptoms of PTSD?





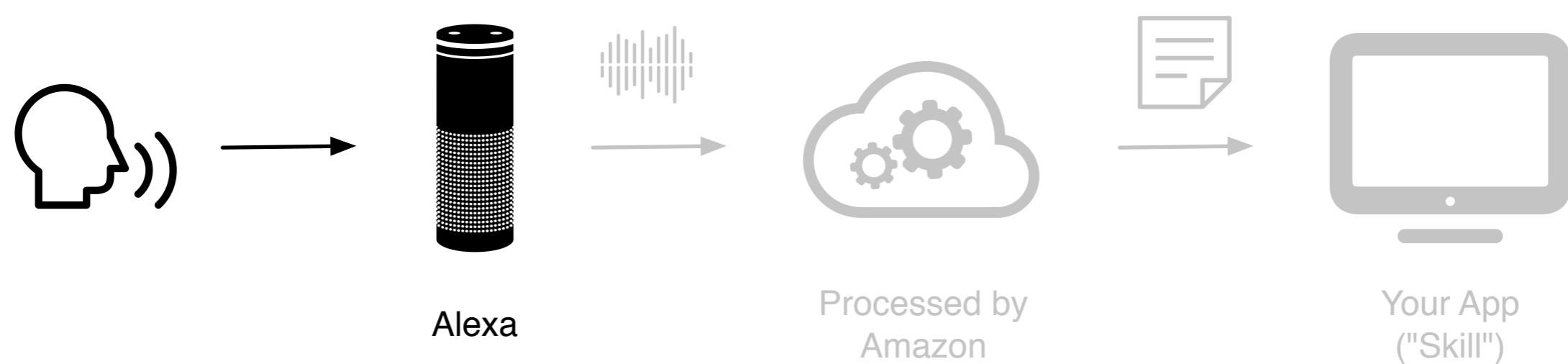
Information

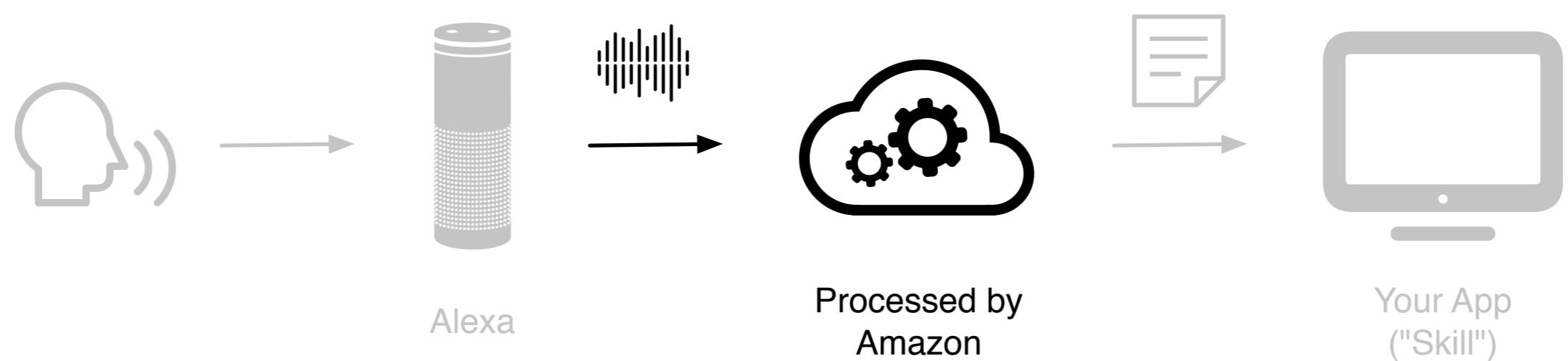


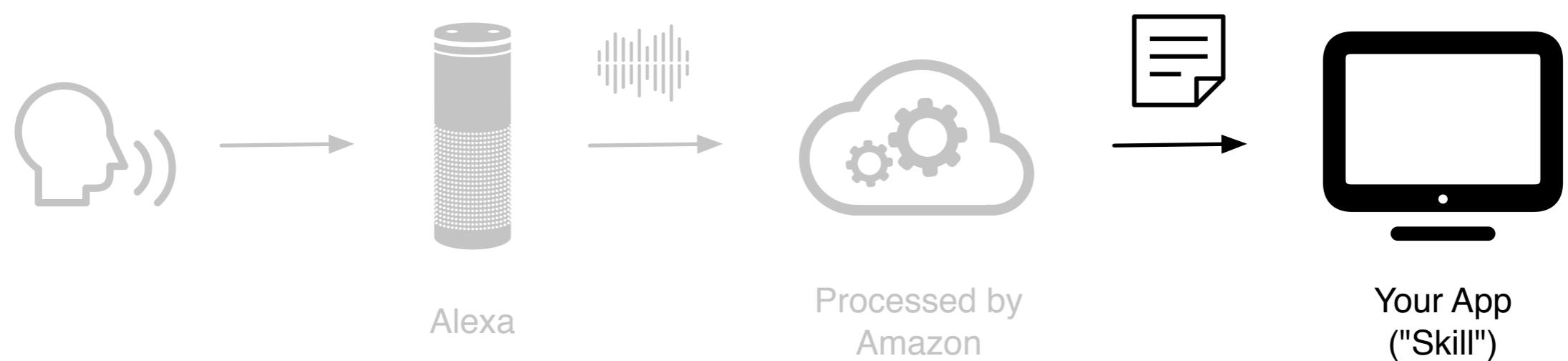
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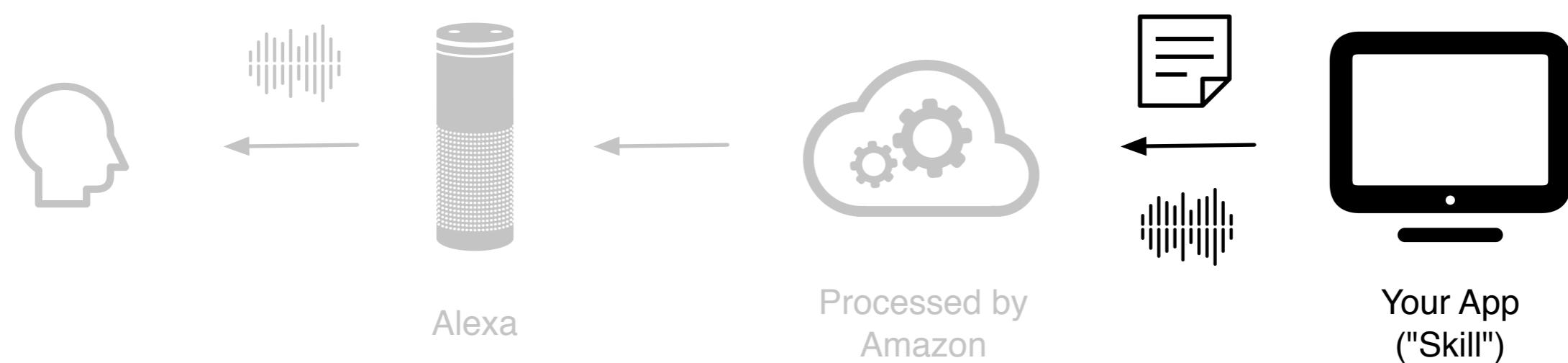


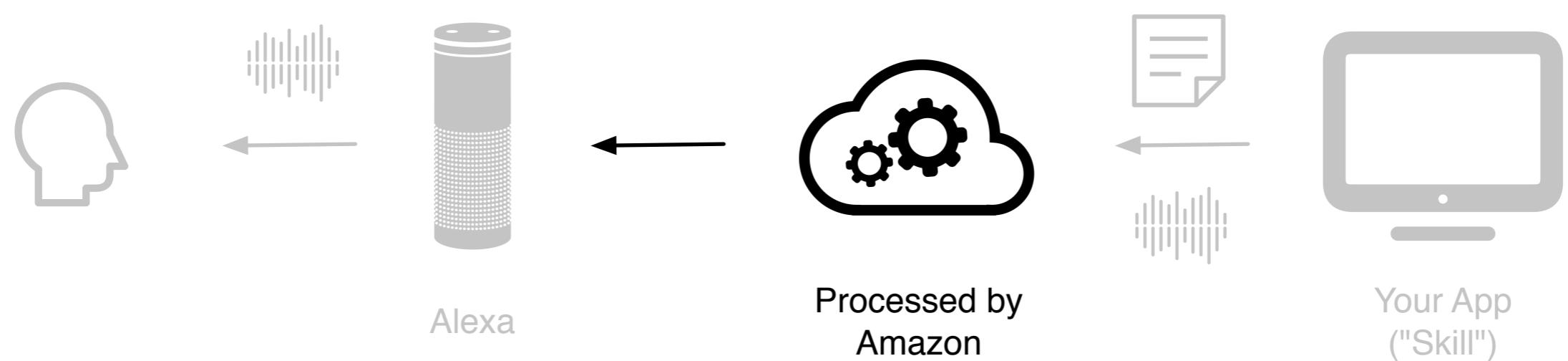
Processing information
from Alexa

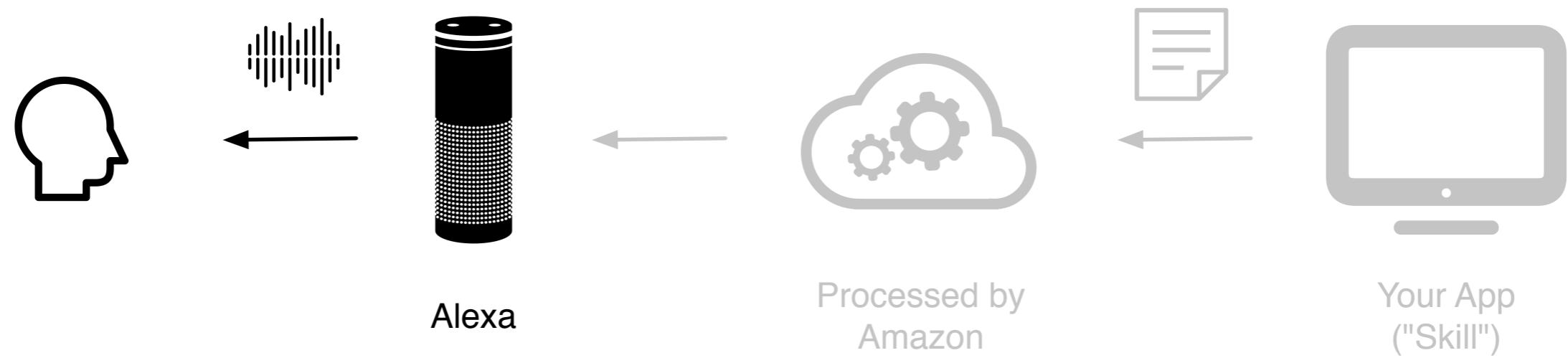


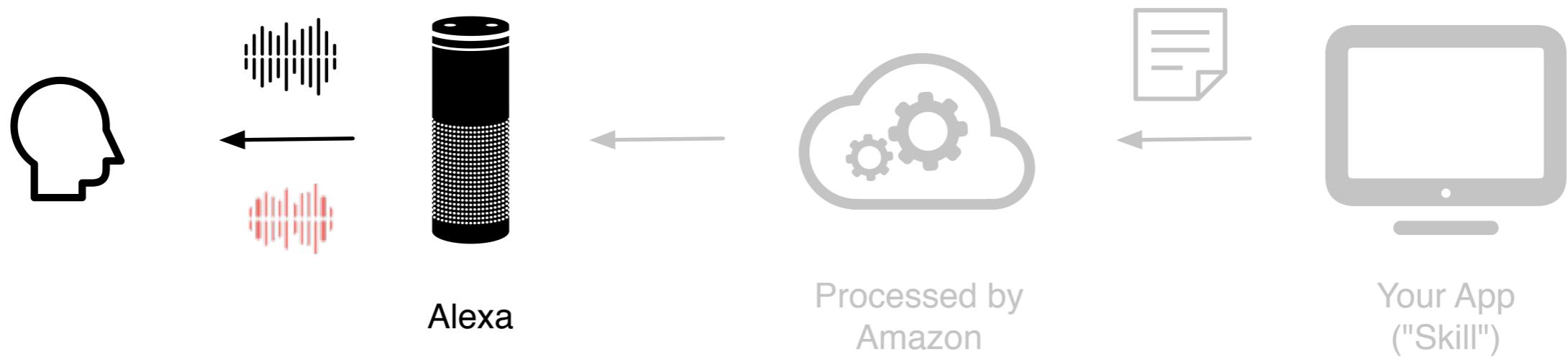




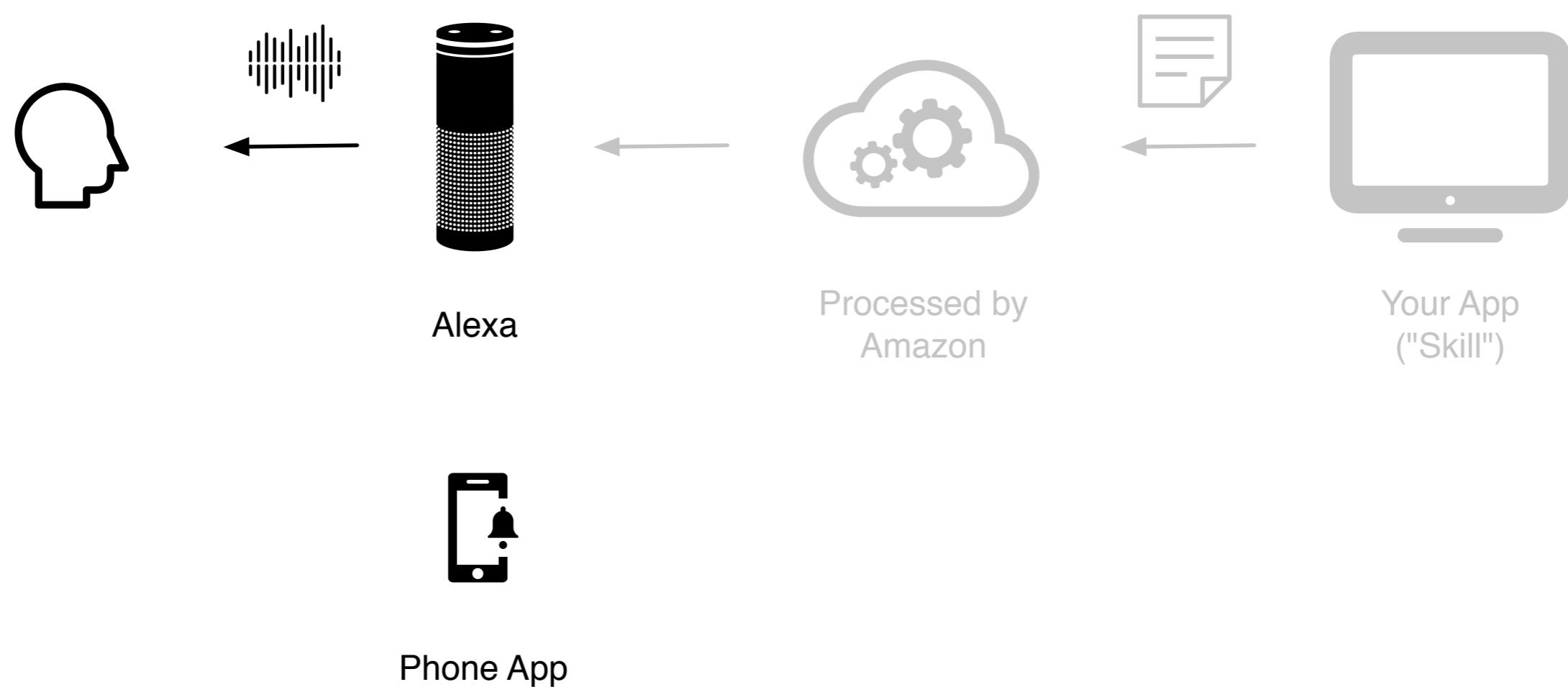








You can determine how the response is spoken by Alexa (prosody, pitch, speed) — making responses more natural

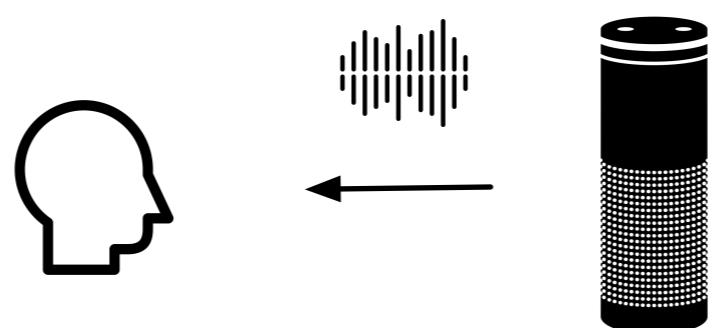


Amazon Alexa for CBCT

- Alexa applications (“skills”)
 - user initiates interaction by using a keyword
 - external notifications

Amazon Alexa for CBCT

- Alexa applications (“skills”)
 - user initiate interaction by using a keyword
 - **external notifications**



Alexa



Phone App

Notifications

- Useful for reminder and engagement
- Not available for all systems yet

Potential **challenges** in using
conversational agents for
intervention delivery

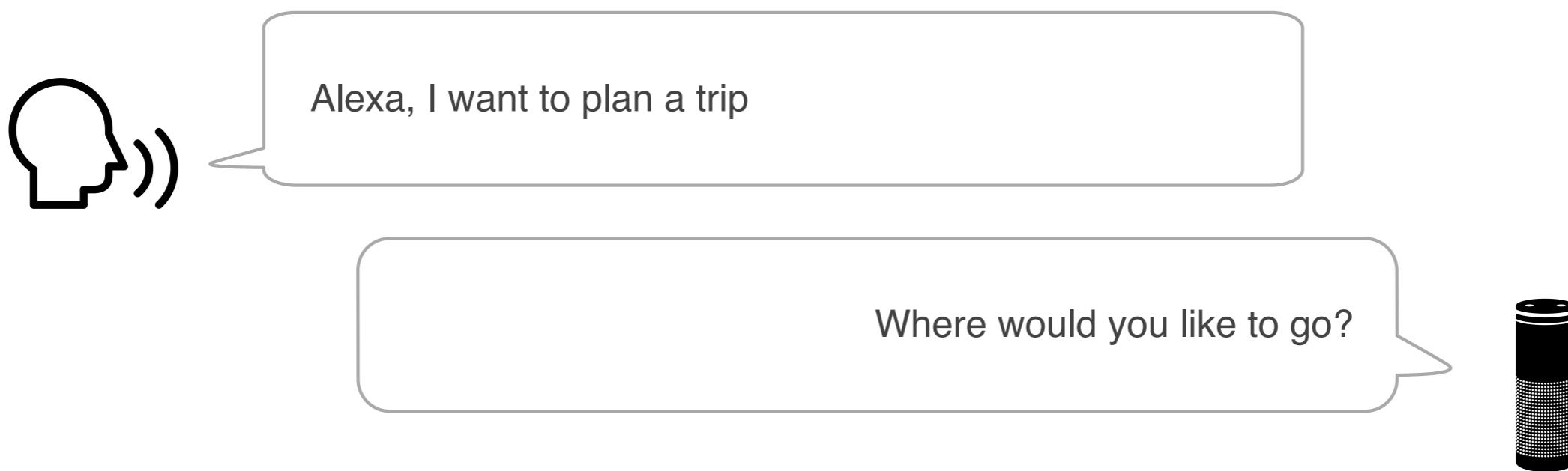
Interactions with conversational agents are fundamentally **different** than reading (or using phone)

Intervention through conversational agents requires a different interaction model compared to mHealth or eHealth systems

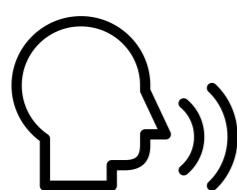
Adapting intervention steps to conversational agents

- Interactions should be short and directed
- Clearly define and indicate when users should provide information

Adapting intervention steps to conversational agents



Adapting intervention steps to conversational agents



Alexa, I want to plan a trip

Let's plan this trip. Say, "I'd like to go to a city name" to say where you'd like to go. Say, "I'll leave on a specific date" to say when you're leaving. Say, "I'm leaving from a city name" to say your departure city. What would you like to do?



Adapting intervention steps to conversational agents

- Better to **provide options** when asking for information
- Limit options to 3 at most
 - otherwise, hard for users to remember
- Provide definitive options

Adapting intervention steps to conversational agents

I can record your mood or symptoms. What would you like to record?



Good

Would you like to record mood or symptoms?



Bad

Adapting intervention steps to conversational agents

- Brevity is key when responding to users
 - one-breath test
- Implications for psycho-education modules
 - long list of text would not work
 - should be short and interactive

Adapting intervention steps to conversational agents

- Handle errors gracefully
 - easy to get frustrated when using voice interactions
 - train your users (in a subtle way!)
 - learn from users

Adapting intervention steps to conversational agents

- Converting an **existing** intervention method to conversational agent?
 - start with script and role-playing
 - develop a flow
 - keep turns brief
 - focus on natural interactions (how people talk — not how they read)

Adapting intervention steps to conversational agents

- Amazon and Google provide good design resources
 - <https://developer.amazon.com/designing-for-voice/>

Engagement

- Long-term engagement is important
 - users need to initiate interactions with your application
- Issues related to engagement
 - “shallow” interactions
 - repetitive

Engagement

- Establishing a routine of use
 - psycho-education at the beginning of each day
 - data recording at the end of the day
- Use mobile app as an assistive system?
- Develop a persona?

Manage Expectations

- Users overestimate capabilities of conversational agents
 - any failure is judged more harshly
- Convey capabilities and limitations
- Train your user to understand why it might fail

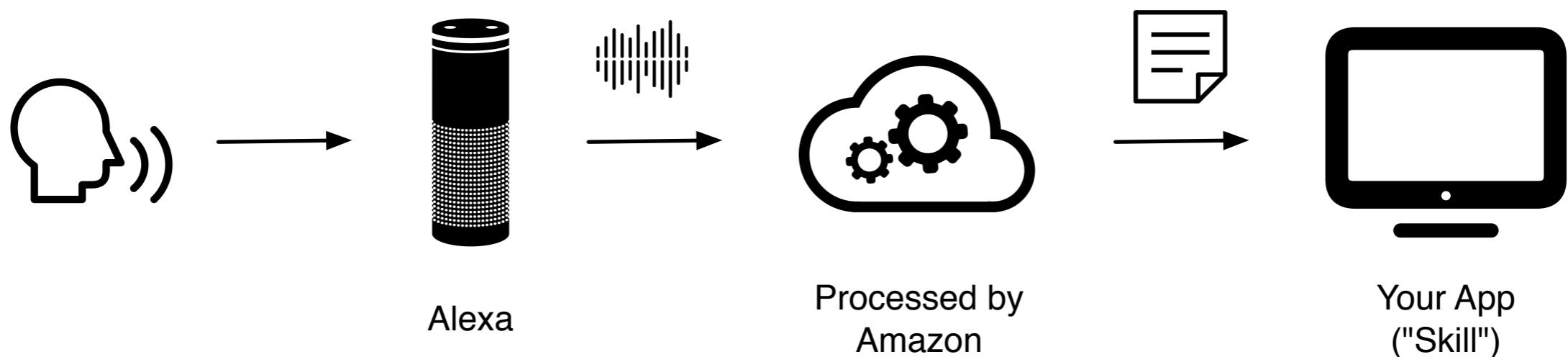
Manage Expectations

- Expectation management is particularly important in the context of mental health
 - a clinician is not listening 24/7 to provide help

Privacy & User Safety

- Particularly sensitive data
 - information collected from home
 - from a vulnerable population
- Who has access to collected data?

Who has access to data?



Privacy & User Safety

- User data and your response goes through Amazon
- It is **not** HIPAA compliant (yet)

Privacy & User Safety

- Need to be particularly careful about data
 - keep information collection minimal
 - do not ask questions with potentially sensitive answers
 - clearly define your application scope and data need
 - communicate to your users

Conversational Agent & Mental Health Care

- History and background
- Woebot — conversational agent on smartphone
- Need to go beyond smartphone
 - focus on family therapy and intervention at home
- Current project: treatment delivery in PTSD using Alexa
- Unique (and difficult) challenges that need to be addressed

Conversational Agents:
there are some challenges but
also **exciting opportunities** for
mental health care

Thank you!