

# Designing a Voice Assistant-based Prompting System

## Summary of Research Study

### Overview

Previous research determined how the cognitive effects of a brain injury can limit the usability of Voice Assistants, and the different factors that can affect the UX of VAs, and their efficiency as cognitive aids. Additionally, previous studies showed potential ways to improve the usability of VAs by employing certain design characteristics to their voice user interface.

This study aimed to assess the efficacy and applicability of the different design solutions to identified usability barriers, and look for new methods to increase the usability of VAs for people with ABI. This was accomplished through the evaluation of the design of a **prototype VA-based prompting system**, which aims to increase the independence of people with cognitive impairments due to ABI. The VUI of the prototype was evaluated through an **Expert Review** study with eight experts in the fields of Human-Computer Interaction (HCI) (n=4) and brain injury rehabilitation (n=4). The participants were presented with the different aspects of the system's interface and provided feedback on its design.

The results were analysed to determine how the VUI of the prototype should be designed to: 1) Convey information to the user; 2) Provide prompts; 3) Enable users to insert information to the system, 4) Monitor and assess the user's activity, and 5) Increase the system's learnability.

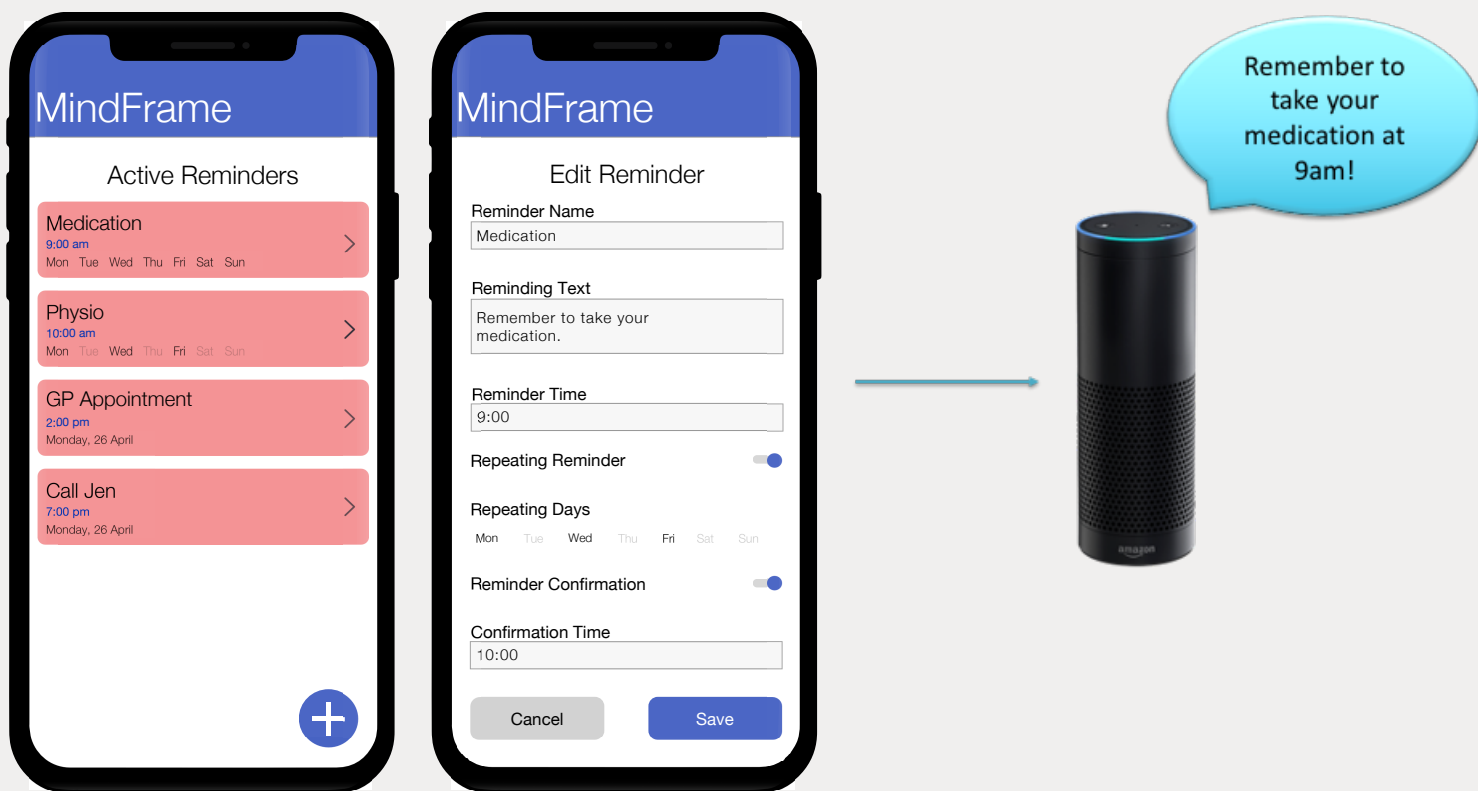
---

### Prototype design

*Mindframe*, the prototype designed for the purposes of this study, is a multi-functional skill for Amazon's Voice Assistant (Alexa), which enables people who provide support to a person with ABI (professional carers, family members, therapists) schedule prompts through a web or mobile interface. The prompts are then conveyed to the end user (person with ABI) through a smart speaker (Amazon Echo) in an unsolicited manner, at the programmed time and date. Mindframe also enables users to use its Voice User Interface to: 1) Receive a list of all the reminders programmed for a specific day; 2) Receive a list of missed or unconfirmed reminders; 3) Create new reminders, and 4) Modify or delete existing reminders.

### Methods

The *System in the Loop* method was used for the development and evaluation of the prototype, implementing only the functionality of the system that was needed to collect the required data. The participants of the study interacted with the skill through the testing simulator provided by Amazon's Alexa developer's console.



A set of *storyboards* were used to explain the concept of the prototype to the participants, as well as different discussion topics (such as potential challenges in using the system). Two different *personas* of potential users were created based on data collected from previous studies, which were shown to the participants at the beginning of the study, outlining some of the most common difficulties in people with ABI that were found to affect the usability of VAs.

The participants were asked to interact with the prototype to perform the following tasks:

1. Receive the day's schedule
2. Receive a reminder
3. Create a reminder
4. Edit a reminder

For each task, a number of different versions of the VUI had been implemented, employing different approaches in the design of the interface based on results from previous studies. Each task was repeated a certain number of times, enabling participants to interact with the system using the different versions of the VUI.

After completing the tasks, the participants were asked to provide insights on the design of the prototype's VUI in the following areas:

1. **Confirmations for task completion:** ways to overcome issues induced by poor cognitive performance, such as forgetting the prompt a short time after it is received, not being able to remember the prompt's purpose, or being distracted before completing the intended task.
2. **Teaching users how to use the system:** what would be the most suitable ways for people with cognitive impairments due to ABI to learn how to effectively and independently use a system like Mindframe.
3. **Monitoring the user's activity:** Potential ways that a tool like Mindframe could benefit people with ABI by monitoring their daily activity and supporting their long-term memory and facilitating the rehabilitation process.

The audio of the sessions was recorded and transcribed, and the transcribed data were analysed using Deductive Thematic Analysis, the framework for which was based on the objectives of the Study and the overall research objectives of the thesis. The findings were analysed to create a set of **design guidelines** for VA-based prompting systems, for people with Acquired Brain Injury:

### **Lists of reminders/tasks**

1. Memorisation of list items should not be expected, regardless of the list's size.
2. Can be useful for providing an overview of daily tasks/schedule.
3. First item should be emphasised/re-iterated (in the case of upcoming tasks).
4. Items on the list should be prioritised based on their importance, or execution time (for tasks).
5. Users should be informed of the current time.
6. Search functionality for specific items should be provided, after the list is conveyed.
7. Easier to process when the user is looking for a specific item on the list (e.g. when changing a reminder).
8. Repetition can cause frustration but is recommended, if the contained items are part of the user's schedule.
9. Easier to process or retain when the user is familiar with the contained information.

### **Reminding prompts**

1. Unsolicited prompts are useful, but depend on user's proximity to the device.
2. Users are unlikely to react to the notification indication of smart speakers (light).
3. Important or urgent missed prompts should be repeated at regular intervals, until user confirmation.
4. Current time should be provided, if relevant.
5. Should be phrased to prompt immediate action.

### **Confirmation prompts**

1. Require different wording than the original prompt.
2. Should allow users to mark prompts as delivered, or tasks as completed by:
  - a. Allowing users to unpromptedly notify the system that they have completed a task.
  - b. Being phrased as questions, expecting a yes/no answer from the user.
3. Should be repeated at regular intervals, until user confirmation (where applicable).

### **Information input**

1. Ensuring correct information input is essential in the case of reminders.
2. Single-utterance input is very demanding when containing multiple pieces of information (e.g. creating a reminder)
3. Breaking down input to small steps (one piece of information at a time) can improve information recall and input errors.
4. Open-ended questions (e.g. *'what would you like to do'*) can be confusing and lead to input errors.
5. Confirmation dialogues should be given only once, after input completion, offering the option to start over or change a specific item in the case of an error.
6. Switching between interface modes (e.g. from structured to flexible) should be decided by the carer/therapist.

### **System help**

1. User tutorial should be provided which:
  - a. Is automatically enabled the first time the system is used.
  - b. Walks users through the completion of training tasks, giving detailed instructions and feedback for every step.
2. A 'help' command should be available, providing the following options:
  - a. Describe of what the system can be used for, providing example queries.
  - b. Launch the tutorial for a specific function.
  - c. Provide guidance for the task currently performed by the user.
3. Help should be given automatically when the system detects consecutive errors, or phrases like *'I don't know what to do'*.

### **Monitoring**

1. Users should be asked to input their activity, once per day, at a specific time.
2. Users should be asked to confirm the completion of specific activities in their schedule. Open-ended questions should be avoided (e.g. *'what did you do today'*).