

# Predicting Activity Transitions for Prompting



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## Introduction

### Purpose

To develop a machine-learning algorithm that will detect transition periods between activities. Then, we will assess whether context-aware transition period prompting will be more effective than traditional time-based prompting.

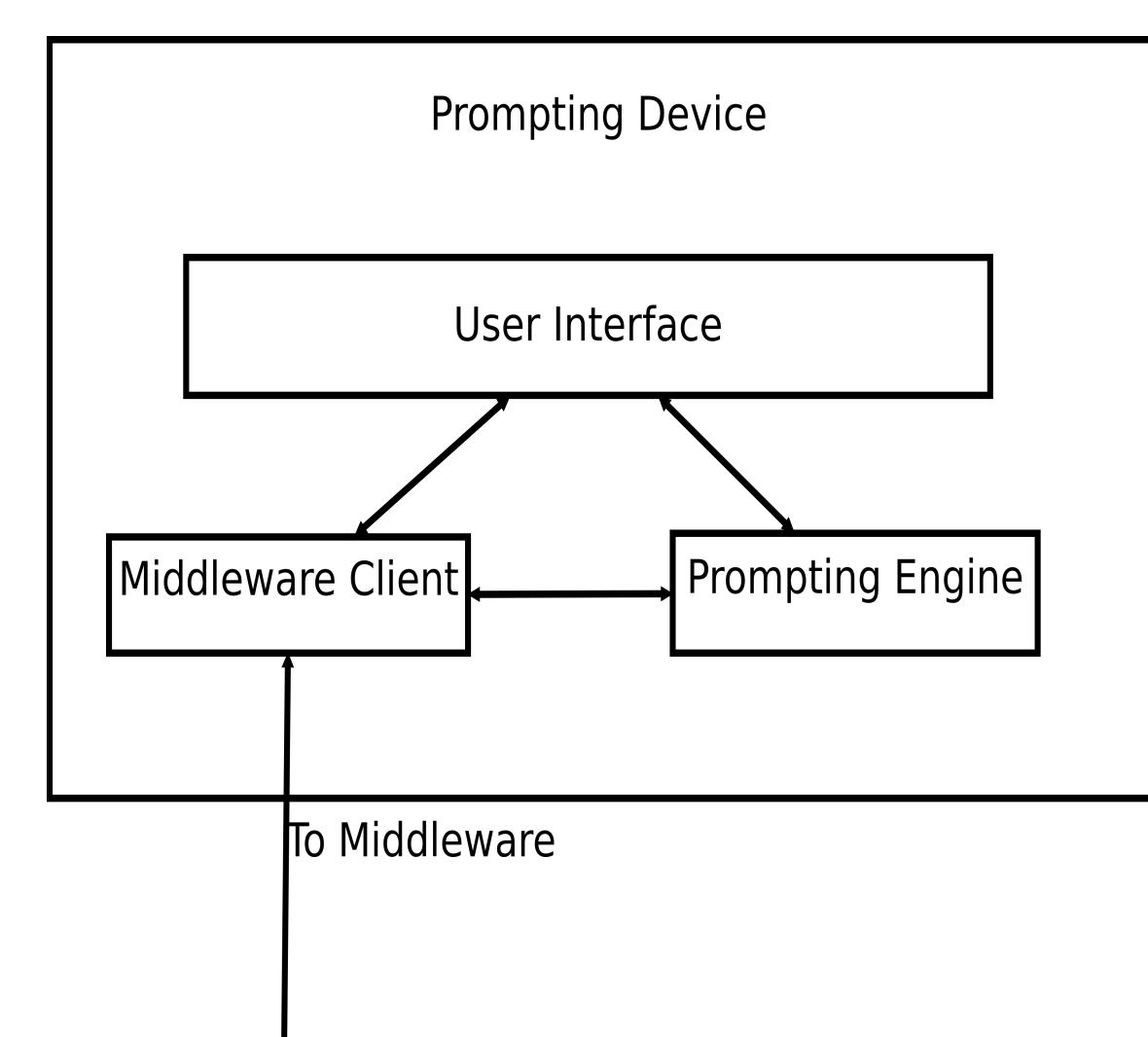
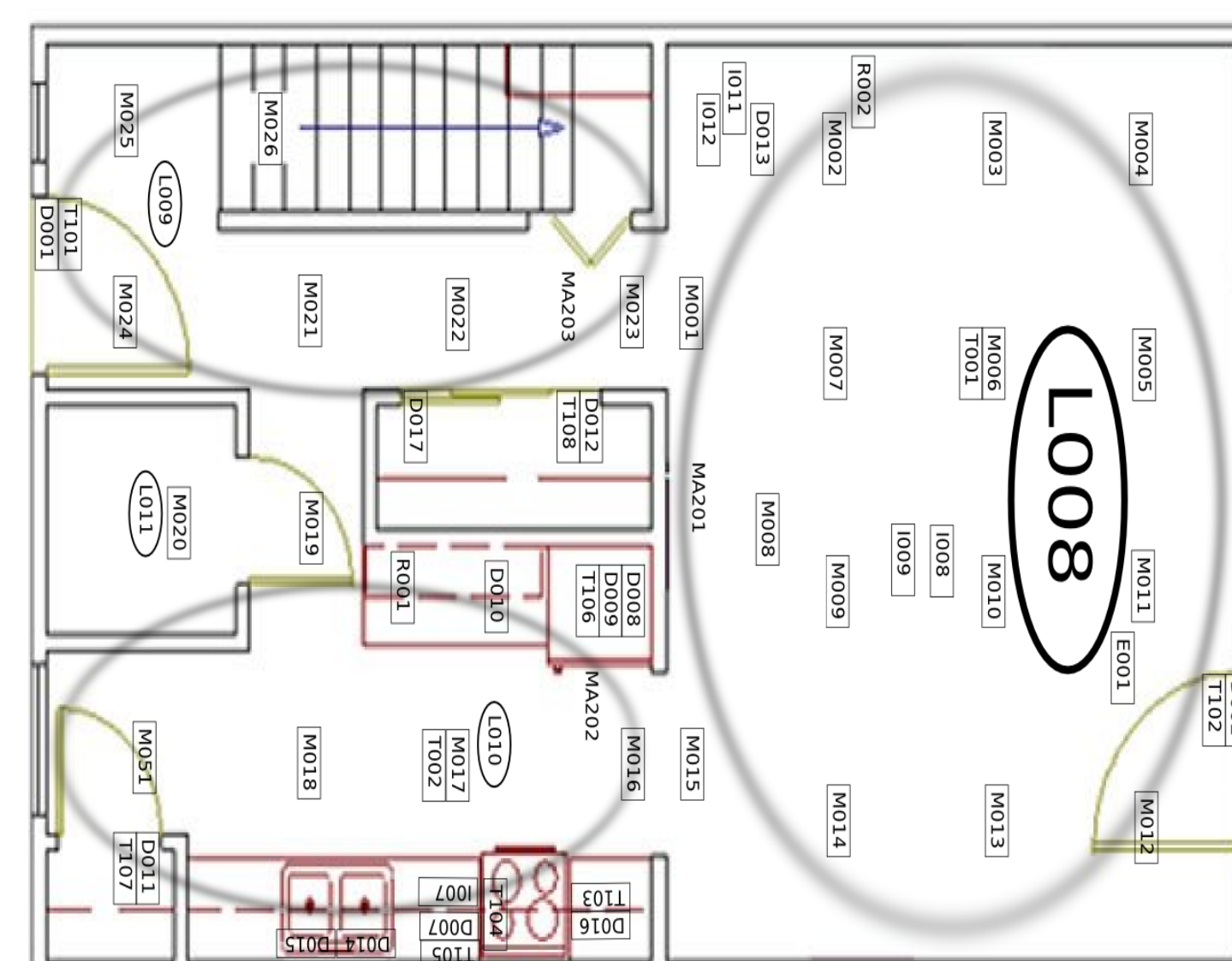
### Background

- Prompting technologies have gained popularity because of their effectiveness to increase successful activity completion for people with cognitive impairments<sup>1-3</sup>.
- Studies have shown that delivering prompts at convenient times is a crucial factor for adherence to prompts<sup>4</sup>.
- Context-aware prompting is more effective than time-based prompting; however, limitations of context-aware prompting still exist<sup>5-6</sup>.
  - Assumptions of context-aware prompting set by the experimenter are not always correct.
- Prompting during activity transition, when a person is not engaged in anything, may be the most effective prompting time. Thus, prompting during transitions will lead to better task performance because there will not be a requirement to divide attention between the task at hand and the task immediately following.

## Methods

### Experiment #1: Developing and Testing Machine Learning Algorithm

- 15 undergraduate participants
- Participant's performed 12 everyday activities in a smart environment.
- Gathered labeled data that was used to train the machine learning algorithms to detect transitions between activities.



- Two different methods to detect transitions:
  - Supervised learning using a decision tree (AR).
    - Features: Window size (in time), time sensor for previous sensor event, dominant sensor for the previous two windows, sensor counts for the current window, and time since the last sensor fired (for each sensor).
  - Unsupervised learning using RuLSIF to detect changes in sensor distributions (CD).
    - Used current state of the sensors as features.

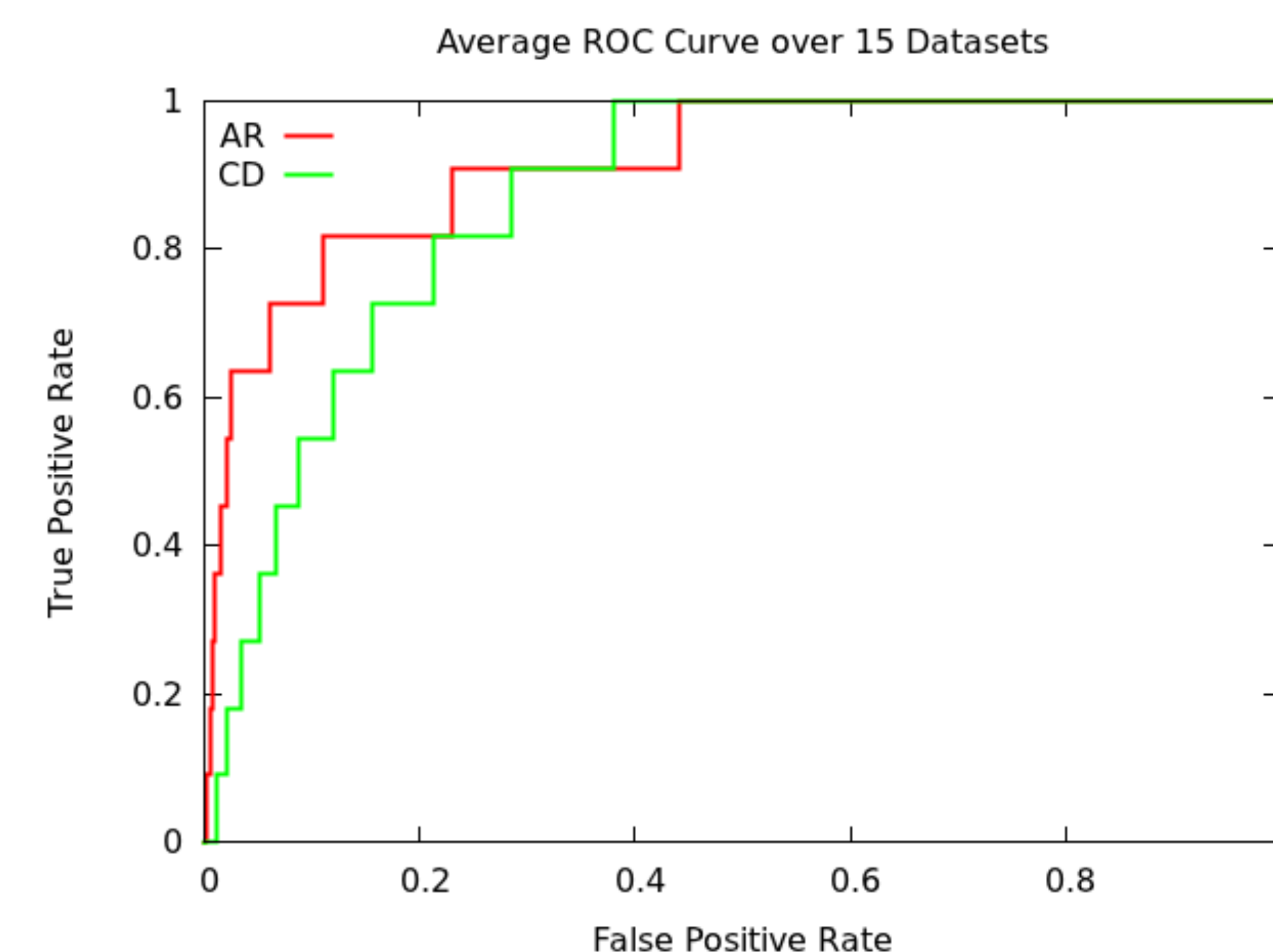
### Experiment #2: Evaluating whether transition-based prompting is more effective than time-based prompting.

- 15 undergraduate participants
- Participant's performed 12 randomized everyday tasks in the smart apartment and were prompted to record their activities in a digital memory notebook.
- Participant's received one of two prompting conditions: time-based on transition-based.
- Outcome measures: Use of digital memory notebook and questionnaire.

## Results

### Experiment #1:

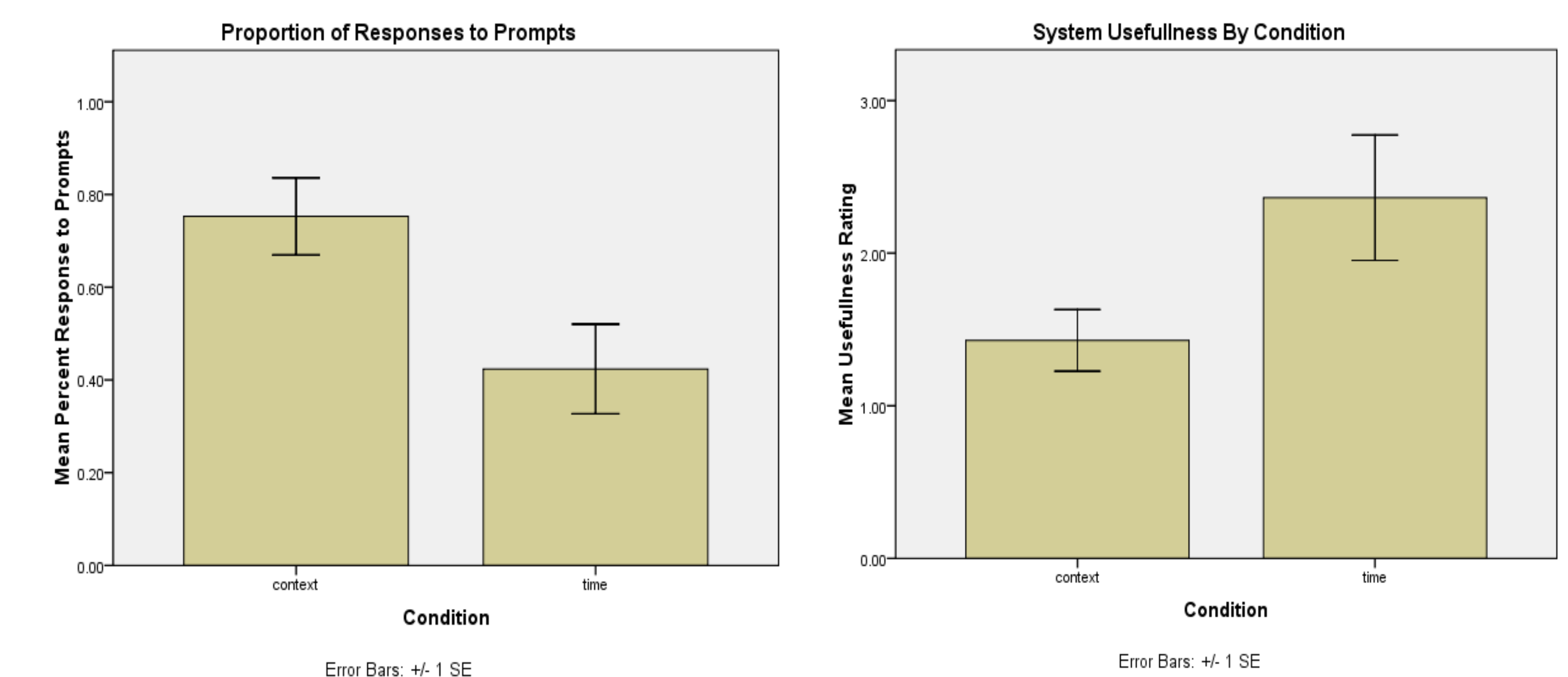
- The supervised and unsupervised techniques performed comparably, as can be seen below.



- The ROC curve shows that we can achieve on average an 80% true positive rate, while maintaining a false positive rate of less 25% with either technique.
- Although the supervised learning technique performs slightly better than the unsupervised technique in these trials, the results of a t-test indicate there is no statistically significant difference between the two techniques.

### Experiment #2:

- Preliminary results reveal that the participant's in the transition-based condition rated the system significantly more useful compared to participant's in the time-based condition.
- Furthermore, the participant's in the transition-based condition responded to the first prompt 30% more, on average, than the participant's in the time-based condition.



## Discussion

- We were able to detect transition periods using supervised and unsupervised techniques, which is important for the future development of effective prompting technologies, as well as other technological interventions that rely on activity recognition.
- Preliminary results reveal that individual's find transition-based prompting more useful and choose to respond to prompts during transition periods more often than time-based prompts. Thus, prompting during transition periods will increase the effectiveness of interventions that utilize prompting technologies.

### References

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