Digital Memory Notebook: Experimental Evaluation of Motivational Reward Strategies

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INTRODUCTION

Background

An estimated 5.4 million Americans are diagnosed with AD, with rates on the rise. With this comes an increased need for methods to automate caregiving tasks such that we can reduce the costs and burden associated with caregiving [1]. A Digital Memory Notebook (DMN) can help individuals record independent activities of daily living, and prompting technology can help users remember to write in the DMN [2].   Previous work has shown that prompts delivered during activity transitions are more effective than prompts delivered at specific time intervals [3].

Purpose

We aim to show that a simple scalable reward can further increase compliance to transition-based DMN prompts.   We test both a gain-on-compliance and loss-on-noncompliance model to determine which reward structure better fits this environment.

METHOD

Participants and Procedures

- 48 undergraduates (Mean age = 19.96, range = 18-24) performed twelve randomly-ordered activities in a Smart Apartment on the WSU campus.
- Participants were asked to record their completed activity after being prompted by a voice message from the DMN. There were a total of 11 voice message prompts issued from the DMN, each prompt issued between each activity completion.
- Two experimenters recorded the participants' activities, delivered prompts, recorded use of the DMN and launched the Sudoku by using Real-Time Annotation (RAT) in the control room in the Smart Apartment [4].
- After activity completion a Sudoku puzzle (obtained from the Google Play Store) was generated through the DMN for which the participant had up to 30 minutes to complete.
- Participants were given a questionnaire assessing demographic information, the prompting interface, and reward motivation (see Figure 3).

Technology Design and Implementation

- DMN → Samsung Galaxy Note tablet 10.1
- Extended RAT interface with features for Sudoku launch and compliance tracking. Extended Android interface with progress bar which showed participant's compliance.
- The participants were informed of their progressive compliance via Android notification sound (whistle).
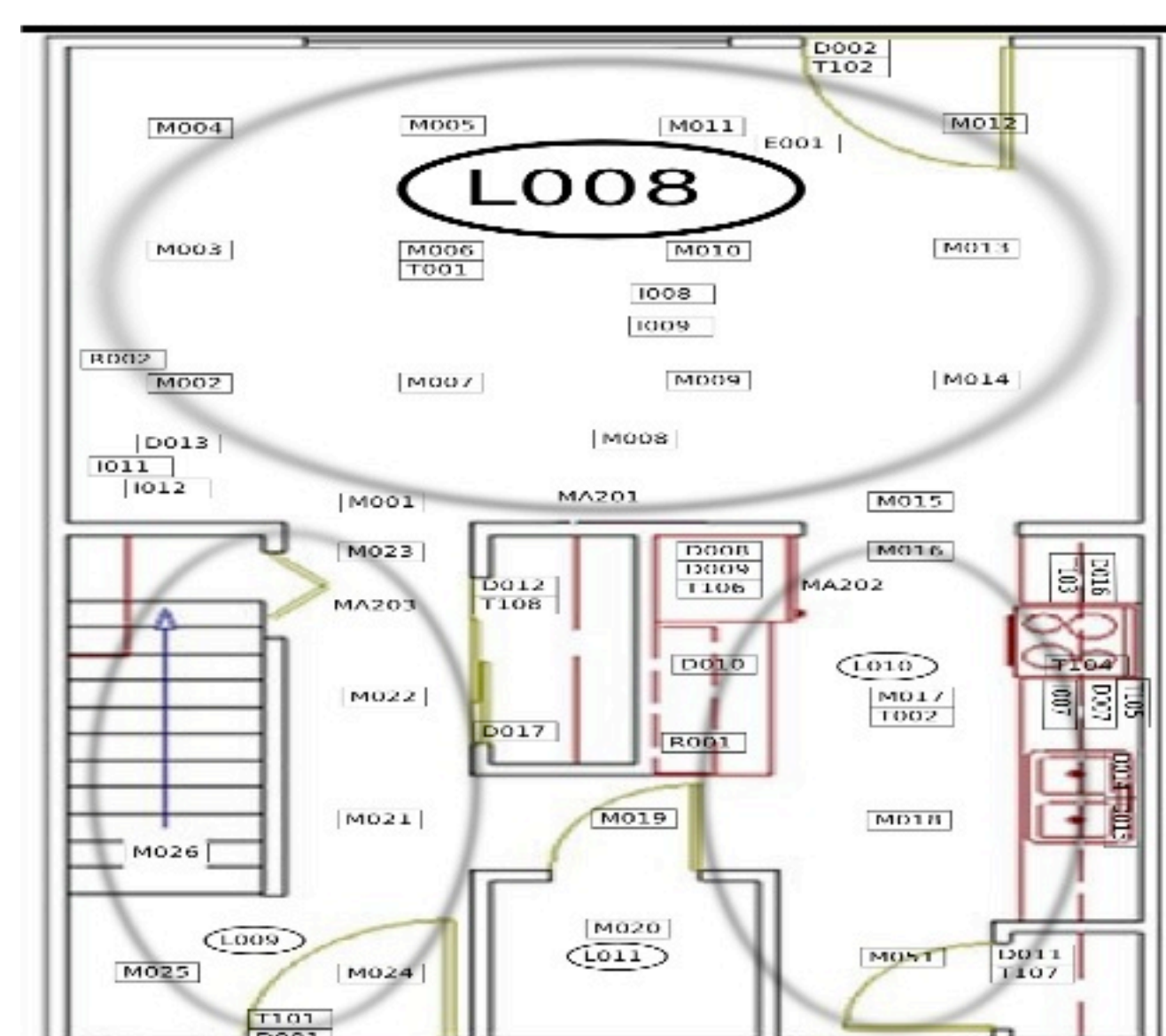

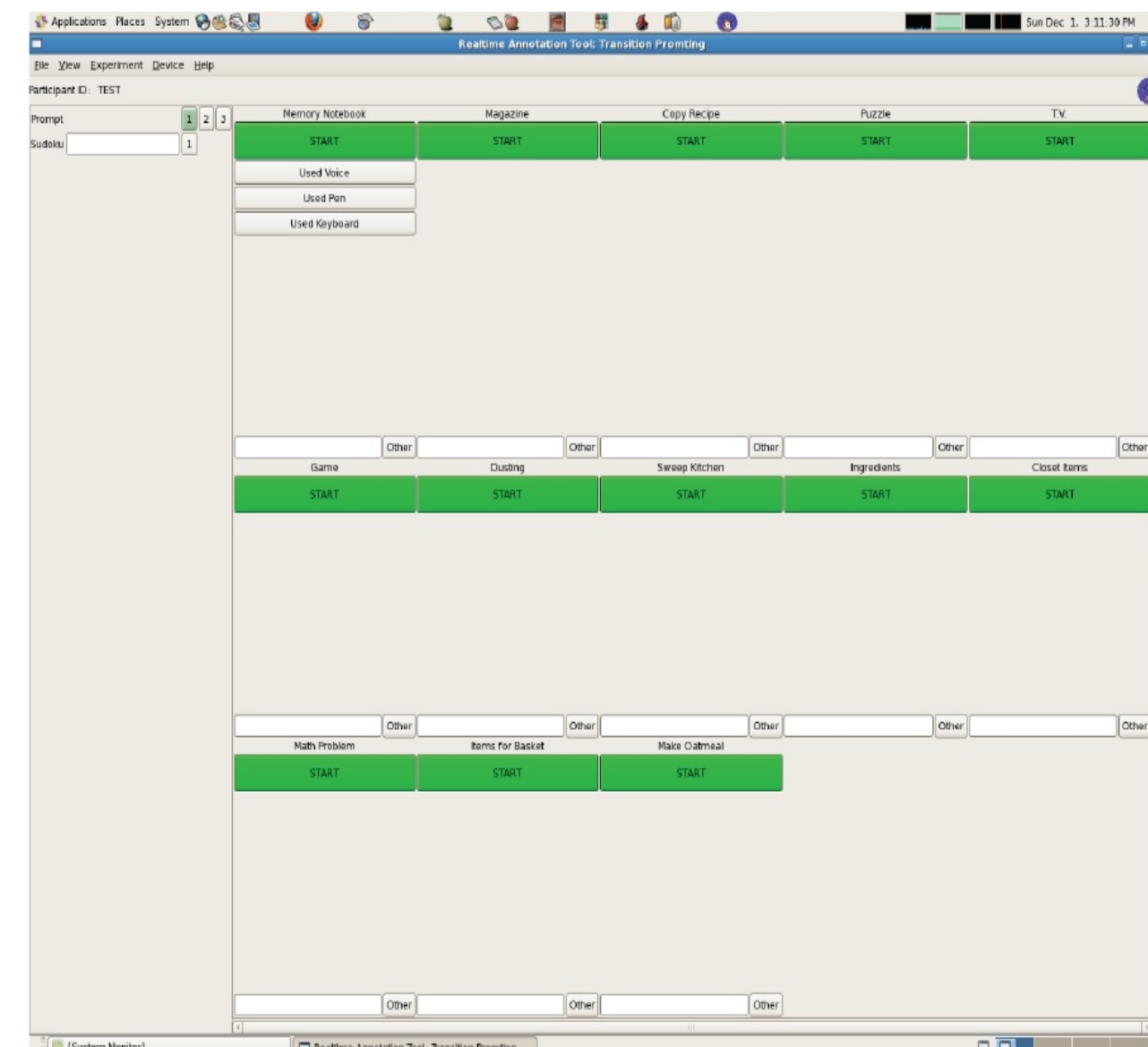**Figure 1. Layout of the on campus Smart Apartment with sensor location.**

Figure 2. Real-Time Annotation (RAT) interface.

METHOD

Reward structure

- Assistance of a Sudoku puzzle through the use of compliance rate was selected as a reward type because of its scalability and motivational gaming aspect.
- Difficulty of solving the puzzle was reduced by complying to the prompts.
- Two conditions were used for motivating the participants' to comply to the transition-based prompts.
- Standard (N=14): If participant complied by responding to the DMN prompt and recording their activity,   a number was filled in the Sudoku puzzle to assist in the completion of their puzzle at the end of the study.
- Take-away (N=11): Participant began the study with the max amount of boxes filled in the Sudoku puzzle, however if the participant did not comply, a number was removed from the puzzle as a sign of penalty.
- The effect of each strategy is measured in terms of number of compliances.

RESULTS

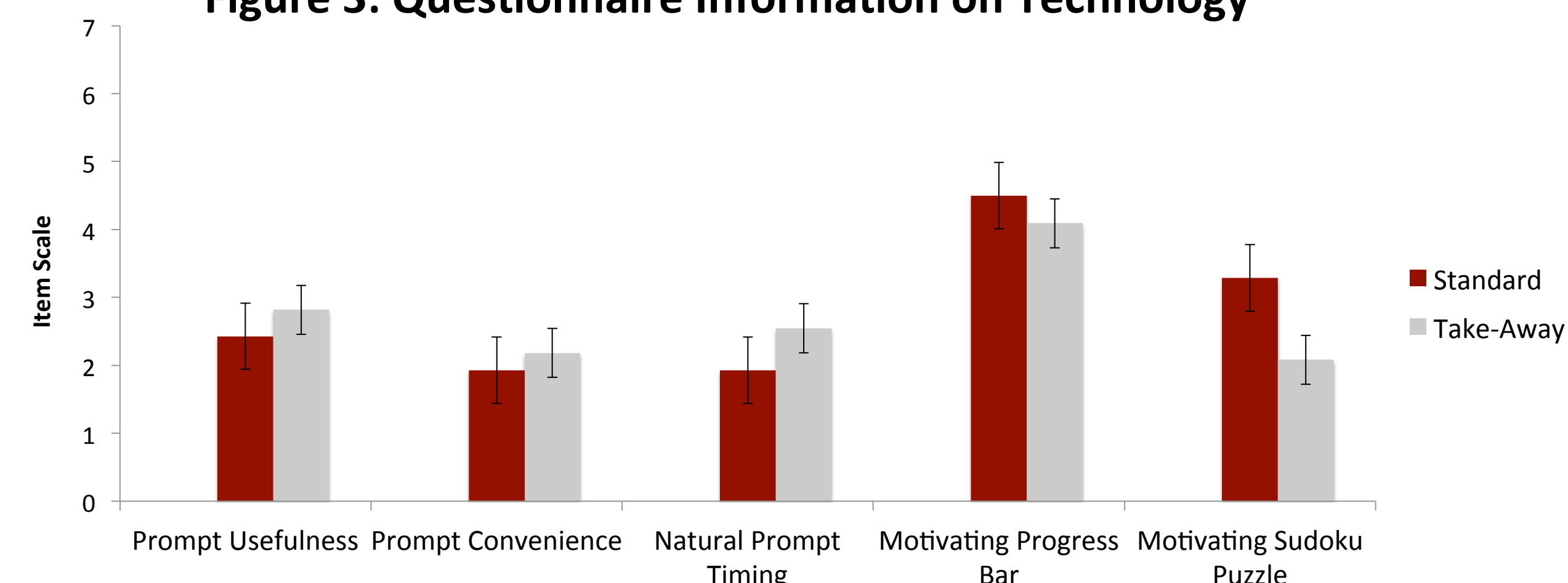### Figure 3: Questionnaire Information on Technology

Figure 3. Prompting and reward structure feedback between both standard and take-away reward conditions (Item scale: 1 = Strongly Agree, 4= Neutral, 7= Strongly Disagree)

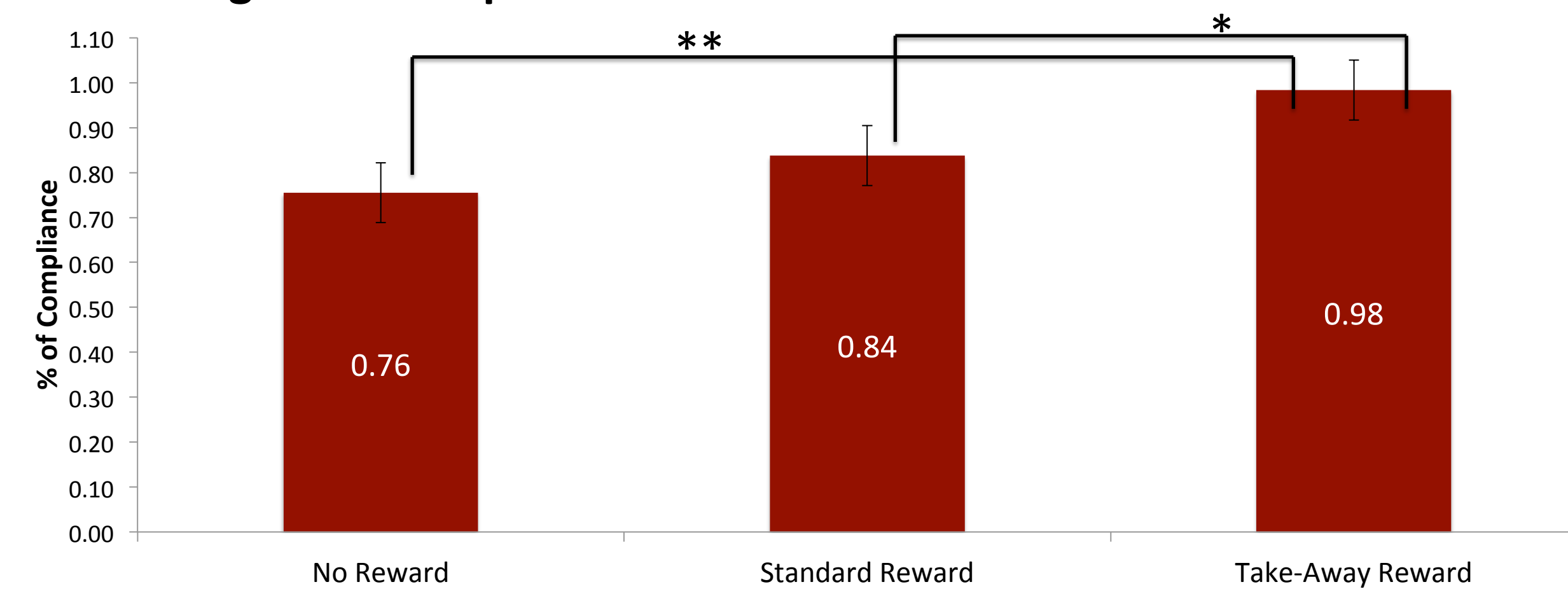### Figure 4: Compliance Rate Between Each Condition

Figure 4. Note: *$p < 0.05$, **$p < 0.01$. Compliance rate (determined by the number of recordings in the DMN after a prompt was issued) between each condition (no reward, standard reward, and take-away reward).

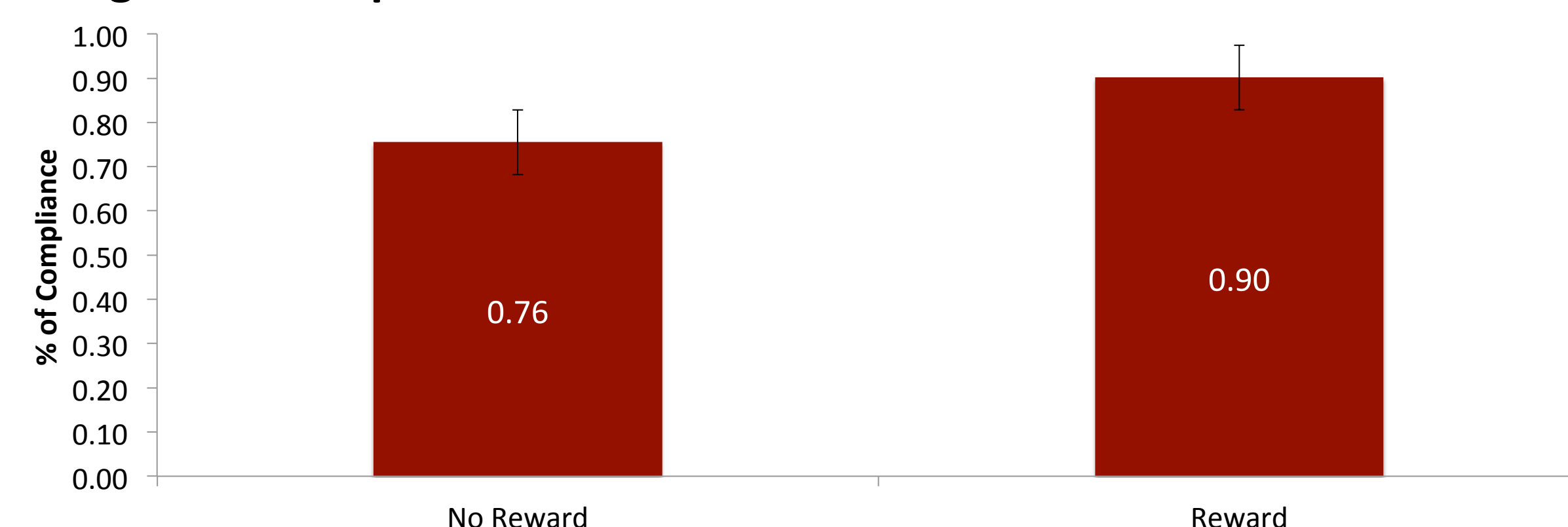### Figure 5: Compliance Rate Between No Reward and Reward Conditions

Figure 5. Compliance rate (determined by the number of recordings in the DMN after a prompt was issued) between no reward and reward (standard and take-away combined) conditions [$t(46)=2.03$, $p = 0.049$].

CONCLUSIONS

- Use of our simple scalable motivation reward (Sudoku puzzle) demonstrates an increase in compliance to record daily activities in the DMN.
- While the take-away condition was the only one that significantly increased compliance over the no reward condition, the standard condition still had a higher compliance rate than the no reward condition.
- Although the reward condition (solving an 'easier' Sudoku puzzle) has shown to increase the compliance rate of recording activities in the DMN, the length of the current study is too short to decide which model outperforms the other in terms of the compliance rate over an extended period of time.

FUTURE WORK

- Measure the effect of adaptive reward types to sustain the compliance over a longer period of time.
- 4 participants will wear a Fitbit Flex wristband for 6 weeks, with different reward types designed to motivate individuals to move more.
- Record average daily number of steps during the first week and set an increased daily number of steps as a goal for the next 5 weeks.
- Introduce a new reward type after failure to maintain the goal level of participant's movement.
- We aim to measure the extent to which switching a reward type can return the participant back to their goal-defined compliance level.
- We will integrate the most sustaining reward type with the DMN in the smart apartment.
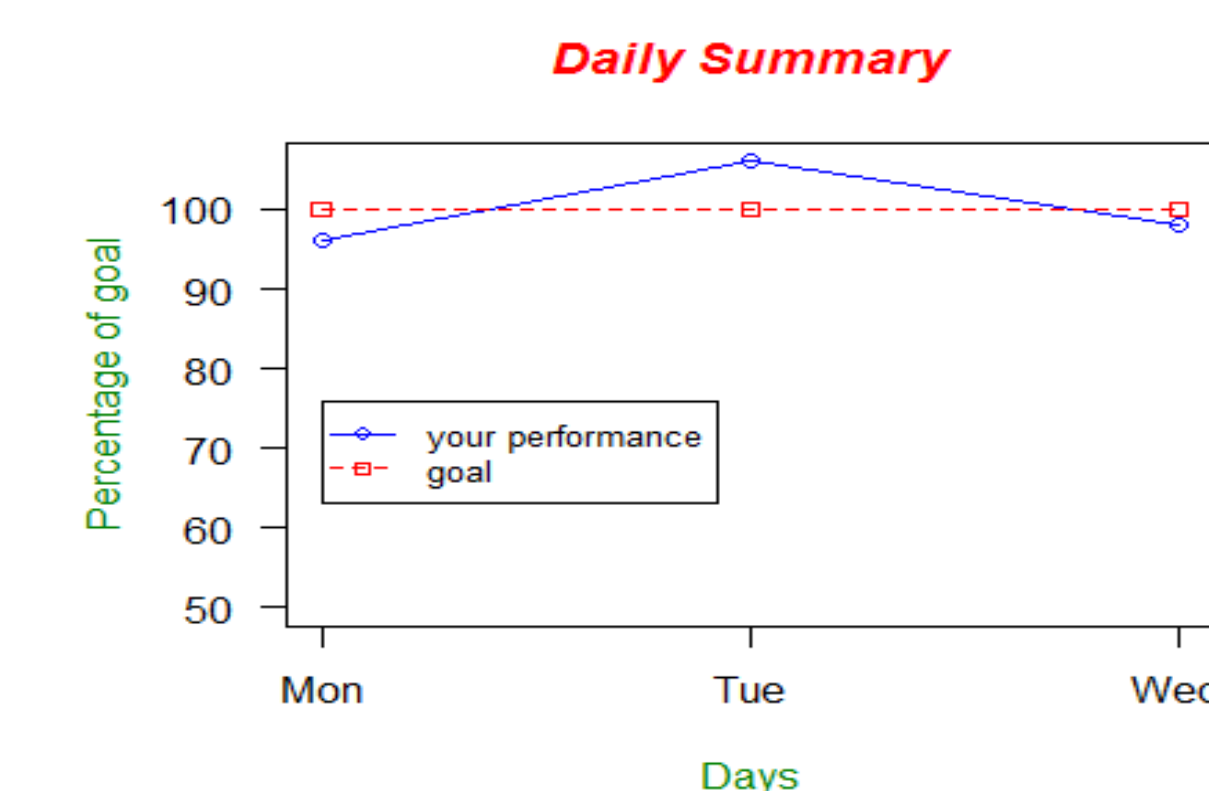

Figure 6. Time window of participant daily activity for 3 days including goal performance.

Figure 7. Fitbit Flex activity wristbands.

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ACKNOWLEDGMENTS