CS 7633 Fall 2016 Written Case Study #1

Submit response on T-Square by Thu, Oct 6, 2016 3:00pm

The purpose of the written case studies is to assess each student's individual mastery of the HRI curriculum. Topics covered include relevant literature review, study design methodology and evaluation methodology across multiple domains. Each written response will be graded by the course instructor and the TA, with the ultimate grade reported as a ✓+, ✓ or ✓- (equivalent to 100%, 80%, 60%). Students receiving a ✓ or ✓- may resubmit (by email to the instructor) up to one updated response for reevaluation within 7 days of the original deadline.

Note that each of the case studies previously appeared on the Robotics PhD Qualifer Exam, for which CS7633 serves as a core course. Thus, for PhD students in the course the case studies serve as valuable practice for the written portion of the quals. I'm happy to arrange a time to meet outside of class for any PhD student interested in practicing the additional oral component.

The submissions system will close at 3pm on the date that the assignment is due. Late assignments will not be accepted except for pre-arranged absences or special considerations because the content of the case studies will be discussed in class on the date of submission.

You have recently received a grant from a large health insurance company to evaluate a new healthcare robot for older adults with hypertension (i.e, high blood pressure) in their homes. The mobile robot periodically visits an older adult and asks the person to take his or her blood pressure using a device carried by the robot. The company previously worked with a group of undergraduate summer interns who designed and conducted an experiment. As a first task, the company has asked that you critique this experiment (described below) and suggest improvements. The company has also asked you to answer specific questions that are noted in italics below. As much as possible, you should justify your responses with references to the literature.

Research Questions:
The insurance company wants to answer the following two questions:

1. Do people using the mobile robot more regularly take their blood pressure than people using a stationary reminder alarm?

2. Does adding social capabilities to the mobile robot increase the regularity with which people take their blood pressure?

The interns never actually formulated clear hypotheses. *Please clearly formulate hypotheses from the above questions. Also, what are the null hypotheses?*

The Experiment:
To answer their questions, the interns designed a 2x2 within-subjects experiment that they conducted over 4 weeks. The health insurance company provided a list of 1000 older adults in the Atlanta area who matched the demographics of interest to the company. The interns selected 100 older adults who had previously participated in a robotics study in order to simplify recruiting. The interns called these 100 older adults by phone and asked if they'd be interested to participate in another robotics study. From this process, they arranged for 10 older adults to participate in their experiment.

The interns then visited the homes of these 10 participants and placed a blood pressure robot (BP robot) in each home. For the first week, the BP robot with no social capabilities visited the participant 3 times a day

(morning, noon, and night) and asked the participant to take his or her blood pressure by beeping for 5 seconds. For the second week, the BP robot with social capabilities visited the participant 3 times a day (morning, noon, and night) and asked the participant to take his or her blood pressure by saying "Please take your blood pressure." while smiling with a robotic head that the interns built with servos and attached to the robot. For the third week, the interns removed the robot and left a stationary device in the kitchen that beeps loudly for 5 seconds at morning, noon, and night to remind the participant to take his or her blood pressure. Finally, for the fourth week, the interns attached the robotic head to the stationary kitchen device, so at morning, noon, and night it would loudly say "Please take your blood pressure." and smile.

For each of these four conditions, the interns kept track of the number of times a day that the participant took his or her blood pressure. The blood pressure device used for all four treatments was Wi-Fi enabled and each day reported a value of 0 to 3, indicating if the person took a measurement in the morning (+1), afternoon (+1), and evening (+1). So, for a participant over a week, the dependent variable could assume a value in the range of 0-21. This was the only information that the interns collected during the experiment.

Data Analysis and Conclusions:
The interns performed a two-way repeated measures ANOVA on the data from their experiment. The results follow:

	Not Social	Social
Mobile Robot	14 13 16 17 14 15 12 18 20 11	15 16 14 19 13 16 14 19 20 10
No Mobile Robot	10 11 9 10 8 12 14 12 18 9	8 0 10 5 1 3 2 0 9 1

Means for the 4 conditions, columns, rows, and all data:

	Not Social	Social	Totals
Mobile Robot	15	15.6	15.3
No Mobile Robot	11.3	3.9	7.6
Totals	13.15	9.75	11.45

ANOVA Summary

A = row variable (Mobile Robot / No Mobile Robot)
B = column variable (No Social / Social)
Subj = subjects

Source	Sum of Squares	df	Mean Square	F	p
Subjects	134.4	9			
Within Subjects					
A	592.9	1	592.9	70.5833	<.0001
Subj x A	75.6	9	8.4		
B	115.6	1	115.6	13.7076	0.004902
Subj x B	75.9	9	8.4333		
A x B	160	1	160	17.6686	0.002295
Subj x A x B	81.5	9	9.0556		
TOTAL	1235.9	39			

Unfortunately, the interns did not provide any interpretation of these results. We are aware that the

experiment may have some issues. Nonetheless, please first interpret these results for us as if the experiment had been perfectly designed and executed. Next, given your critique of the experiment, how would you interpret these results? Can we learn anything from them? In addition to your recommendation for how to design a better experiment, we are very interested in the potential to integrate social capabilities into the robot. Please discuss possible future social capabilities that could be beneficial and support your discussion with your knowledge of the HRI literature.