

Human-Computer Interaction

# Project Introduction

Professor Bilge Mutlu

# Recap of *Module 3*: *Project*

# General Outline (Recap)

We will carry out a semester-long research project where you will connect and practice the **seminar** and **methods** modules.

- >> We will use the last 30 minutes of class on Mondays and time left on Wednesdays to discuss project goals, steps, deliverables
- >> Feedback during office hours, through deliverables
- >> Individual or pairs, expectations are different
- >> 30% of your total grade

# Project Deliverable (Recap)

We will incrementally write a four-to-six-page paper potentially submittable to an HCI conference.

>> **Individuals:** 4 pages

>> **Pairs:** 6 pages

## Designing Persuasive Robots: How Robots Might Persuade People Using Vocal and Nonverbal Cues

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### ABSTRACT

Social robots have potential to serve as personal, organizational, and public assistants as, for instance, diet coaches, teacher's aides, and emergency responders. The success of these robots—whether in motivating users to adhere to a diet regimen or in encouraging them to follow evacuation procedures in the case of a fire—will rely largely on their ability to persuade people. Research in a range of areas from political communication to education suggest that the nonverbal behaviors of a human speaker play a key role in the persuasiveness of the speaker's message and the listeners' compliance with it. In this paper, we explore how a robot might effectively use these behaviors, particularly vocal and bodily cues, to persuade users. In an experiment with 32 participants, we evaluate how manipulations in a robot's use of nonverbal cues affected participants' perceptions of the robot's persuasiveness and their compliance with the robot's suggestions across four conditions: (1) no vocal or bodily cues, (2) vocal cues only, (3) bodily cues only, and (4) vocal and bodily cues. The results showed that participants complied with the robot's suggestions significantly more when it used nonverbal cues than they did when it did not use these cues and that bodily cues were more effective in persuading participants than vocal cues were. Our model of persuasive nonverbal cues and experimental results have direct implications for the design of persuasive behaviors for humanoid robots.

### Categories and Subject Descriptors

H.1.2 (Models and Principles): User/Machine Systems—human factors, software psychology; H.5.2 (Information Interfaces and Presentation): User Interfaces—evaluation/methodology, user-centered design

### General Terms

Design, Human Factors

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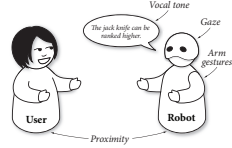


Figure 1: The vocal and bodily cues of persuasion in human-robot interaction.

### Keywords

Persuasion, compliance, nonverbal immediacy, nonverbal cues, gaze, gestures, proximity, vocal tone

### 1. INTRODUCTION

Robots hold great promise as social actors that may positively affect and improve people's motivation and compliance in such areas as education [3], health [11], and well-being [26]. The success of these robots in motivating people will rely largely on their ability to persuade. But how could robots persuade people? And how can we design persuasive robots?

Research in human communication has identified a number of behavioral attributes that shape individuals' nonverbal immediacy—the degree of perceived bodily and psychological closeness between people—and suggested that individual nonverbal immediacy plays a key role in persuading others [25]. These attributes include primarily nonverbal behaviors, particularly bodily cues such as proximity, gaze, gestures, posture, facial expressions, touching and vocal cues such as vocal tone and expressions [43]. While a considerable amount of research in robotics has explored the role of nonverbal cues in human-robot interaction (e.g., [47, 5, 25]), the way in which these cues might shape the persuasive ability of a robot has not yet been studied.

A few studies in human-robot interaction have explored how robots might be designed as persuasive agents [48, 27]. While existing work highlights the importance of persuasion in human-robot interaction and provides some guidelines for

## Is cheating a human function? The roles of presence, state hostility, and enjoyment in an unfair video game<sup>1 2 3</sup>

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### Abstract

In sports and board games, when an opponent cheats, the other players typically greet it with disdain, anger, and disengagement. However, work has yet to fully address the role of the computer cheating in video games. In this study, participants played either a cheating or a non-cheating version of a modified open-source tower-defense game. Results indicate that when a computer competitor cheats, players perceive the opponent as being more human. Cheating also increases player aggravation and presence, but does not affect enjoyment of the experience. Additionally, players that firmly believed that their opponent was controlled by the computer exhibited significantly less state hostility compared to players that were less certain of the nature of their competitor. Game designers can integrate subtle levels of cheating into computer opponents without any real negative responses from the players. The results indicate that minor levels of cheating might also increase player engagement with video games.

### 1. Introduction

In society, the concept of cheating is largely met with disdain, anger, and revenge. For example, Bernie Madoff enacted a largescale fraudulent investment operation, which resulted in the theft of \$64.8 billion from thousands of investors (Frank, Efrati, Lucchetti, & Bray, 2009). A judge sentenced Madoff to 150 years in prison and hundreds of billions of dollars in restitution. Thus, society viewed Madoff's cheating as highly unethical and inhuman. Similar rules about cheating are also applied to sporting events, children's games, schoolwork, and video games. For example, when humans are playing video games against other human gamers, cheating is not accepted. If one player cheats in the game world, other players either resent to cheating themselves or disengage entirely with the game (Kabus, Terpstra, Cilia, & Buchmann, 2005).

When it comes to computer-controlled agents, cheating is not only the norm; the human competitor generally accepts it (Fairclough, Fagan, Mac Namee, & Cunningham, 2001). That is, in order to construct a realistic and evenly matched competitor, designers must create algorithms that allow the agents to “see” through walls or use other means to locate the human player's avatar. The human player does not disengage with the game; rather, he or she is aware on some level that this subtle form of cheating is necessary in order for the game to possess an aspect of challenge (Fairclough et al., 2001). Interestingly, little empirical evidence has been collected and analyzed regarding a cheating agent controlled by the computer. This paper presents a study that begins to analyze the effects of the computer cheating in video games in order for designers to be able to create video games that are more enjoyable, immersive, and engaging. Two theoretical models will help to explain possible effects of cheating in a game.

<sup>1</sup> University of Wisconsin-Madison, Department of Computer Sciences provided financial support for this research.

<sup>2</sup> A preliminary version of this manuscript has been presented at the 2012 Association for Education in Journalism and Mass Communication Conference.

<sup>3</sup> Authors thank Karyn Riddle for her valuable comments.

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## Handheld or Handsfree? Remote Collaboration via Lightweight Head-Mounted Displays and Handheld Devices

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### ABSTRACT

Emerging wearable and mobile communication technologies, such as lightweight head-mounted displays (HMDs) and handheld devices, promise support for everyday remote collaboration. Despite their potential for widespread use, their effectiveness as collaborative tools is unknown, particularly in physical tasks involving mobility. To better understand their impact on collaborative behaviors, perceptions, and performance, we conducted a two-by-two (technology type: HMD vs. tablet computer; task setting: static vs. dynamic) between-subjects study where participants ( $n = 66$ ) remotely collaborated as “helper” and “worker” pairs in the construction of a physical object. Our results showed that, in the dynamic task, HMD use enabled helpers to offer more frequent directing commands and more proactive assistance, resulting in marginally faster task completion. In the static task, while tablet use helped convey subtle visual information, helpers and workers had conflicting perceptions of how the two technologies contributed to their success. Our findings offer strong design and research implications, underlining the importance of a consistent view of the shared workspace and the differential support collaborators with different roles receive from technologies.

### ACM Classification Keywords

H.5.3 Information Interfaces and Presentation: Group and Organization Interfaces—Collaborative computing, Computer-supported cooperative work, Evaluation/methodology

### General Terms

Human Factors; Performance; Experimentation

### Author Keywords

Computer-supported cooperative work; remote collaboration; videoconferencing; head-mounted displays (HMDs); wearable computing; handheld devices; tablet computers

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Figure 1: Participants remotely collaborated in pairs using either a tablet or an HMD in a construction task in use of two task settings: a static task setting, requiring low levels of mobility, or a dynamic task setting, requiring high levels of mobility.

### INTRODUCTION

Collaborative work across many domains involves physical tasks. A team of doctors performing surgery, workers repairing machinery, and young adults learning how to cook from their parents are examples of hands-on activities where the level of expertise differs across members of the collaboration. Distributed physical tasks, in which not all members of the collaboration are collocated, have important roles in medical, industrial, and educational domains. With the rapid development of communication and collaboration technologies that enable remote workspace sharing, such as smartphones, tablets, and lightweight head-mounted displays (HMDs), remote collaboration for physical tasks has become more feasible than ever. These technologies promise easy assistance to users from their co-workers, family members, or friends who have expertise in their task—not just those individuals who are most geographically accessible.

While many technologies that support assistance in physical tasks are finding widespread use, little research has been conducted to evaluate their efficiency and effectiveness in these settings. One class of collaboration technologies are handheld mobile devices, such as smartphones and tablet computers, which are equipped with videoconferencing capabilities that can enhance collaboration [8]. Tablets are also becoming increasingly popular for both work and casual use [9]. The larger screen size of a tablet computer relative to the smartphone may

## A Motion Retargeting Method for Effective Mimicry-based Teleoperation of Robot Arms

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### ABSTRACT

In this paper, we introduce a novel interface that allows novice users to effectively and intuitively tele-operate robot manipulators. The premise of our method is that an interface that allows its user to direct a robot arm using the natural 6-DOF space of his/her hand would afford effective direct control of the robot; however, a direct mapping between the user's hand and the robot's end effector is impractical because the robot has different kinematic and speed capabilities than the human arm. Our key technical idea that by relaxing the constraint of the direct mapping between hand position and orientation and end effector configuration, a system can provide the user with the feel of direct control, while still achieving the practical requirements for telemanipulation, such as motion smoothness and singularity avoidance. We present methods for implementing a motion retargeting solution that achieves this relaxed control using constrained optimization and describe a system that utilizes it to provide real-time control of a robot arm. We demonstrate the effectiveness of our approach in a user study that shows novice users can complete a range of tasks more efficiently and enjoyably using our relaxed-mimicry based interface compared to standard interfaces.

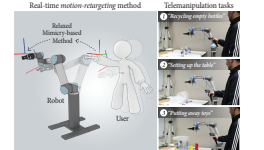


Figure 1: We propose a mimicry-based telemanipulation method that uses relaxed constraints on the mapping between a user and a robot arm as an effective real-time control mechanism and evaluate it in three telemanipulation tasks that follow a home care scenario.

providing remote home care for an elder parent, requires interfaces that are intuitive and effective to novice users.

Our goal is to provide a direct control interface that will allow novice users to effectively teleoperate robot arms and will support applications such as remote home-care or tele-surgery that require considerable human judgment and involvement without the opportunity for extensive training in system operation [18, 14]. We posit that enabling users to work in the “natural” space of their arms will allow them to draw on their inherent kinesthetic sense and ability to perform tasks in controlling a robot. That is, mapping the movement of the robot without significant training. Copying arm motions is a natural part of the user's arm, particularly the position and orientation of their arms, including visual tracking (e.g., the Microsoft Kinect<sup>1</sup>) release controllers (such as the HTC Vive<sup>2</sup>) shown in Figure 1) were used to capture motion into robot movements.

It is a key challenge. Furthermore, because we lack satisfactory solutions to this challenge, the premise that such a mapping between human and robot arms serves as an effective interface for direct control has not been validated.

The key technical challenge stems from differences in the characteristics and capabilities of robot and human arms, making it difficult to map human arm motions to robot arm motions.

<sup>1</sup>Microsoft Kinect: <https://dev.windows.com/en-us/kinect>

<sup>2</sup>HTC Vive: <http://www.vive.com/en/>

Chidambaram et al., 2012  
 (137 citations)

De Simone et al. 2012  
 (11 citations)

Johnson et al., 2015  
 (36 citations)

Rakita et al., 2017  
 (22 citations)

# Project Topics (Recap)

We will take inspiration from last year's best-paper-award winners at CHI and choose a topic following the algorithm:

**Skim a set of papers**

**Focus on 2-3 based on interest/research style**

**Read related work to understand gap**

**Read what the paper did to understand where it fits**

**Determine what else remains unexplored from limitations**

**Zoom out, choose topic, find partner (optional)**

# Project Deliverables (Recap)<sup>11</sup>

- >> Project Topic
- >> Literature survey, RQs
- >> Method
- >> Data
- >> Analysis, results
- >> Final paper

The screenshot shows the Overleaf LaTeX editor interface. The top navigation bar includes 'Overleaf', 'PROJECT', 'VERSIONS', 'SHARE', 'PDF', and 'NEXT STEP: SUBMIT TO JOURNAL'. The left sidebar shows a file explorer with 'files' containing 'bio.cls', 'biorefs.bst', 'color.sty', 'fig1.pdf', 'fig2.pdf', 'fig3.pdf', 'fig4.pdf', and 'refs.bib'. Below the file explorer is a 'DOWNLOAD AS ZIP' button and a 'Save to Dropbox' button. The main editor area shows the LaTeX source code for a document titled 'Exploration of empirical Bayes hierarchical modeling for the analysis of genome-wide association study data'. The document includes author information, a summary, and an abstract. The rendered PDF is visible on the right side of the editor.

<sup>11</sup> [Image source](#)

# Why are we doing this? (Recap)

- » Practicing research with different levels of uncertainty
  - » **Hands-on activities**: controlled, structured, short
  - » **Assignments**: semi-controlled, semi-structured, medium
  - » **Projects**: uncontrolled, unstructured, long
- » This might feel redundant, but redundancy is often good!
- » Bridging the seminar and the methods, contextualizing the methods within the seminar topics



# What's Next?

# We'll execute the algorithm

1. Skim a set of papers
2. Focus on 2-3 based on interest/research style
3. Read related work to understand gap
4. Read what the paper did to understand where it fits
5. Determine what else remains unexplored from limitations
6. Zoom out, choose topic, find partner (optional)

# 1. Skim a set of papers

- >> Paper award winners from CHI 2019
- >> Available at the ACM Digital Library
- >> Copied in Google Drive folder

## 2. Focus on 2-3 based on interest/research style

- >> Skim the titles and abstracts and see what looks interesting
- >> Look for what type of research: *systems/studies, qualitative/quantitative, etc.*

### 3. Read related work to understand gap

- >> The anatomy of an HCI paper
  - >> Introduction/problem formulation
  - >> *State of the art, gap*
  - >> Method, findings
  - >> Discussion, recommendations

## 4. Read what the paper did to understand where it fits

>> Ask the question:

*What did the paper do to close the gap?*

>> Create a map of knowledge in this area, including the what the paper did

## 5. Determine what else remains unexplored from limitations

- >> From the map you created, find remaining gaps
- >> Problems worth studying must be:
  - >> Not studied/understudied
  - >> Significant/impactful
  - >> Pervasive/frequent
  - >> Persistent

## 6. Zoom out, choose topic, find partner (optional)

- >> Outline a portion of the remaining gap for your study
- >> Make sure that it is *nontrivial* but *feasible* to do in a semester
- >> You can use Piazza or in-class discussion next week to find a partner



# Questions?