



University of Colorado
Boulder

Human-Robot Interaction

Intro to Research Methods

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Video of the Day

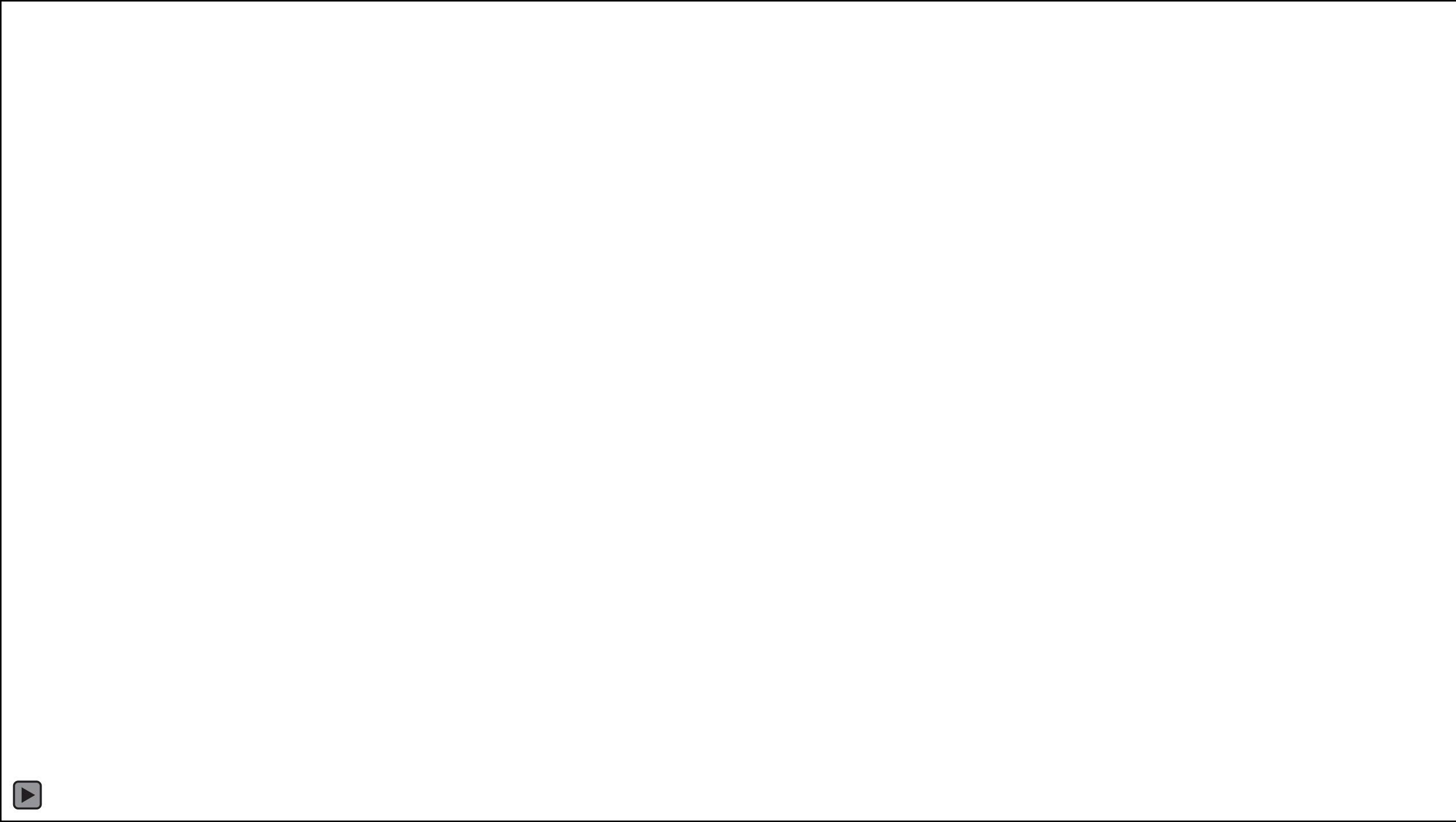
[Research with HERB the Robot](#)

Carnegie Mellon University's Robotics Institute

[Personal Robotics Lab](#)

Siddhartha (Sidd) Srinivasa





Methods Overview

Methods Component

Building a “toolbox” of research methods

Used in

Planning

Conducting

Writing

Empirical Research

HRI research is founded on “empirical” principles

Definition of “empirical:”

“Relying on or derived from observation or experiment.”

– American Heritage Dictionary

Empirical Epistemologies Applied to Human-Centered Computing Research

Leysia Palen, University of Colorado Boulder, November 16 2014

EMPIRICAL FORMS OF INQUIRY		RESEARCH DESIGN COMPONENTS	
Positivist	Interpretivist	Research Objective Are the broad aims to prove something within an existing area or set of knowledge, or to create a new area or set of knowledge? Which parts of this will be reported on formally? These choices determine whether the empirical research program is positivist or interpretivist.	Research Questions (RQs) Depending on the size of the research program, there may be multiple sub-research questions under the governance of the meta-research question or objective. Individual sub-research questions might be positivist or interpretivist, and summative or formative in nature. Often interpretivist inquiry will precede positivist inquiry.
Empirical Goals: hypothesis testing proving knowledge	Empirical Goals: thesis formation building knowledge	Units of Analysis Do the bounds of observation match the scope of concern? The bounds of observation are the "units of analysis." In interpretivist research, units of analysis can be large, but are still bounded. Do RQs, procedures, methods & participant selection match units of analysis appropriately at each stage?	Procedures Positivist research will require an experimental apparatus that controls for variables using within- or between-subjects design and so on. Interpretivist research will require careful selection of participants in ways that match objectives, units of analysis, and methods. Procedures may vary for each sub-component of a larger research program.
Related Terms (but not necessarily synonymous): hypothesis-driven scientific method experimental design deductive "quantitative research"	Related Terms (but not necessarily synonymous): data-driven ethnographic inductive "qualitative research"	Participants Do participants need to be selected to be representative of a larger sample (this matter can be asked in both positivist or interpretivist inquiries)? Do they need to be selected to deliberately pursue understanding of a new behavior (this is more common in interpretivist/formative research)? Are they co-designers (participatory design; usually interpretivist/formative), or co-researchers (action research, which can be either positivist or interpretivist), or more classically treated as "subjects"?	Methods The applications of methods and the use of their results can vary greatly and so therefore on their own cannot be inherently positivist or interpretivist. Methods can include: Interviews, Surveys, Participant or Non-Participant Observation, Diary Studies, Experiential Sampling Method, Eye Tracking, Field Deployments, Social Graph Analysis, Data Mining & Modeling and so on...
Positivist/Summative Example: How many people affected by a disaster turn to social media during the warning period of a hurricane?	Interpretivist/Summative Example: How do people make use of social media during the warning period of a hurricane?	Summative Research whose purpose is to explain something that is preexisting or has already occurred, without deliberate intervention (other than what the research might incur on its own simply by being conducted, as in ethnographic research)	HCC-ORIENTED GOALS
Positivist/Formative Example: Did the intervention to improve warning messages change the number of users by comparing 2 regional samples?	Interpretivist/Formative Example: Are there ways to improve information access during the warning period of hurricane disasters through social media?	Formative Research whose purpose is to inform something subsequent, including design of artifacts, policies, procedures or more refined RQs. The aim of formative research is what drives Human-Computer Interaction commitments to iteration	

Trademarks

Emphasizes systematic observations of a sample of
Individual behavior
Interactions
 Among people, between people and objects (artifacts)

Uses varying degrees of “control”
 Allows for descriptive or comparative research
 Maintaining reliability, validity
 Will come up repeatedly through the semester

Uses specific “designs”

Basic Concepts

What is a sample?

A subset of a population

General population is too large to measure

Collecting data from a smaller sample, called “sampling”

Make generalizations on the general population from the sample

Examples of sampling

Random sampling – for controlled experiments

Purposive sampling – for “representational” studies

Snowball sampling – used to reach particular groups

Convenience sampling – for assignments in this course

Sampling Considerations

Any population of concern

- Sensitive populations

- Ethical considerations

- Principles of responsible conduct of research (this is why you completed CITI training)

Sampling bias

- Self selection – e.g., online and phone-in polls

- Experimenter bias – e.g., convenience sampling

- Non-response bias – e.g., surveys

Research Design

Depends on the goals of the investigation

Goal-based categories

Generalization vs representation

Control-based categories

Limited control or uncontrolled studies

Fully controlled experiments

Data-based categories

Qualitative vs quantitative

Affects design, measurement, data format, analysis

Goals

Representation

In-depth understanding of phenomena – how particular actors affect particular situations under particular circumstances

- Mainly used for generating theory

- Uses small samples

Generalization

Testing hypotheses – how findings from a small sample can be generalized to a larger population

- Mainly used for testing thin slices of theory

- Uses relatively large samples

Control

Fully controlled experiments

All aspects but the manipulated aspect are controlled – a true experiment

Difficult to conduct when using human subjects

Field experiments

Limited control in a naturalistic setting – e.g., studies in public

Observational studies

No control on any aspect of the phenomenon

Surveys, archival research, cohort study, etc.

Data: Measurement

Objective measures

Comparing measurements against an objective standard

Examples: knowledge test, speed, accuracy

Subjective measures

Individual and relative evaluation

Examples: liking, NASA-TLX (workload)

Behavioral

Measuring how people behave instead of report

Physiological

Measuring body responses

Examples: heart rate, breathing rate, electrodermal activity (EDA)

Data: Measurement

Qualitative data collection

Fly-on-the-wall observations

Participant observations

Open-ended interviews

Quantitative data collection

Questionnaires, surveys

Biometric / physiological measures – e.g., eye-tracking

Task performance

Data: Analysis

Qualitative data analysis

Interpretations, comparative analysis, modeling

Qualitative data can also be quantified

Coding, counting, comparing

Grounded Theory

Quantitative data analysis

Statistical methods – e.g., counting, t-tests, analysis of variance (ANOVA), time-series analysis, regression

Emphasis on Writing

Research ≈ Journalism

- Goal is to create a plausible story

- Selective reporting

- Open to interpretations

- Editors / reviewers can say “no”

Research ≠ Journalism

- Time span – months-old vs days-old news

- Rigor – systematic process, documentation of observations

- Experimentation, intervention

- Generalization

Questions?

Next

Week 2 Readings:

Posted on Moodle

Due **Wednesday**

Assignment 1:

Due **Monday**

Project

5 minute project pitches on **Monday**

Instructions on Moodle

Come talk to me if you are really struggling to come up with ideas



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THANKS!

Professor **Dan Szafir**

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