Study Design

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Framework of a Study

- Research Question
- Literature Review
- Method
- Results
- Discussion

Research Question

- A testable question that is based on the problem statement (goals of the study)
- Wording of the question is critical
  - **Difference** questions
  - **Relationship** questions
  - *Determines the method and analyses*
- ***THIS IS THE MOST IMPORTANT ISSUE IN DESIGNING A STUDY***

Study Variables

- **Dependent** Variables
  - Outcome measures
  - The events being studied
- **Independent** Variables
  - Conditions/factors
  - Variables you have control over

Method

- Procedure
- Participants
- Measurements
- Analyses

Procedure

- ***Within*** vs. ***Between*** subjects studies
- What are the steps of the study
  - What does the robot do and when
  - How does the robot react to humans
- How are the conditions varied
- Where and when conducted
- What instructions are given to subjects

Ordering Effects

- Bias introduced by order in which conditions are presented
  - fatigue, frustration, learning
- Need to ***counterbalance*** conditions
  - Complete: All possible combinations (randomized testing)
  - Incomplete: Latin Square

A	B	C	D
B	A	D	C
C	D	A	B
D	C	B	A

Participants

- Sample pool
  - Generality of results
- How selected
  - Need to avoid bias
- Number of subjects needed
  - Sufficient for statistical validity

Measurements

- Measurement Types
  - categorical, ordinal, interval (ratio, logarithmic)
- Quantitative Measures
  - e.g. time on task, distance from robot, number of utterances
- Qualitative Measures
  - e.g. facial expressions, topics of utterances

Importance of accuracy and repeatability

Measurements

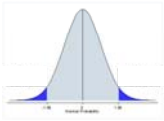
- Surveys
  - Semantic Differential
  - Likert-Scale
  - Questionnaires: Closed vs. Open
  - Structured interviews
  - Validated instruments
    - e.g. Godspeed questionnaire
  - Combining questions
    - Cronbach's alpha

Descriptive Statistics

- Central Tendency
  - mean, median, mode
- Variance
  - range, interquartile, standard deviation

Statistical Analyses

- Significance testing
  - Type I and Type II errors
  - Rejecting the null hypothesis
  - p-value
  - 1-tailed vs. 2-tailed
  - Parametric vs. non-parametric tests



Statistical Analyses

- Difference questions
  - chi-square, t-test, ANOVA, …
  - Main and interaction effects
  - Different tests if measures are related (within) or not (between)
- Relationship questions
  - Phi coefficient, Pearson coefficient, Spearman coefficient, regression, …

Study Validity

- Internal Validity
  - Effects that systematically bias the results
  - e.g. order effects, measurement bias, selection bias, experimenter bias, subject bias, …
- External Validity
  - How generalizable beyond the specifics of the study
  - e.g. population, location, time, day, …

IRB

- Institutional Review Board
  - Monitor and review research involving humans and animals
  - Protect rights and welfare of subjects
    - prevent physical or psychological harm
    - explanation of risks and benefits
    - confidentiality
    - informed consent
    - right of refusal to participate

Some Resources

- Defining a research question
  - http://www.statpac.com/statistics-book/basics.htm
- What statistics to use
  - http://www.csun.edu/~amarenco/Fcs%20682/When%20to%20use%20what%20test.pdf
  - http://www.graphpad.com/support/faqid/1790/
- The Godspeed questionnaire
  - http://www.bartneck.de/2008/03/11/the-godspeed-questionnaire-series/