# A Study on Trust in a Robotic Suitcase

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# Introduction

- New reality: robots alongside humans
- Urgent need: understand how social robotics and HRI can bring positive outcomes
- Assistive robotics

**Trust** is a key factor

# Our Question

- How much one would trust a robotic bag to carry one's personal belongings?

**aBag**: our prototype of an assistive robot

# aBag – a robotic suitcase

- aBag can assist people in carrying their belongings
- Even more convenient for elderly or disabled people
- Announcements of several robotic platforms that carry luggage

NUA robotics suitcase[1]

Travelmate[2]

Our question becomes more relevant and opportune

[1] http://unbouncepages.com/nuarobotics/

[2] http://travelmaterobotics.com/

# The study - overview

- **Proxemics** is an important factor
- **Questions:** Will users trust their belongings to a robotic suitcase? And will that trust differ depending on aBag's distance-behavior?
- **Task:** users are asked to put something of value inside aBag and to go and return to a vending machine buy something they like, while aBag follows them

Within-subjects experimental design

# The study - overview

- Two distance **behaviors**:

  1) aBag followed the user closely

  2) aBag moved more freely, keeping a further distance to the user

- **Hypotheses:**

  **H1**: perceived human-robot trust will be different before and after interacting with aBag

  **H2**: perceived human-robot trust is higher when aBag follows the user more closely than when aBag moves more freely and further away from the user

# The robot

**aBag**

- Regular suitcase attached to the chassis of a remotely controlled car
- Mounted camera to increase believability

# Measures

- **Trust** is a multidimensional concept
- **Trust questionnaire** by K. Schaefer (2013)[1]
  - 40 questions, on a 0-100 percentage scale
  - Total trust score is the sum of each question score

- Questionnaire applied before and after each of the conditions

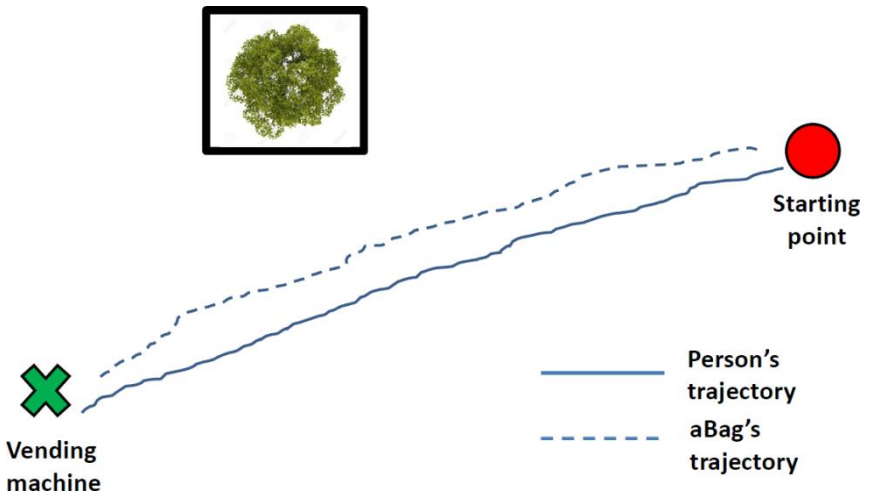
[1]Schaefer, K.: The Perception and Measurement of Human-Robot Trust. PhD Dissertation, University of Central Florida, USA (2013)

# Measures

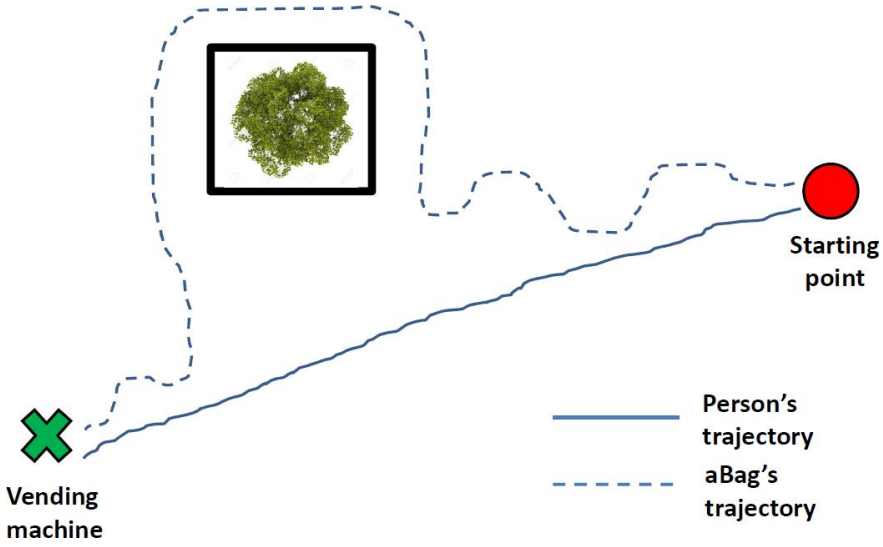
- All interactions were video recorded
- 1h30 recorded material coded
- Counted the number of times participants gazed at aBag

# Pilot study

- 2 Conditions defined

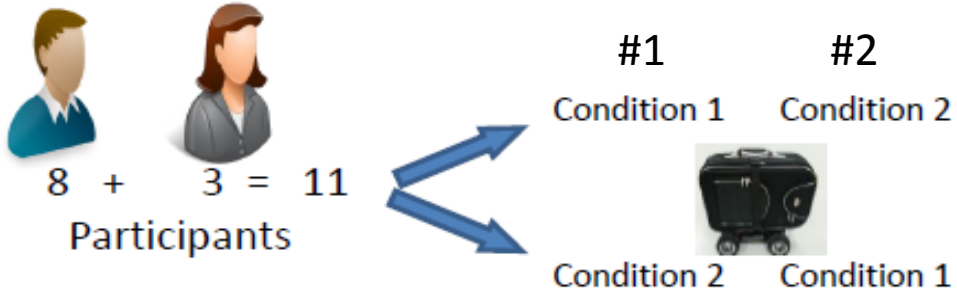



Condition 1: aBag follows the user taking the same trajectory at a small distance behind

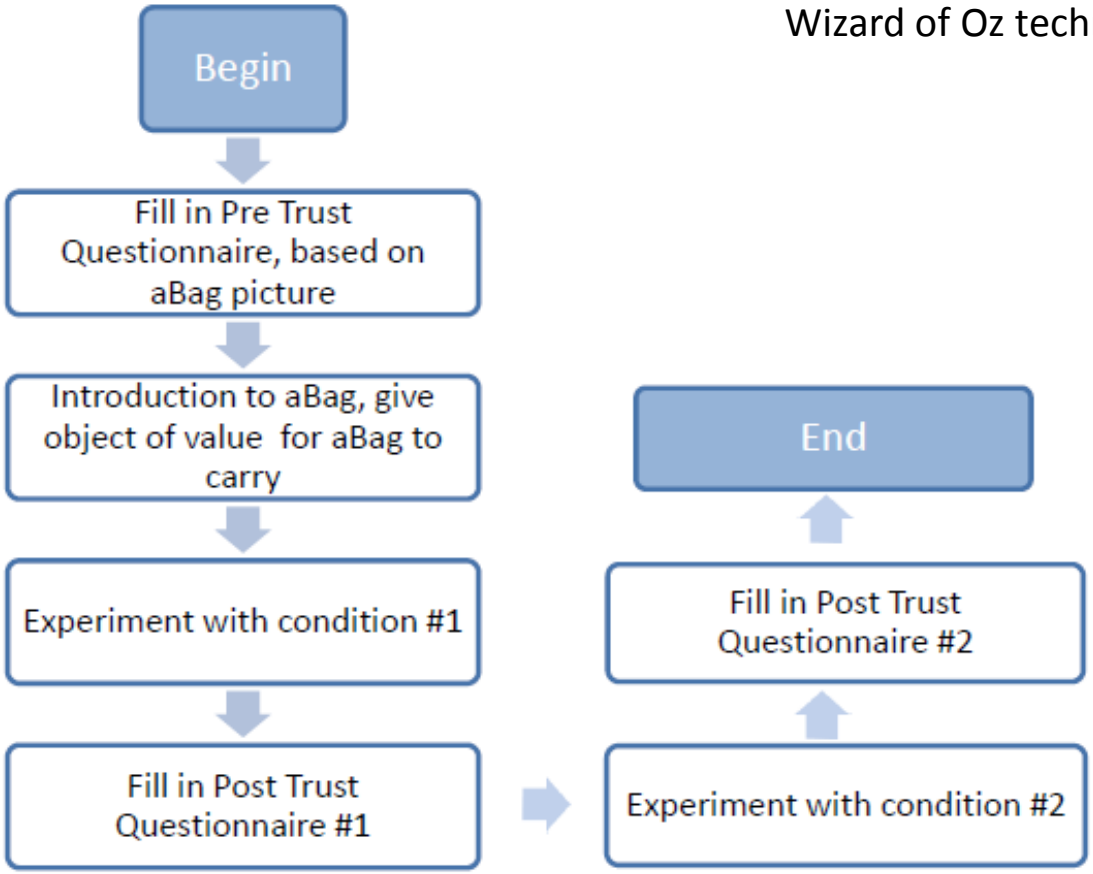


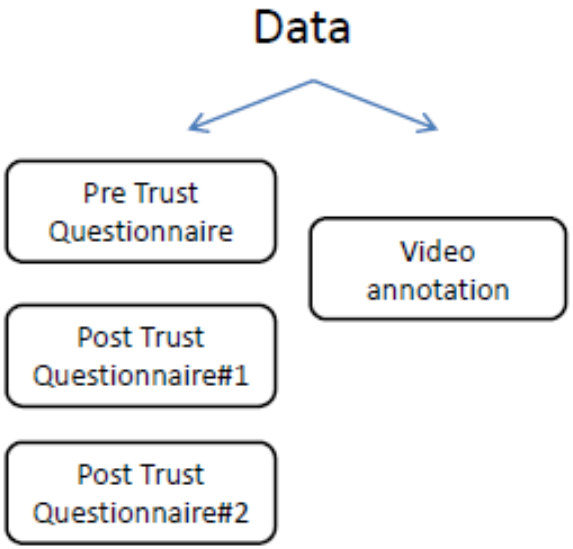

Condition 2: aBag follows the user more freely, keeping a further distance to the user, simulating a more autonomous behaviour

# Study – Experimental Procedure



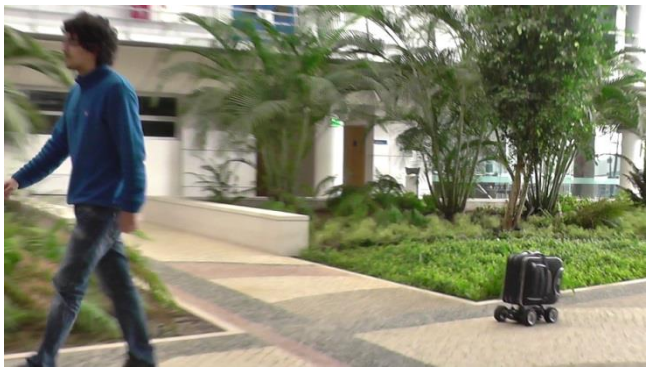

Wizard of Oz technique



# Study

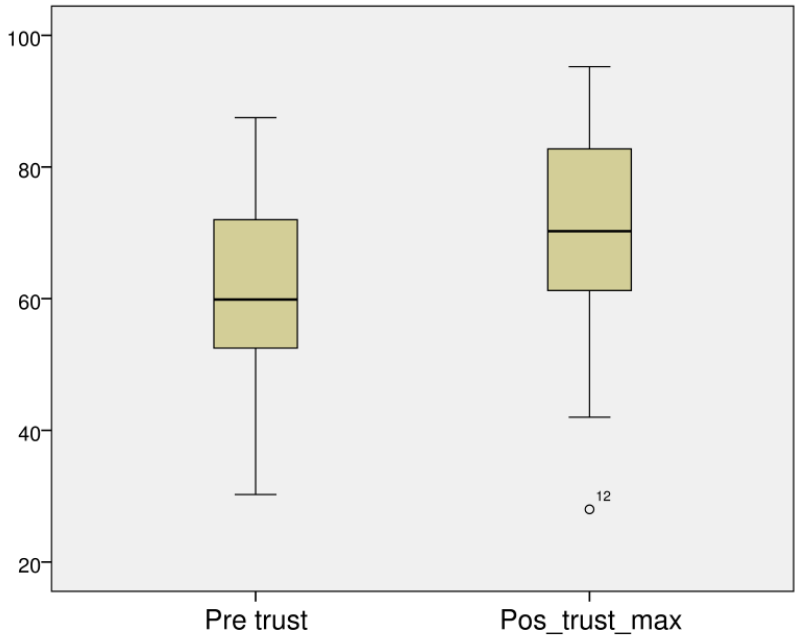
- Place: University entrance hall
- Two different behaviors were not explicitly explained to the participants
- 7 participants only performed one condition



# Participant experimenting aBg

# Results H1 – Trust Questionnaires

- Test **H1**: perceived human-robot trust will be different before and after interacting with aBag
- Data from 18 participants
- Analyzed pre and post interaction trust scores, regardless of the condition



# Results H1 – Trust Questionnaires

- Found a non normal distribution
- Applied non-parametric test for repeated samples
  - Wilcoxon Signed Rank Test confirmed H1 with Z=-2.004 and p= 0.045

Human-Robot perceived trust is significantly different (increased) after interacting with aBag than before meeting the robot

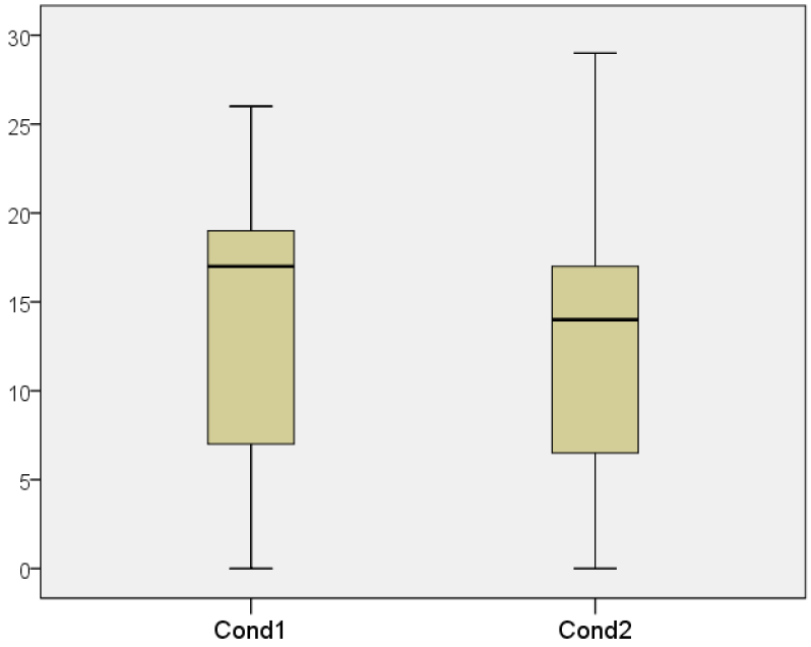
# Results H2 – Trust Questionnaires

- Test **H2**: perceived human-robot trust is higher when aBag follows the user more closely than when aBag moves more freely and further away from the user
- Data from 11 participants (within-subjects design)
- ANOVA test
- Compared 3 groups: pre-trust, post-trust after condition 1 and post-trust after condition 2
- Not significant results

No significant differences in trust between conditions.
Indications that users trust more aBag on condition 2 (more free and distant)

# Results – Recordings

- Number of times each participant looked back at aBag
- Proxy of how much participants trusted aBag
- Data from 11 participants (within-subjects design)



# Results – Recordings

- Found a non normal distribution
- Applied non-parametric test for repeated samples
  - Wilcoxon Signed Rank Test retained null hypothesis with $Z=-0.06$ and $p= 0.95$

There are no significant differences in the number of times participants gazed at aBag between conditions. Data suggests participants tend to look more in condition 1 (closer)

# Results – Recordings

- Difference between number of times male and female participants looked at aBag
- Applied a non parametric test for independent samples
  - Mann-Whitney U test finds a significant difference for condition 2
- Small dataset, cannot make any claim

Female participants tend to look more at aBag

Differences in proxemic preferences according to gender

# Conclusions

- Perceived human-robot trust significantly higher after interaction with aBag than before meeting the robot, independently of study condition
- No significant differences for the 2 conditions
  - Indications that participants trusted more aBag moving more freely and away
- Results from video recordings in agreement with indications from trust questionnaires

# Future Work

- Larger sample
- Target population (elderly people, wheelchair users, ...)
- More controlled environment
- How can variables such as age, gender, personality factors and previous knowledge/experience with robots influence the perceived trust?