

Out of my way! Exploring Different Modalities for Robots to Ask People to Move Out of the Way

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Introduction

- Humans communicate via walking style, body position, tapping, verbal cues:
 1. Enough attention
 2. Communicate intent
- Robots also need to show cues:
 1. Enough attention
 2. Communicate intent
- But which cues?

Related Work: Robot Politeness

- Robot verbal greetings seen as more friendly compared to acoustic signals.
- Social appropriateness: little as possible to navigate through the social space [20].
- What strategies are the most polite?



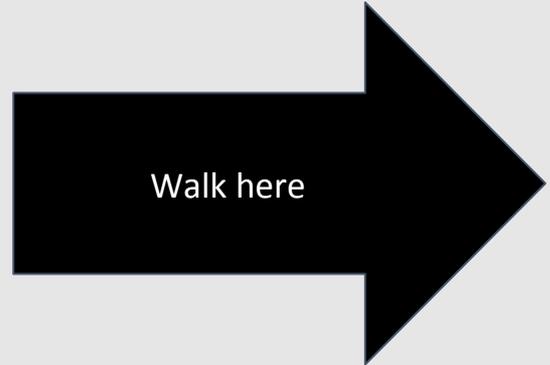
Related Work: Getting Attention

- For humans, multimodal.
- For humans and robots, gaze, head turns, hand gestures [29]
- When it is coming from behind, visual stimulus does not work, which is understudied.



Related Work: Communicating Intent

- Not only attention is necessary, but also intent
- Demonstrating intent means avoiding conflict (i.e., holding door open) [41, 36, 22]
- In human interaction, communicating intent is often accomplished using visual, auditory, and motion cues [22]



Modalities



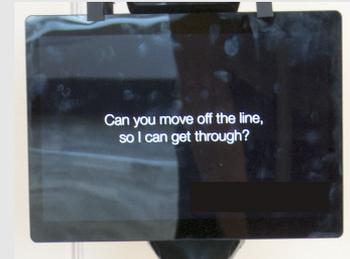
Haptic



Audio

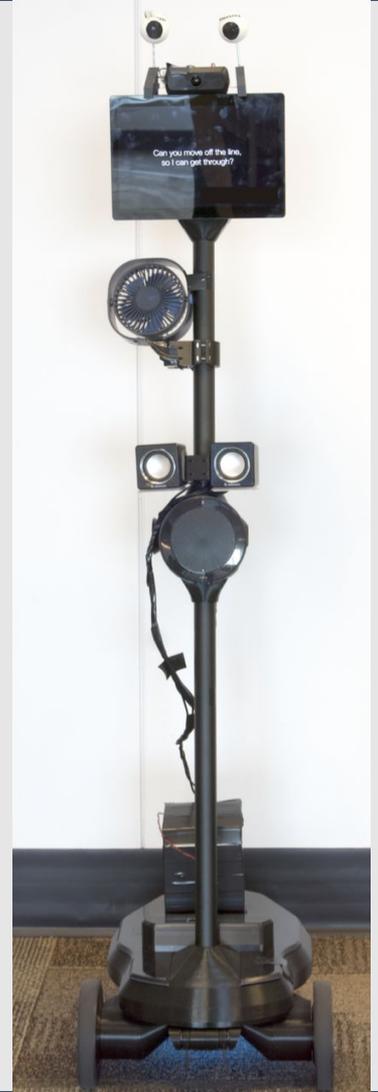


Visual



Study Design

- Setting: **“In the wild” (Office party)**
- Robot: Ohmni Robot
- Operation: **Wizard of Oz**
- Data collection: 6 cameras (4 in ceiling, 1 on robot front, 1 on robot back)
- Participants: N = 25, 4 female
 - N = 19 behaviorally coded
- Conditions:
 - C1: None (not reported)
 - C2: Visual
 - C3: Visual and audio
 - C4: Visual and audio and haptic



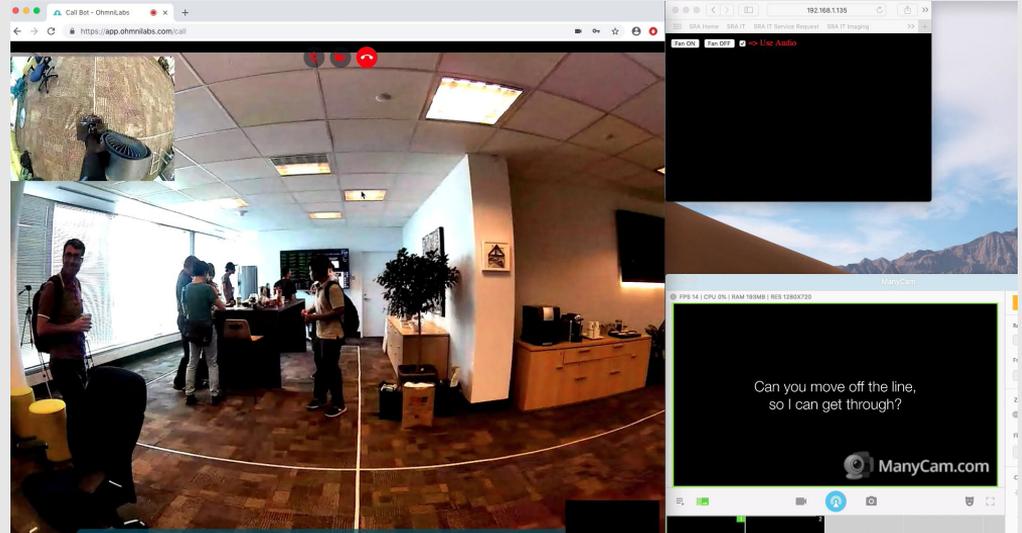
Measures

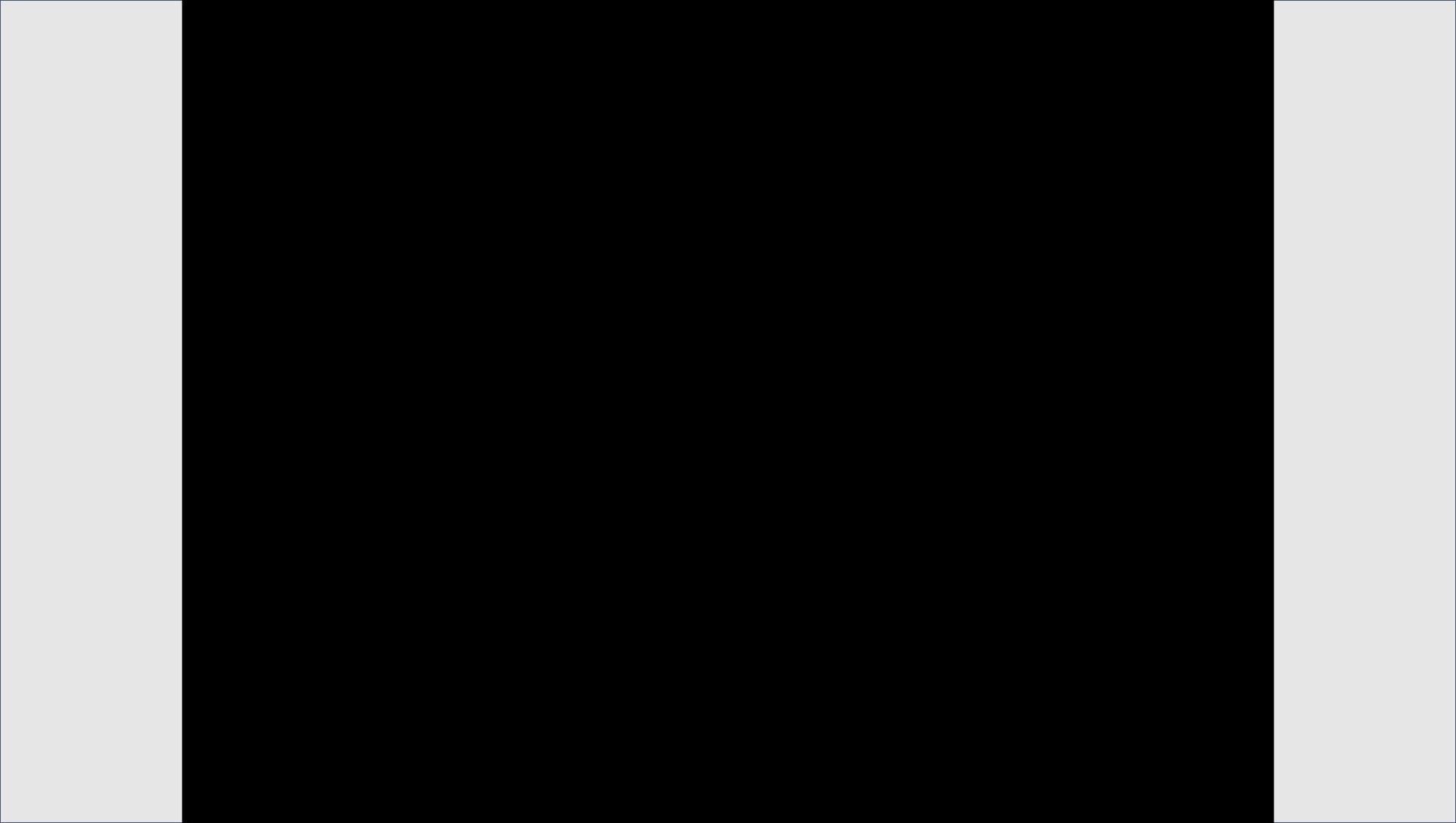
Behavioral measures

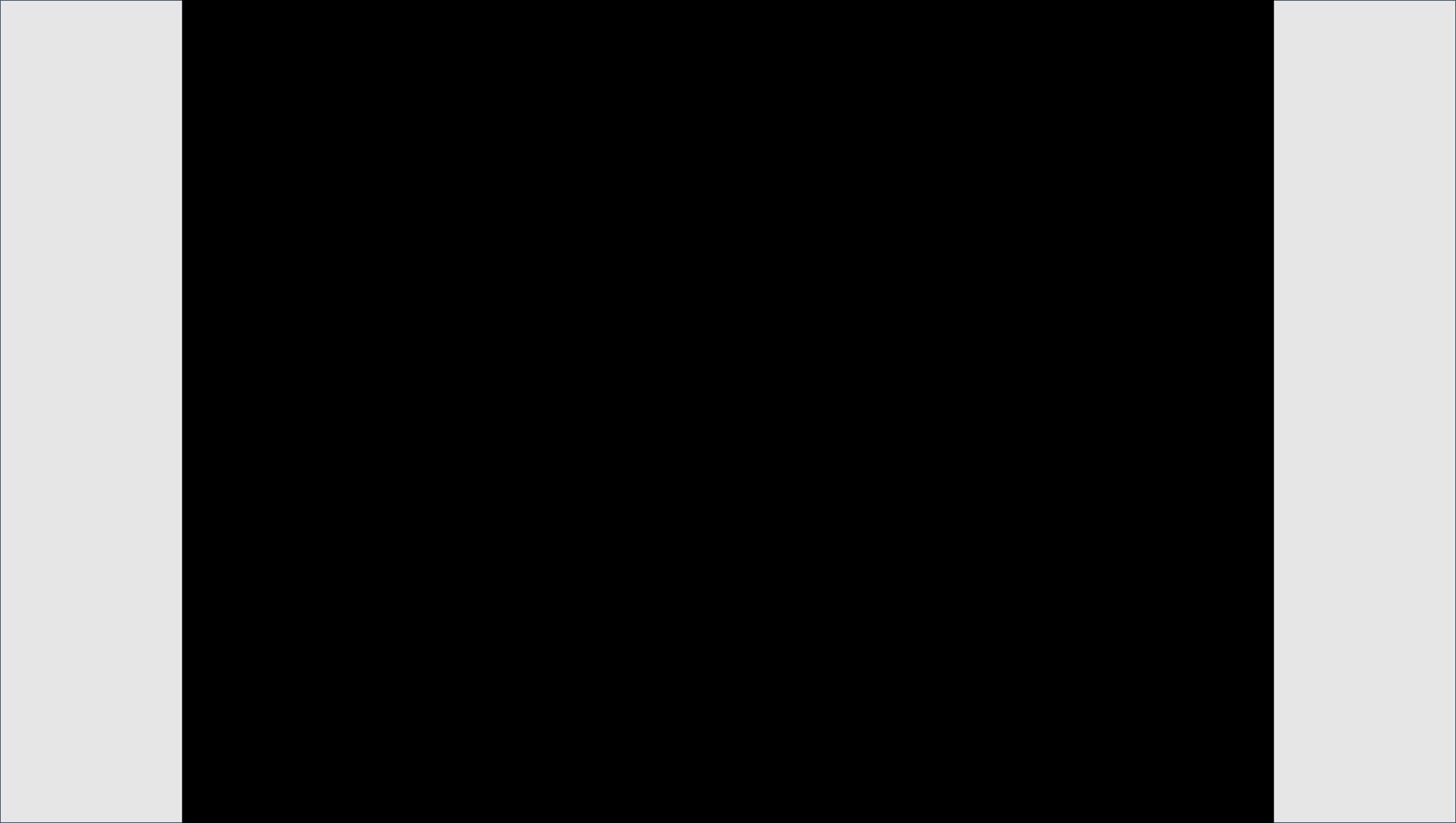
- Interaction time
- Participant moving outcome
- Constructive engagement

Subjective Measures

- Interpersonal dominance scale
 - Self-assurance
 - Panache
 - Conversational control
 - Poise
 - influence







Results

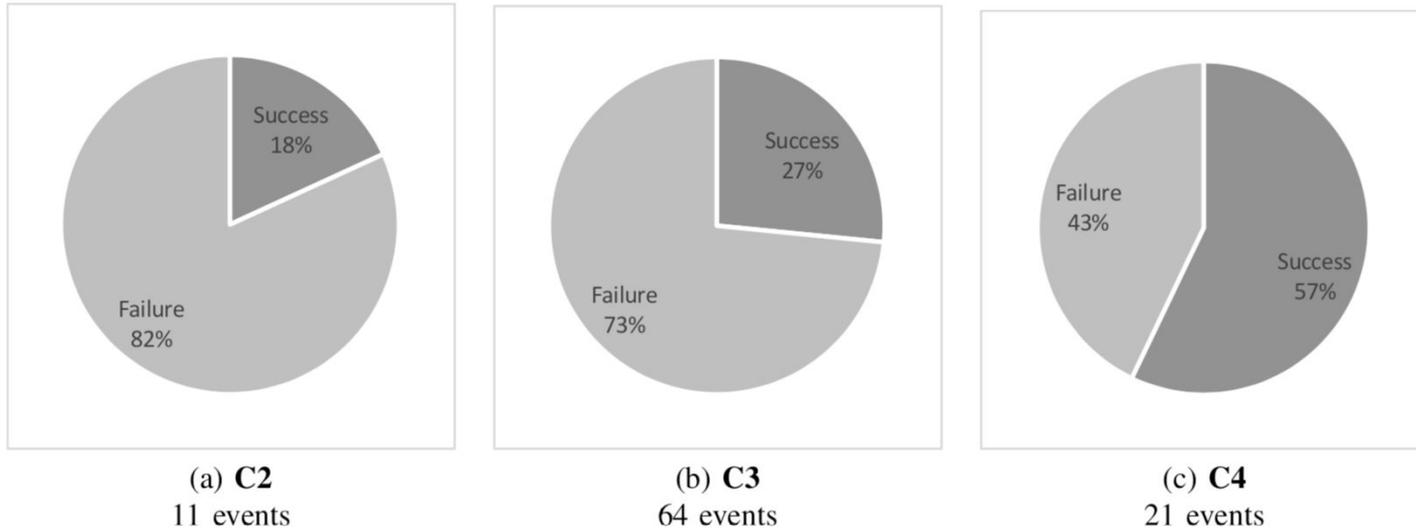


Fig. 3. Interaction success rates by condition. (a) C2, haptic only, (b) C3, haptic and visual only, (c) C4, haptic, audio and visual cues. The legends also shows the number of interaction events per condition.

Results: Interpersonal Dominance

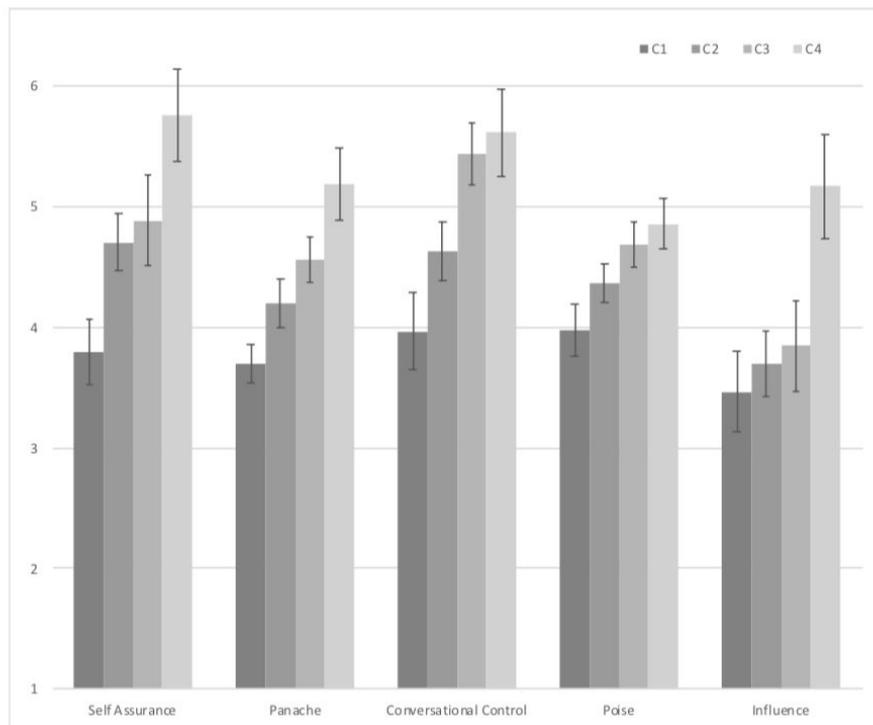


Fig. 5. Interpersonal dominance scale results. Means are plotted along with standard errors on a scale from 1 = strongly disagree to 7 = strongly agree to the robot exhibiting the corresponding social behavior.

Discussion

- Participants in interactions under conditions with more modalities found the robot to be more dominant in a social situation.
- Novelty of fan on robot
- Future work could investigate temporal aspects

Limitations:

- we struggled with maintaining a completely within or between-subjects study design.
- difficult to measure the effectiveness of displacing people when participants are testing or playing with the robot



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