Human-Robot Interaction

Aaron Steinfeld
Robotics Institute
Carnegie Mellon University

Human-Robot Interface

Sandstorm, www.redteamracing.org

Typical Questions:

- Why is field robotics hard?
- Why isn't machine vision a solved problem? (outside the lab)
- etc...

Noise & Uncertainty

HCI has these

- Human behavior is inherently noisy & often unpredictable
- HCI is bound by the I/O of the computer/device
  - Limited modalities/influences
  - Limited quantities
- HCI (usually) has longer time scales
  - Collisions
  - Loss of control

HRI has more

- More of it and from more sources

- Sensing
- Actuation & terrain
- Obstacles
- Additional noise from humans
  - Physical motions, dimensions, features

“Go get my glasses”

“Drive to waypoint X”

“Bring Howie his lunch”

50 “is this it?” queries

Don’t collide with the chair and cover Howie with food

“I’m there”

A feature, not a bug

- Affects human acceptance and trust
- Helps delineate roles and generate frameworks
  - Humans for adaptability and decision making
  - Robots for the D's
- Emphasizes traditional engineering ideas
  - Tolerances, safety margins, robustness
- Makes the problem a lot more interesting

Interviewed Experts

- 6 experts affiliated with Robotics Institute
  - Anonymous: images in this talk imply nothing
- All with extensive autonomous or semi-autonomous mobile robot interface experience
- Four main themes:
  - Challenges
  - Things that seem to work well
  - Things that do not work well
  - Interface wisdom

Steinfeld, A. (2004). Interface lessons for fully and semi-autonomous mobile robots. IEEE Conference on Robotics and Automation 2004 (ICRA).

Categories

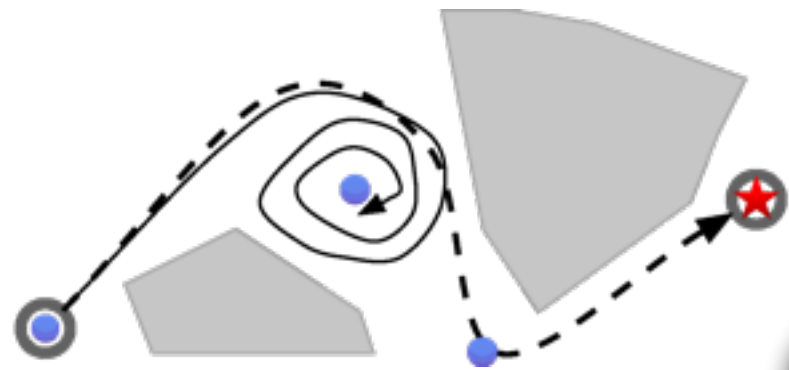
- Safety
- Remote Awareness
- Control
- Command Inputs
- Status and State
- Recovery
- Interface Design

Safety

- Robot should fail into a safe state for:
  - robot
  - operator
  - bystanders
- Calibration and start-up states require critical attention

Command Inputs

- Controls should support input for alternative views; vehicle drive and waypoint selection
- Seek to enhance human-robot communication
- Preplanned macro actions are very helpful
  - "10 second autonomy"
- Robot may be precise even if user only wants approximate behavior



Status and State

- Rapidly identification of health and motion
- Color or pops-up at threshold crossings
- There should be “idiot lights”
- Error and health summary
- Labeling, grouping, and drill-downs

Recovery

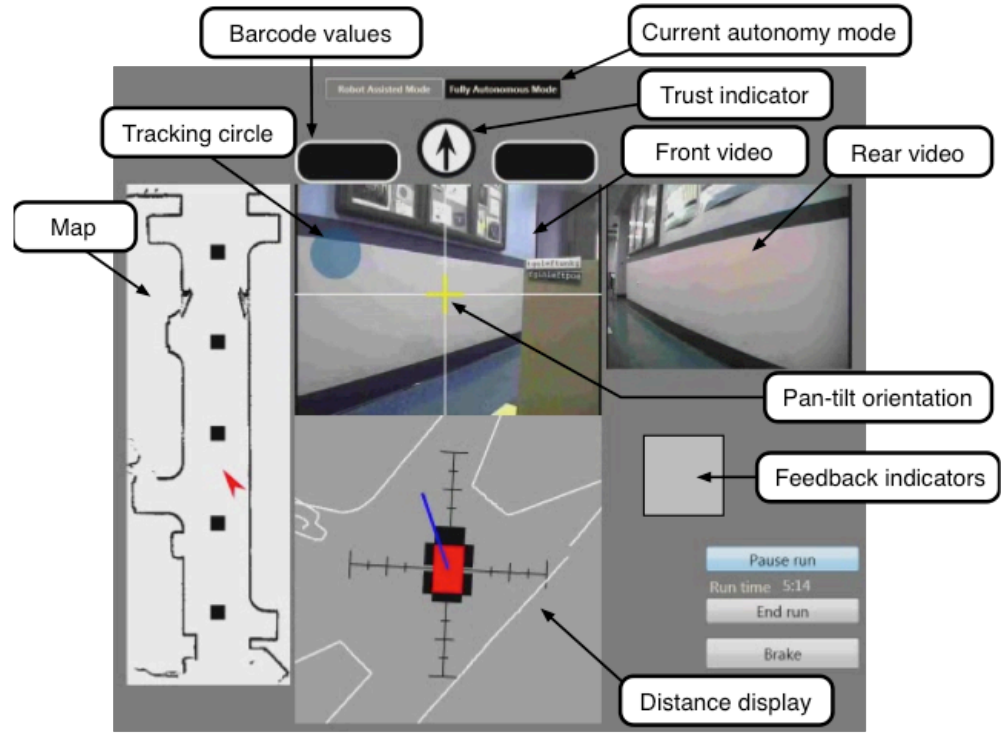
- Autonomous robots always encounter situations where they fail
- Should be designed to fail into states that are safe and recoverable
- Humans can spot obvious, yet hard to encode problems
  - Permit rapid overrides

RHEX, www.rhex.org

Which do you like more?

Who Messed Up?

- Three types of blame
  - Self Blame
  - Team Blame
  - User Blame



- Any blame lowers trust
- User blame disliked
- Self blame negatively impacted trust

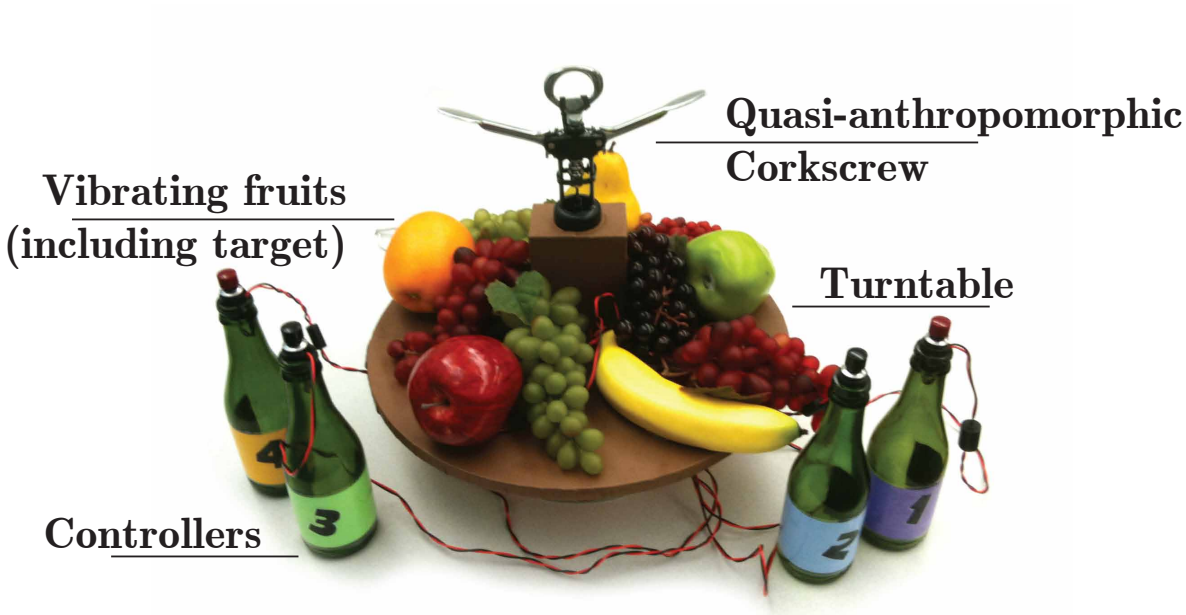
Nico Can't Be Trusted

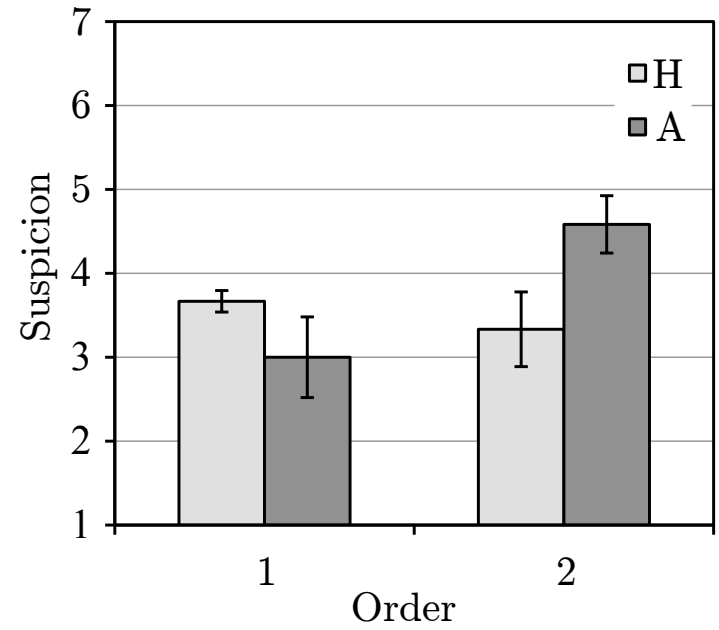
- Rock, Paper, Scissors

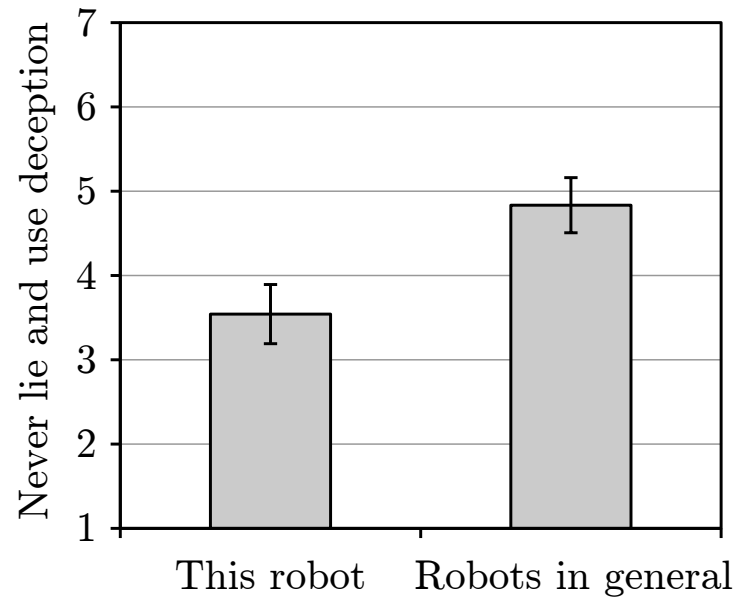
- Verbal cheats viewed a malfunction
- Action cheat viewed as intentional cheating
- Action cheat increases social engagement with the robot vs. other conditions
- Action cheat interpreted as intentional attempts to modify the outcome of the game, and thus make greater attributions of mental state to the robot

E. Short, J. Hart, M. Vu, and B. Scassellati. 2010. No fair!!: an interaction with a cheating robot. ACM/IEEE International Conference on Human-Robot Interaction (HRI '10).

Deceptive Robot Referee







Vázquez, M., May, A., Steinfeld, A., & Chen, W.-H. (2011). A deceptive robot referee in a multiplayer gaming environment, International Conference on Collaboration Technologies and Systems (CTS).

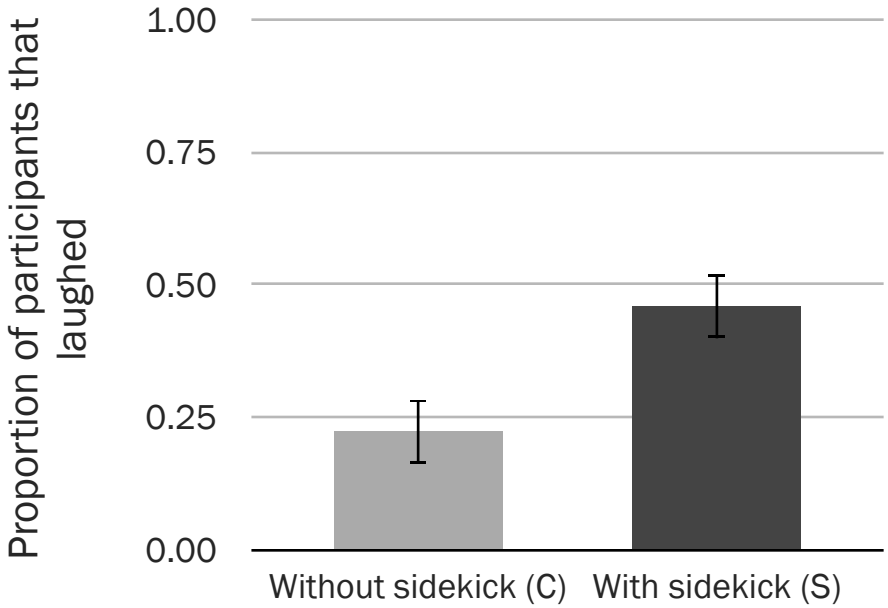
Design Influencing Human Behavior

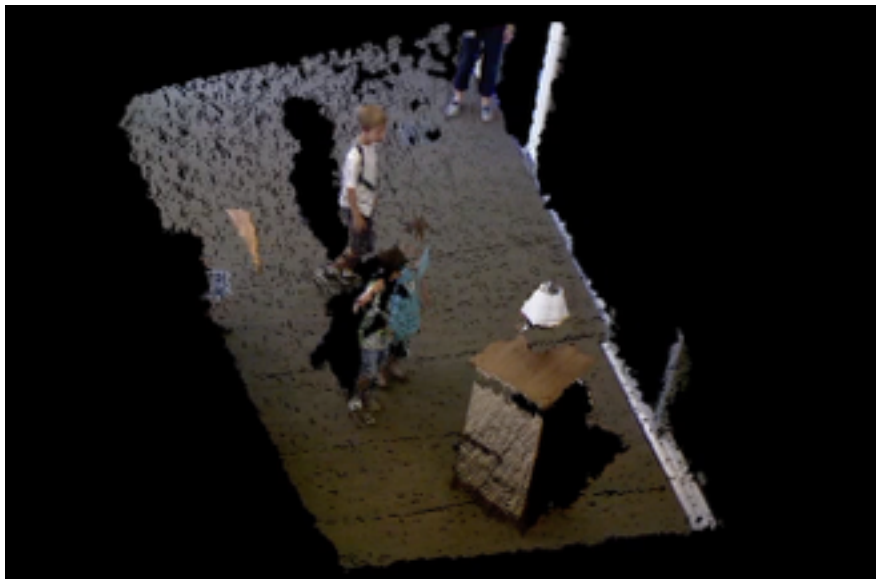
- Sidekicks in entertainment settings
  - Proxemics
  - Human actions
- Groups of kids (mixed ages)

4-5 years old	6-8 years old	9-10 years old
N=24	30	20

Vázquez, M., Steinfeld, A., Hudson, S. E., & Forlizzi, J. (2014). Spatial and other social engagement cues in a child-robot interaction: Effects of a sidekick. ACM/IEEE International Conference on Human-Robot Interaction (HRI).

Sidekicks Can Influence Behavior





- Anthropomorphized household objects
  - Positive engagement effects
- Co-located sidekick
  - Increases attention in some interactions
- Age matters
  - Older kids held back, more inhibited
  - Younger kids talked less
- Highly variable group formations

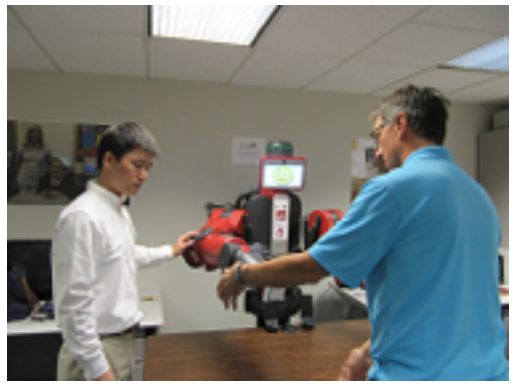
Robot Assistants for Blind Transit Riders

- Baxter
  - Gesture directions
  - Identify cards & tickets
  - Help with manipulation tasks
- “Dog” Guide Robot
  - Meet at door
  - Guide through station
- Smartphones too

Test Concepts with Stakeholders





Sighted experts **Blind travelers**

How do you describe a robot to a blind person?

Min, B.-C., Steinfeld, A., & Dias, M. B. (2015). How would you describe assistive robots to people who are blind or low vision? ACM/IEEE International Conference on Human-Robot Interaction (HRI) Extended Abstracts.

Questions?

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steinfeld@cmu.edu
www.cs.cmu.edu/~astein