Exploring Familiar Design Strategies to Explain Robot Vision Capabilities

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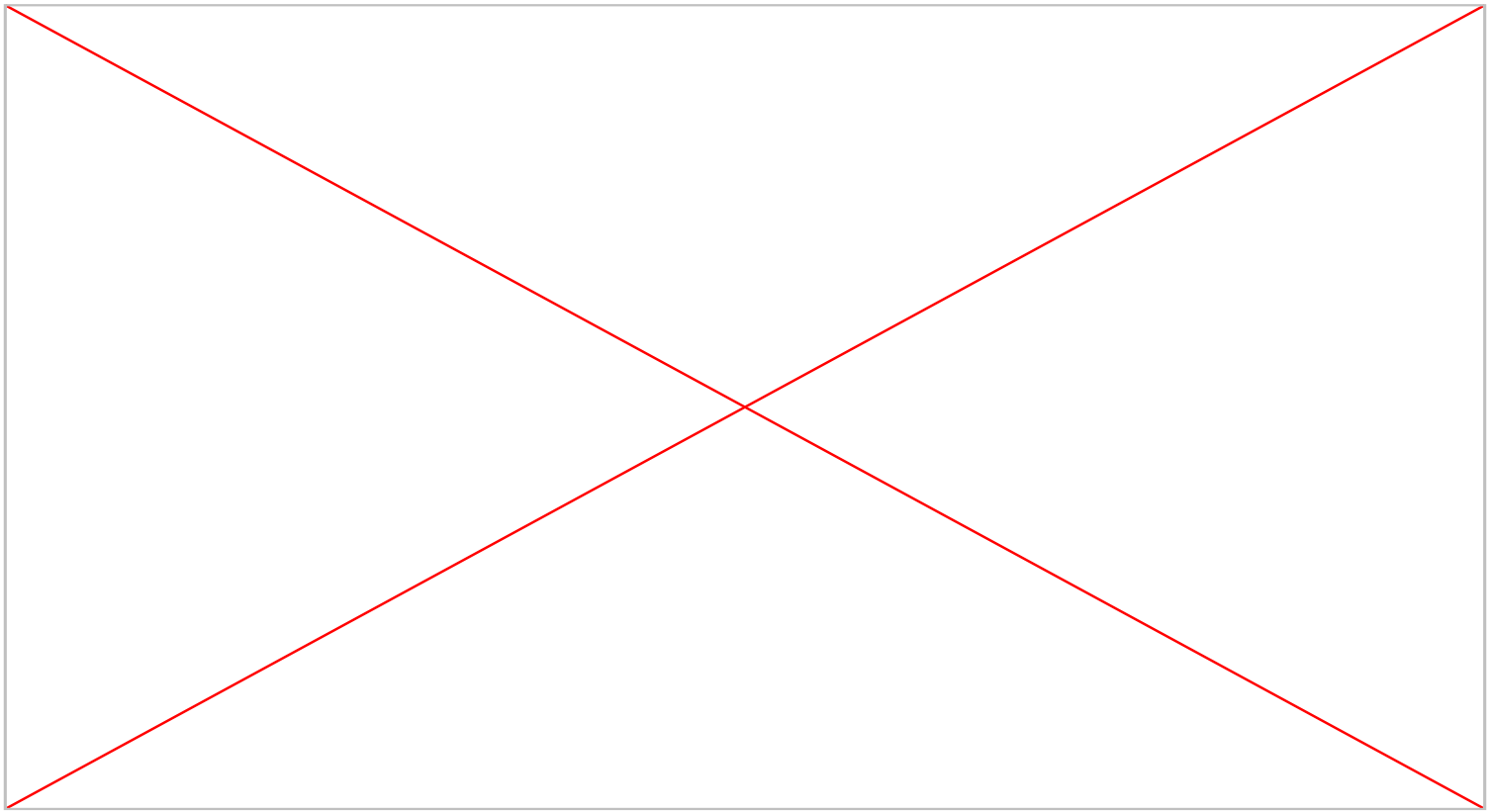
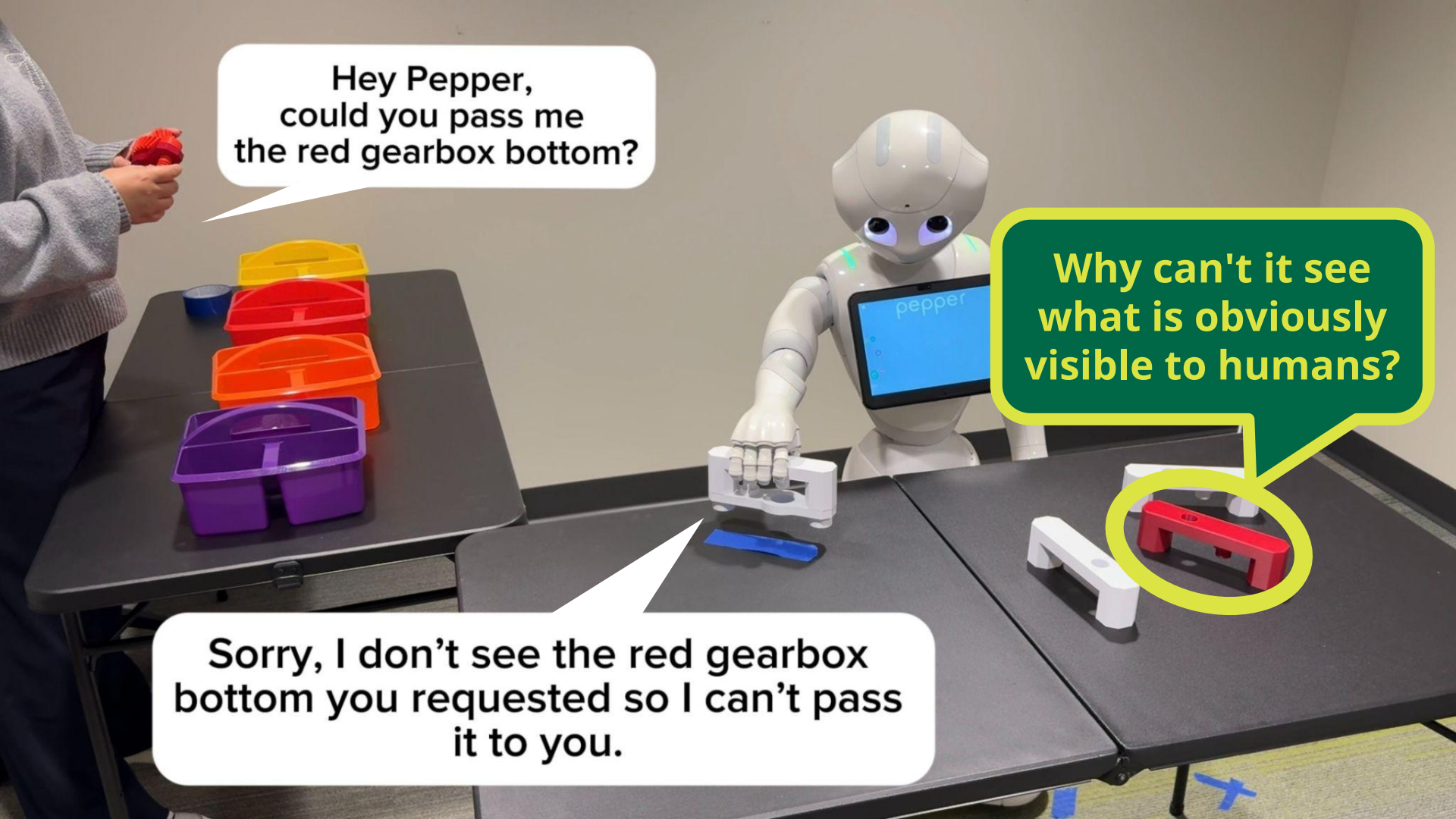
Mar 3, 2025
X-HRI 2025 at HRI 2025

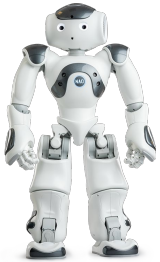
Motivating Scenario: Replenishing Parts




Hey Pepper,
could you pass me
the red gearbox bottom?
pepper
Why can't it see
what is obviously
visible to humans?
Sorry, I don’t see the red gearbox
bottom you requested so I can’t pass
it to you.

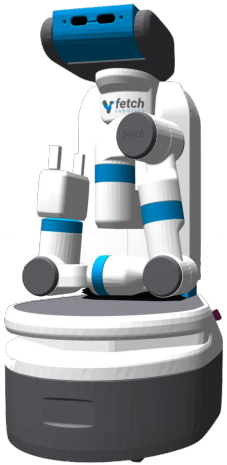
Problem

We mistook a **robot's field of view: ~60°** vs. **>180° (humans)**.



NAO: **56.3°**

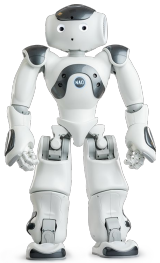
Pepper: **54.4°**



Fetch: **54°**

Problem

We mistook a **robot's field of view: ~60°** vs. **>180° (humans)**.



NAO: **56.3°**

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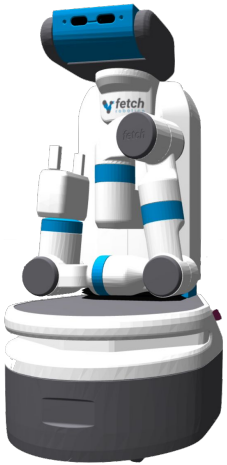


Fetch: **54°**

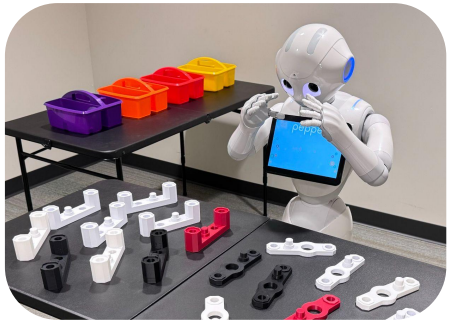
This is problematic!

We will ask robots to do impossible tasks about out-of-view objects!

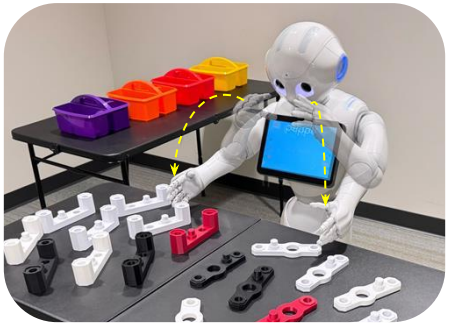
How can we solve this?

Our Designs to Indicate FoV

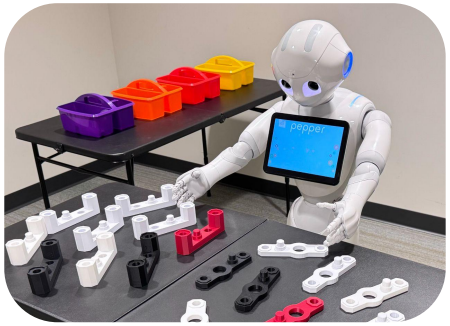
Body Language



Near-Eye Hands

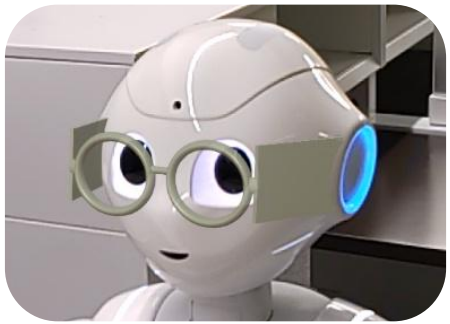


Motion



Extended Arms

Familiar Experience



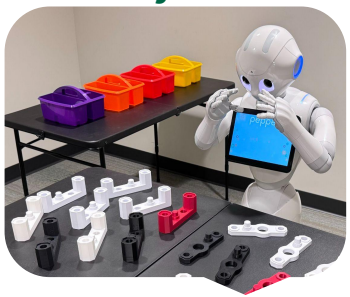
Glasses

Spotlight Scene

Design Taxonomy

Body Language

Familiar Experience



Near-Eye Hands

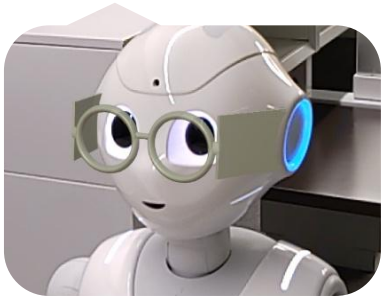
Motion

Extended Arms

Eye Space | Head Space | Transition Space | Task Space

(4) (5) (6) (7) (8)

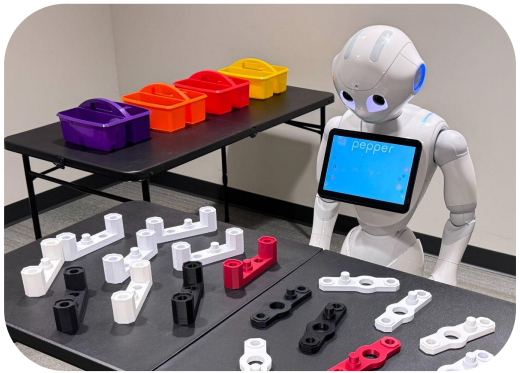
Egocentric ***Allocentric***



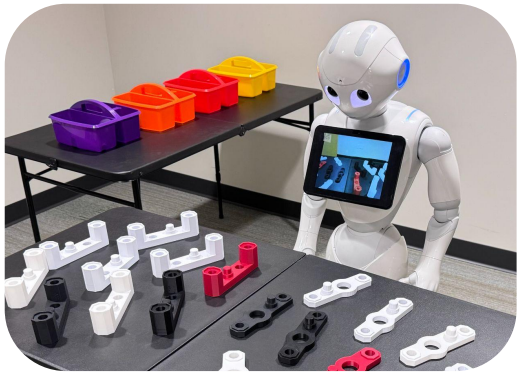
Glasses

Spotlight Scene

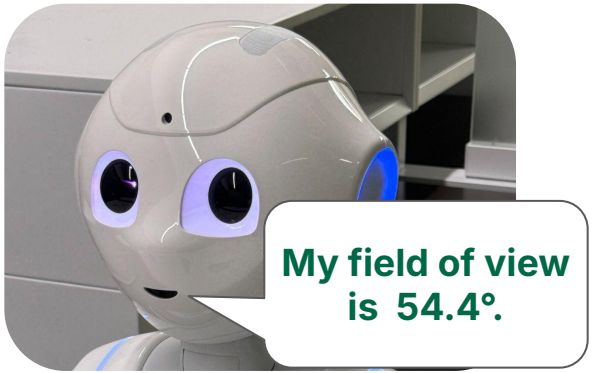
Baseline Conditions in Common Modalities



Baseline



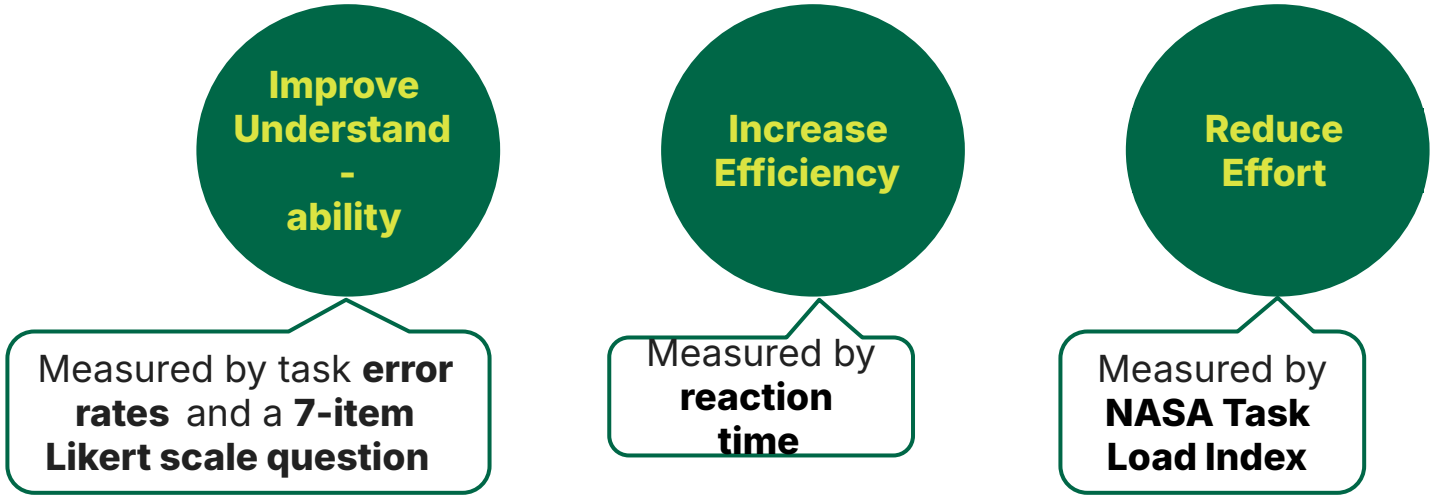
Screen



Voice

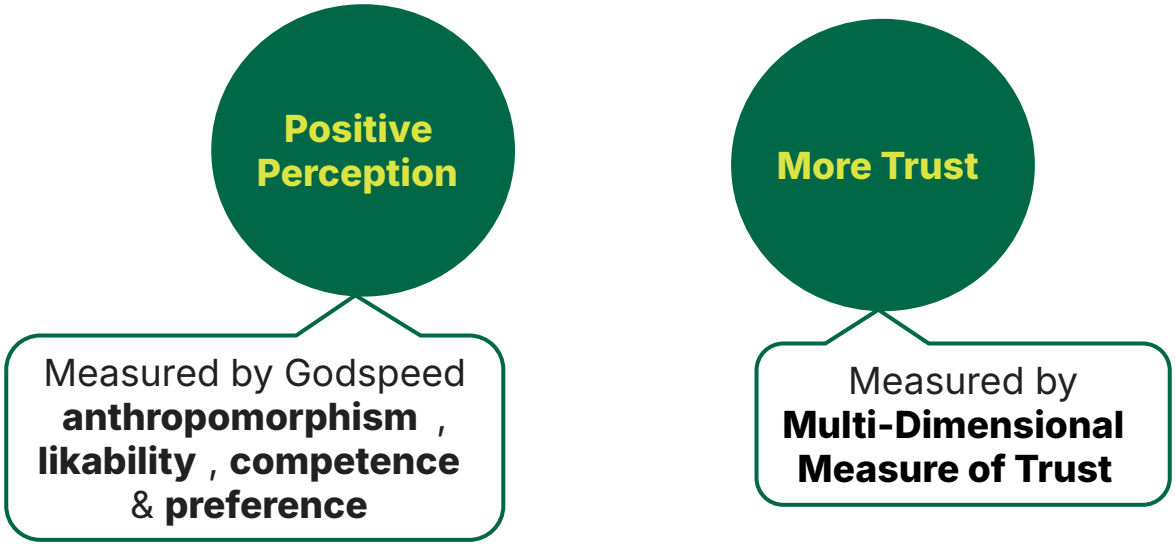
Hypotheses: Objective Outcomes

Designs closer to the **allocentric** space will:



Hypotheses: Trust & Perceptions

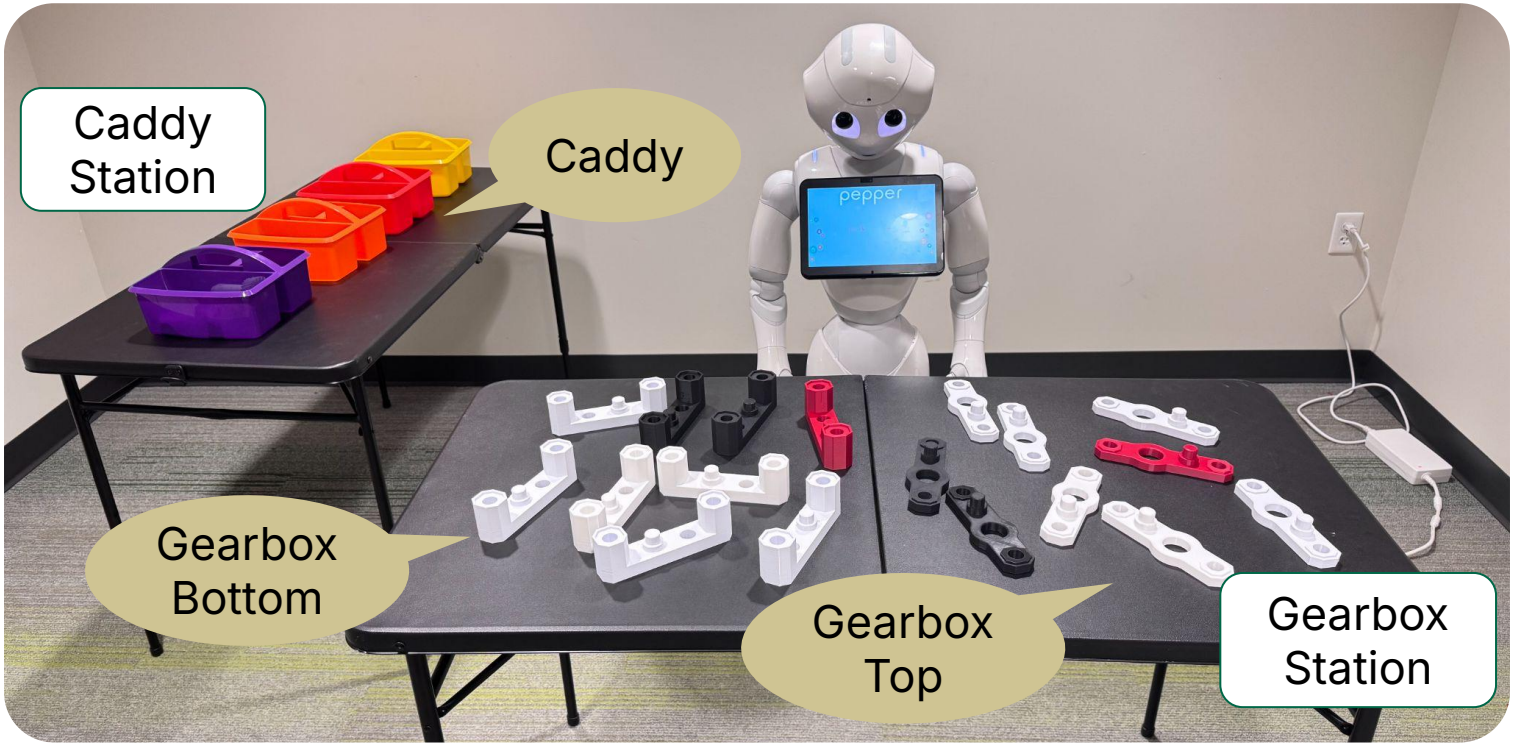
Designs closer to the **egocentric** space will bring:



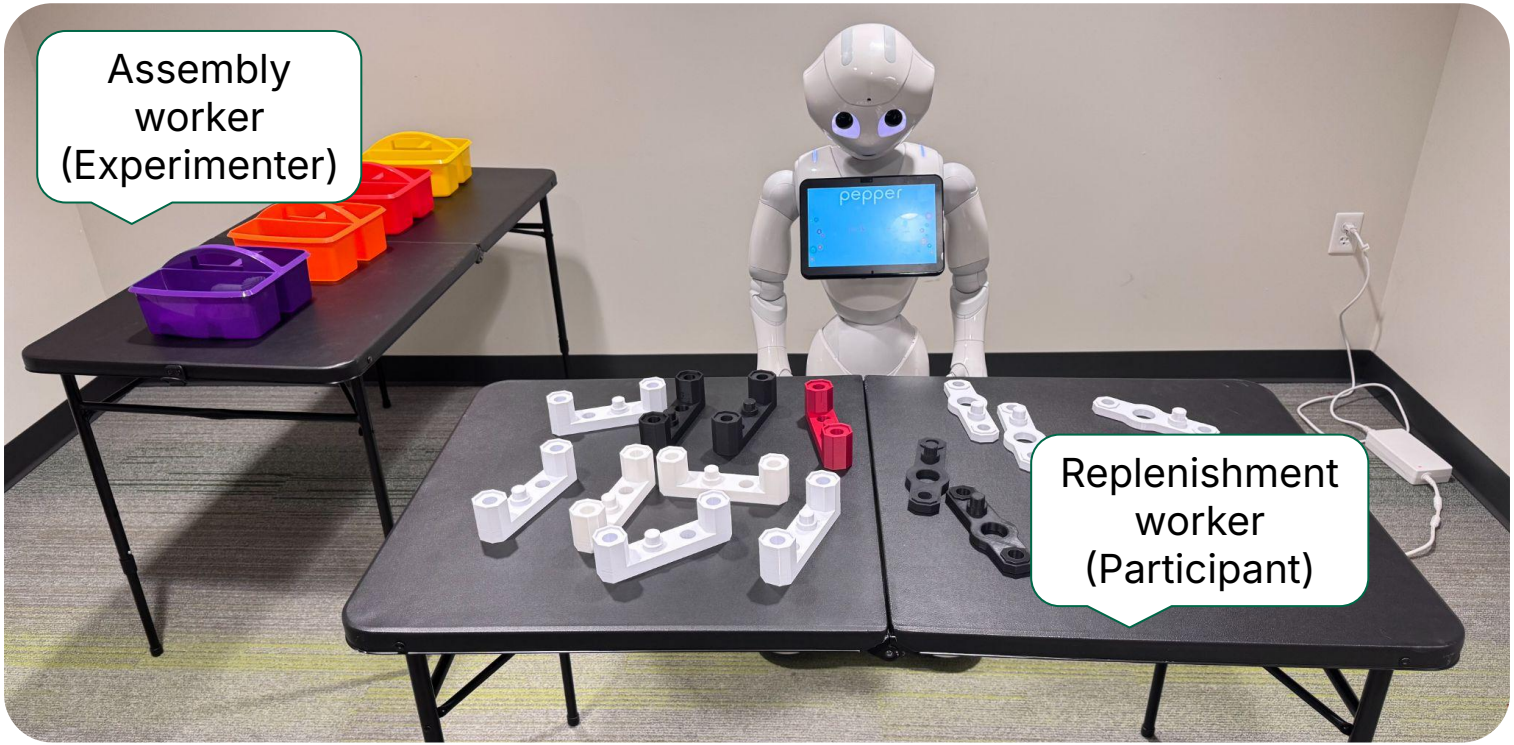
Experiment Design

To test the hypotheses, we design a 1×8 within-subjects study.

Task Environment



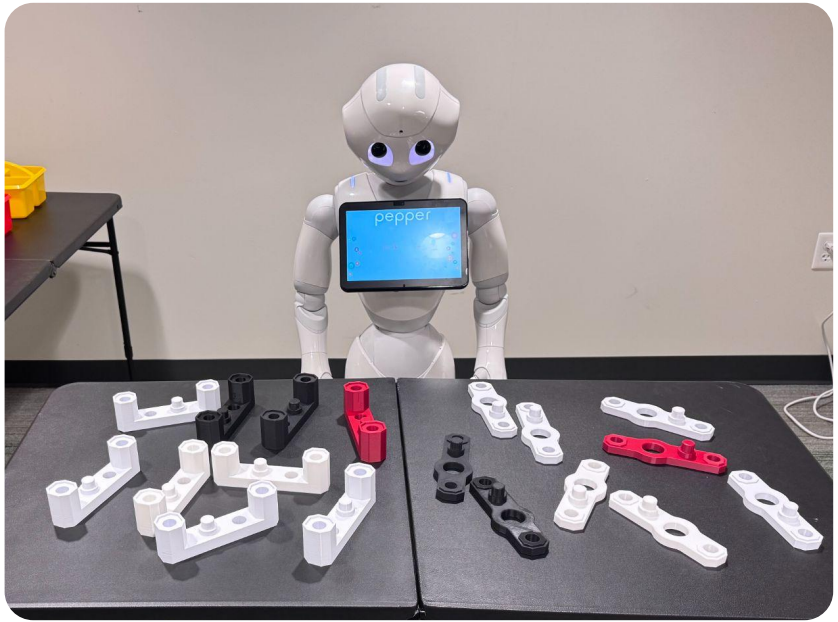
Task Environment



Task

- Put gearbox bottoms & tops on table.
- Guess what objects robot can see.
- Fill out surveys after each condition.

Robot will rotate randomly before moving to next condition



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Key Takeaways

1. Robots' **much narrower FoV** is **problematic** : People will ask for out-of-view objects.
2. We **leverage familiar experiences** to **design indicators** to show robot's vision capability.
3. We hope **future user study** will help **design more explainable robots** .