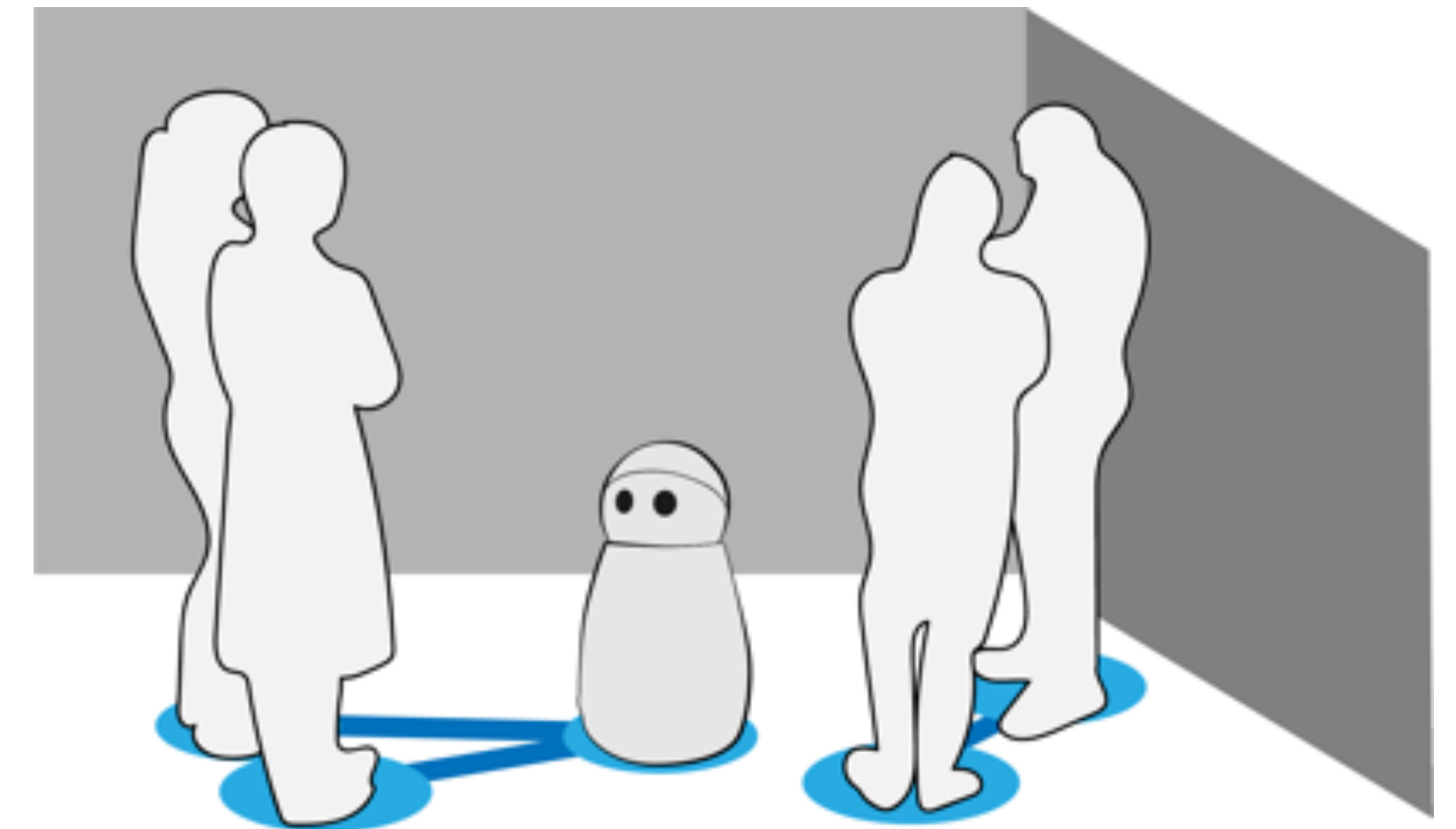


# NRI: FND: Spatial Patterns of Behavior in HRI Under Environmental Spatial Constraints

PI: Marynel Vázquez, Yale University

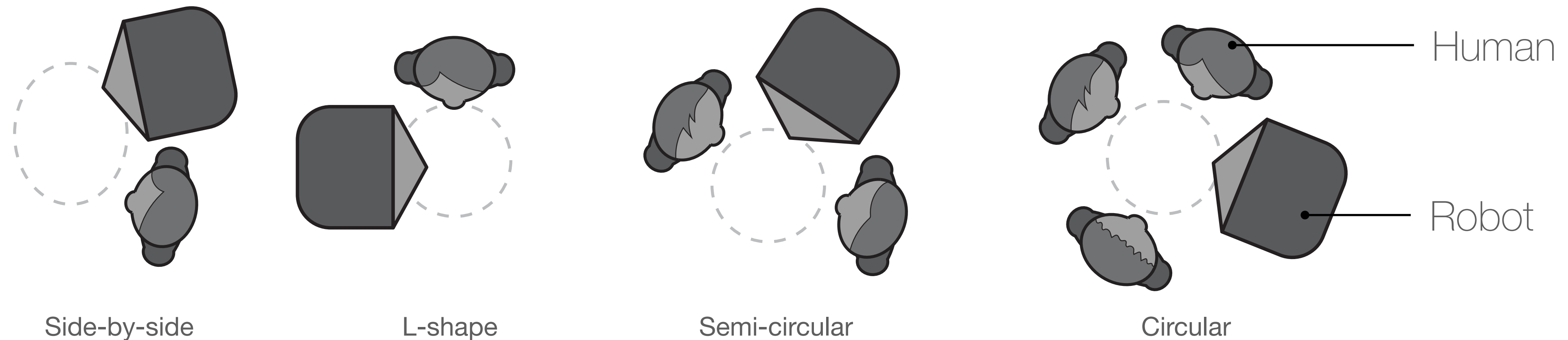
Award #1924802. Start Date: 09/01/2019. Poster #138

Project website: <https://interactive-machines.com/projects/spatial>



# Project Goals

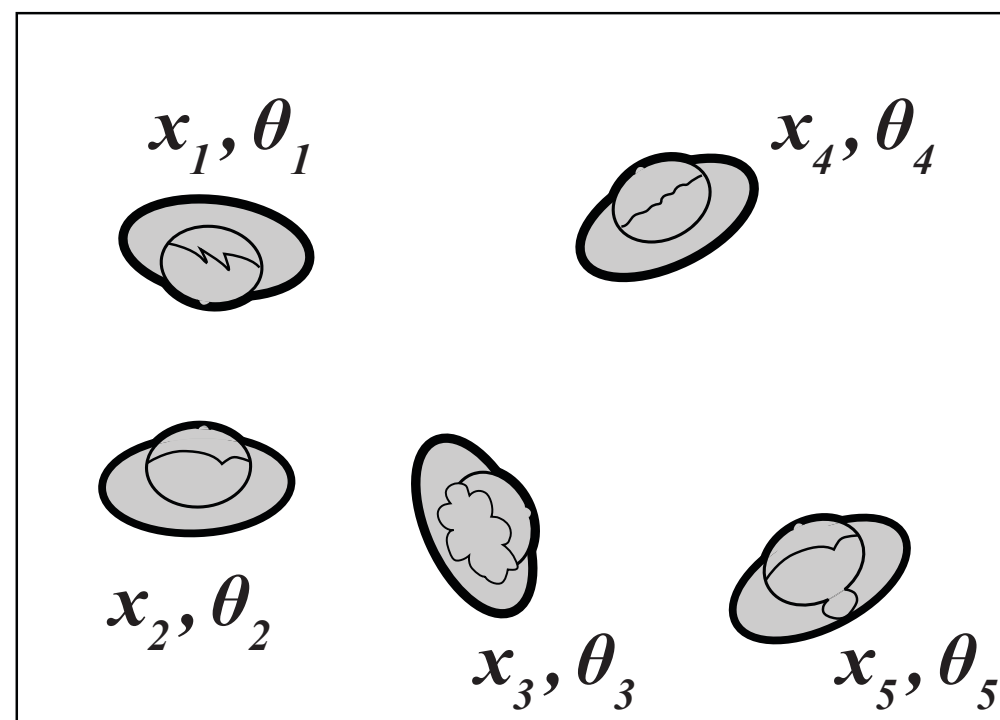
Advance autonomous reasoning about spatial patterns of group behavior that naturally emerge during human-robot conversations.



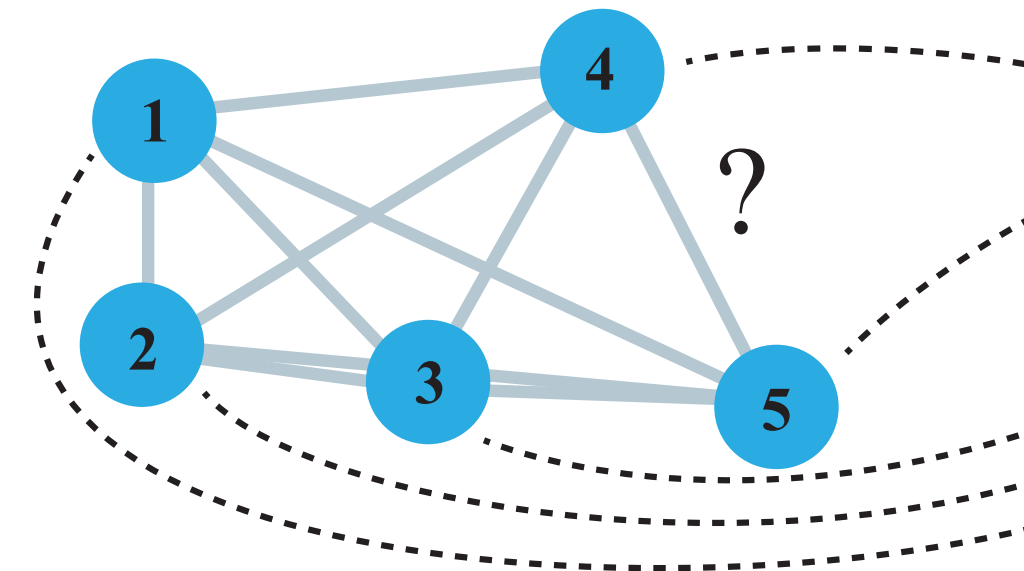
Our work has contributed novel **data-driven methods** to model these spatial formations and **empirical knowledge** to understand how people perceive them.

# Deep Affinity Network for Clustering Conversational Interactants

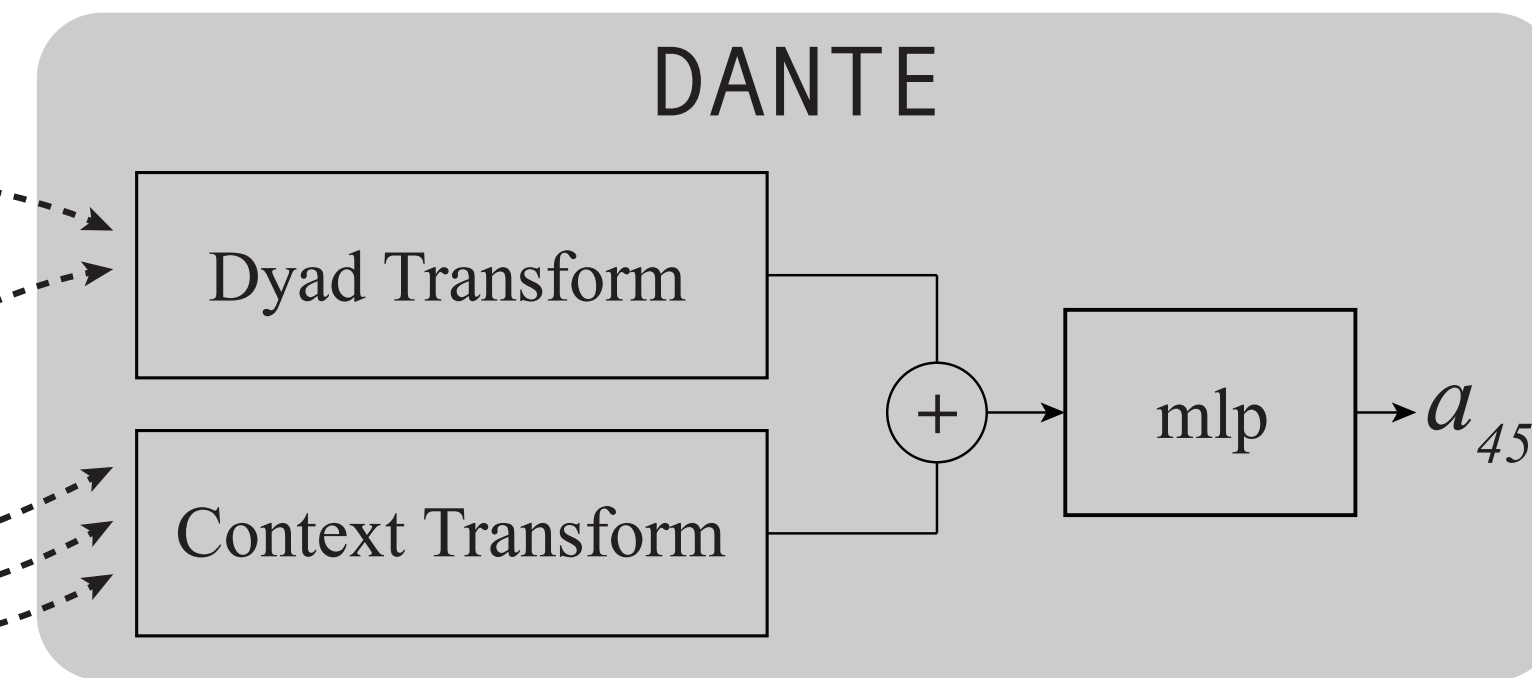
**a** Social scene



**b** Create interaction graph



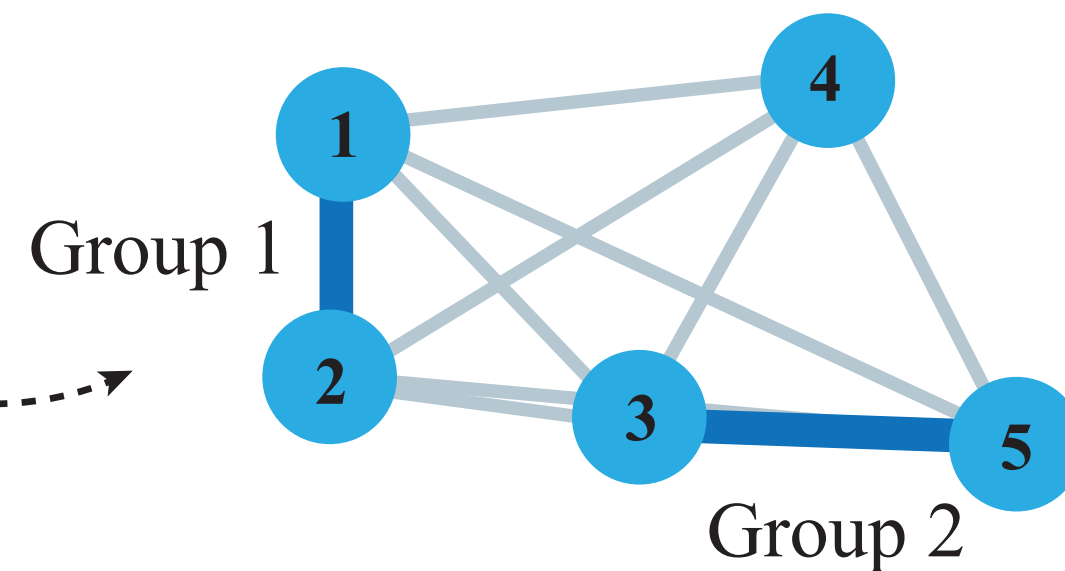
**c** Compute pair-wise affinities



**d** Create affinity matrix

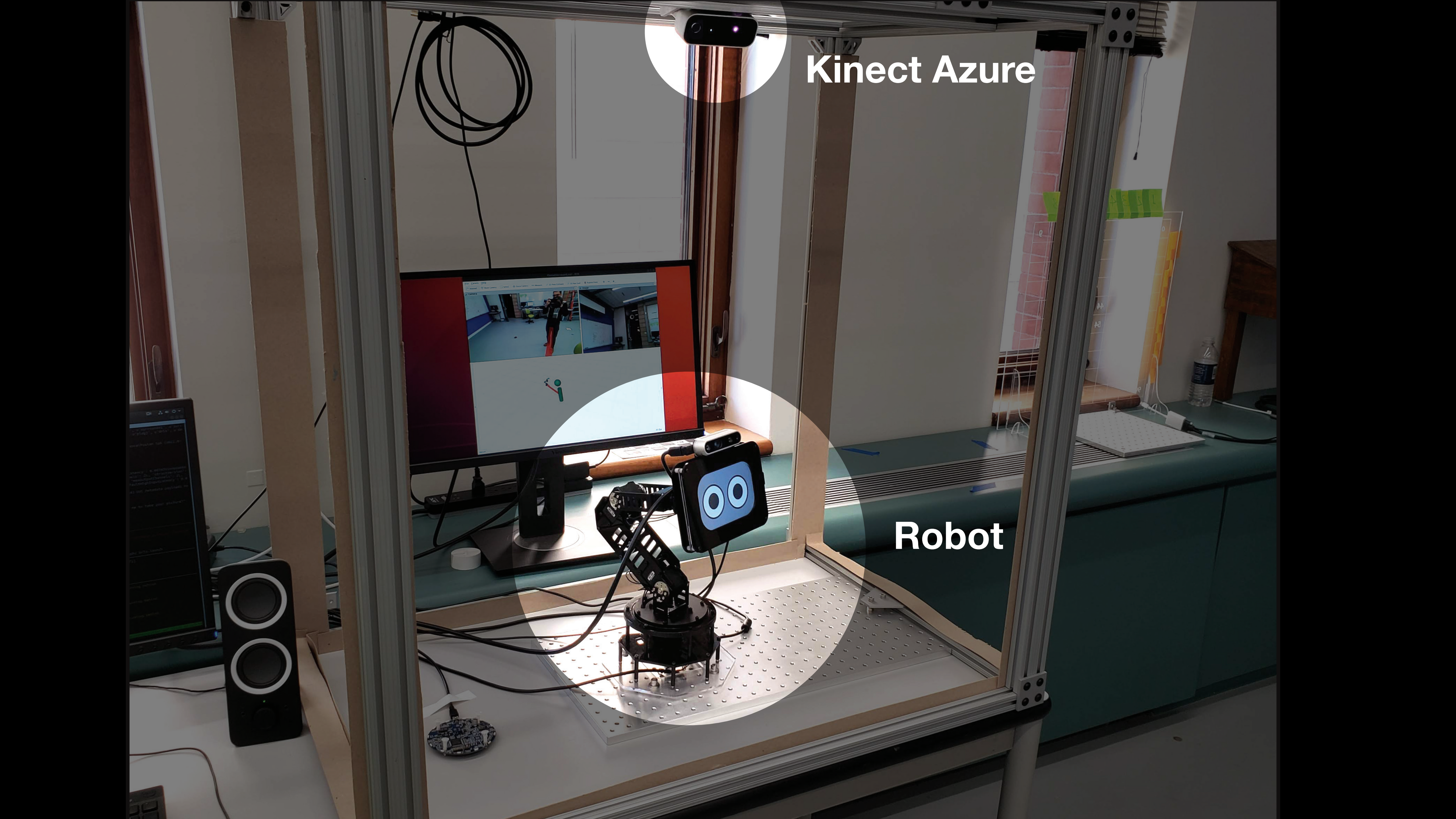
$a_{11}$	$a_{12}$	$a_{13}$	$a_{14}$	$a_{15}$
$a_{21}$	$a_{22}$	$a_{23}$	$a_{24}$	$a_{25}$
$a_{31}$	$a_{32}$	$a_{33}$	$a_{34}$	$a_{35}$
$a_{41}$	$a_{42}$	$a_{43}$	$a_{44}$	$a_{45}$
$a_{51}$	$a_{52}$	$a_{53}$	$a_{54}$	$a_{55}$

**e** Dominant Sets [Hung and Kröse; ICMI '11]

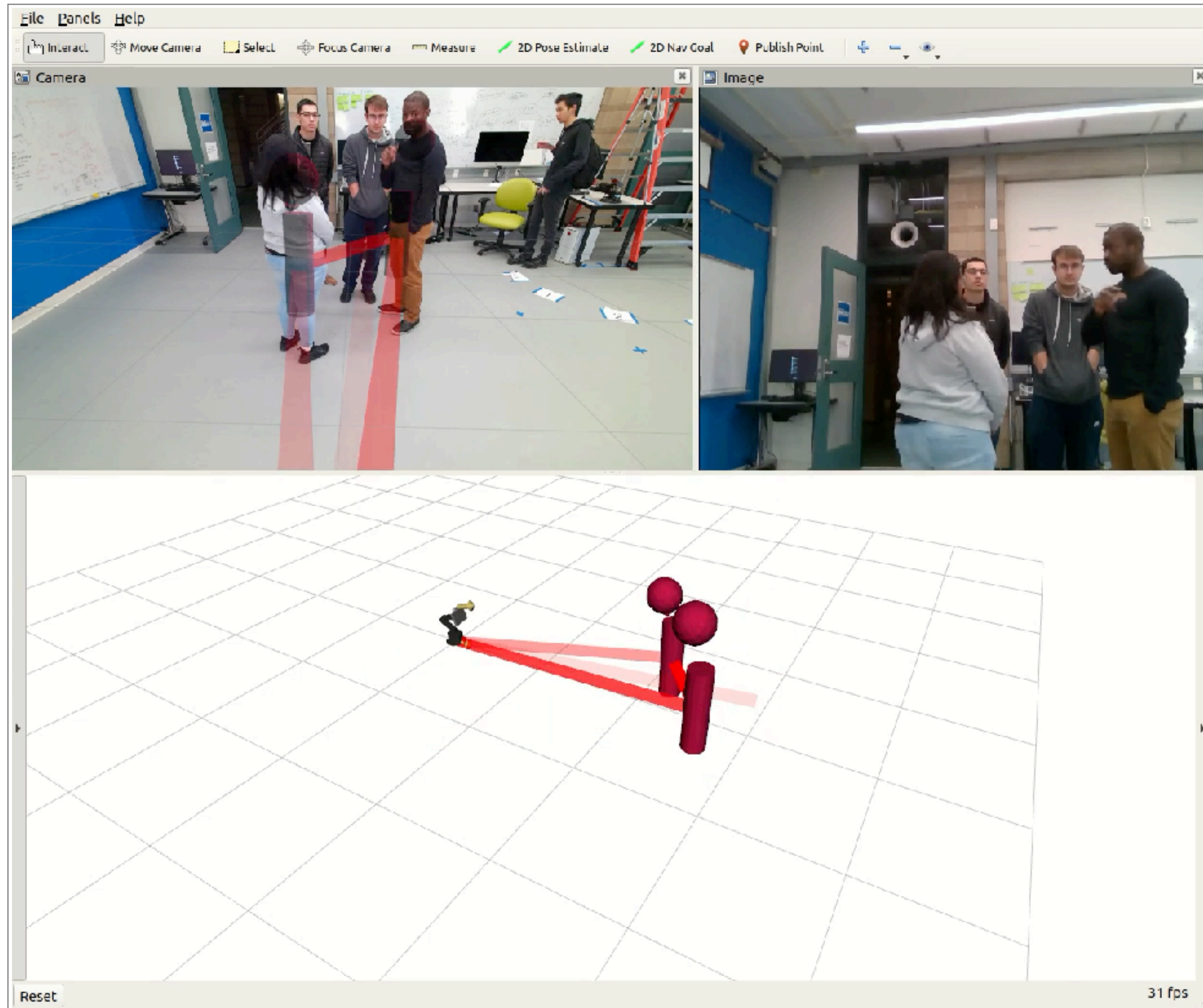
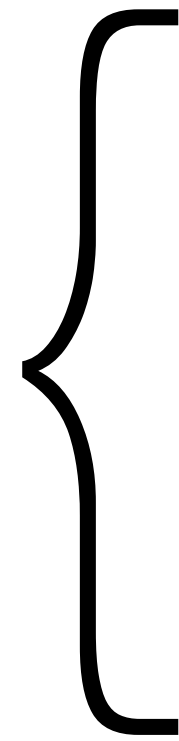


**Kinect Azure**

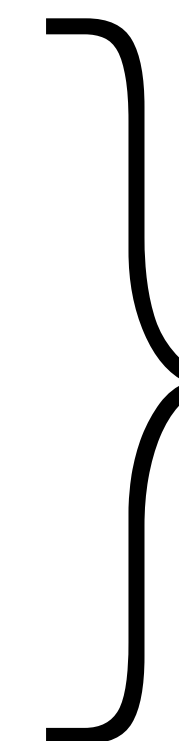
**Robot**



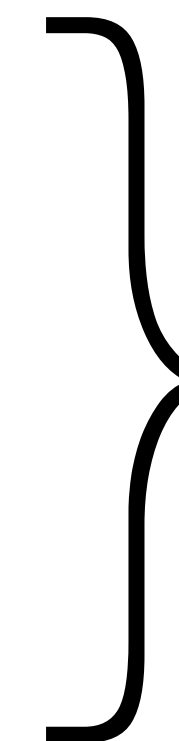
Fixed camera view (Kinect)



Robot's view

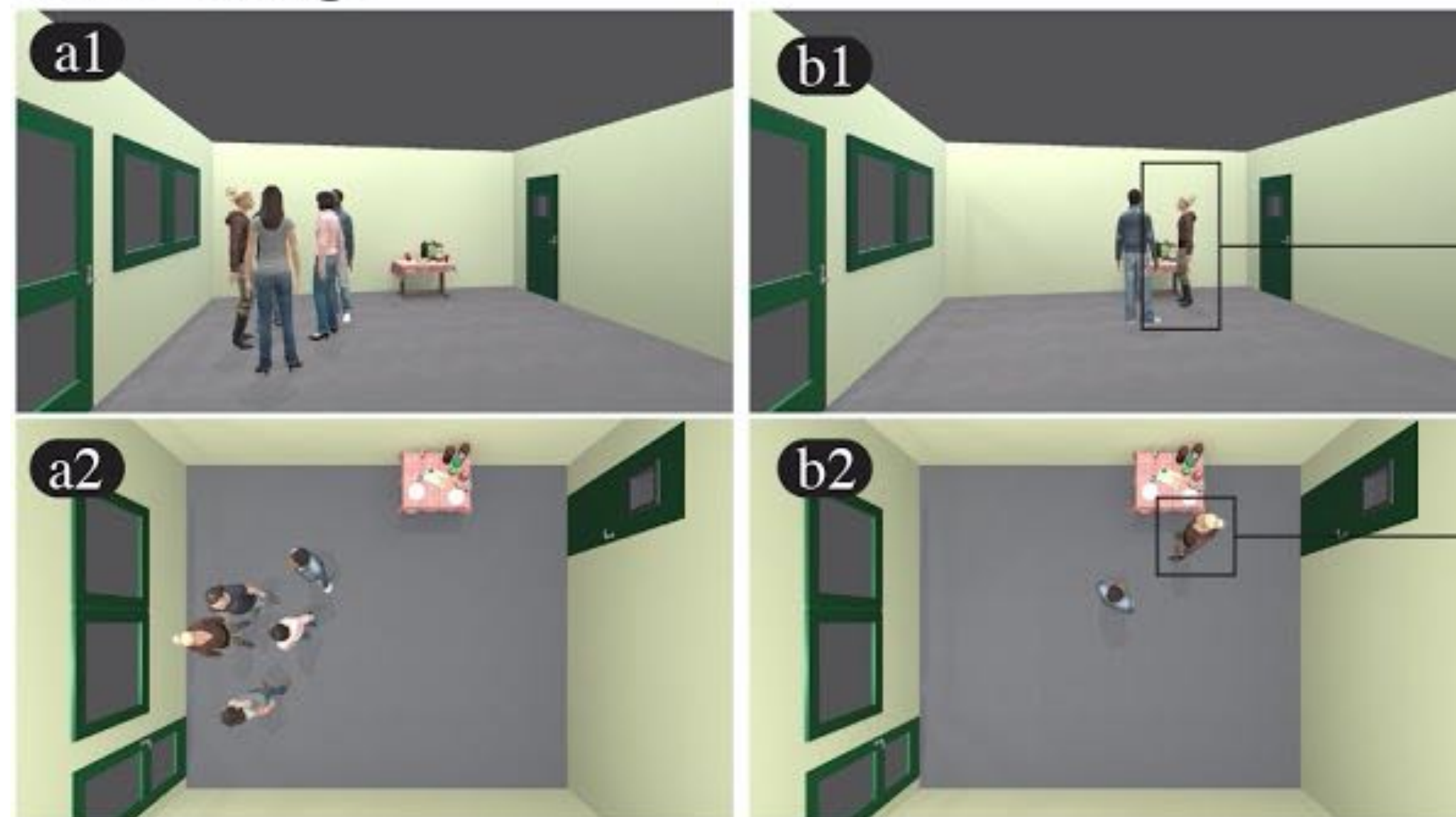


3D visualization

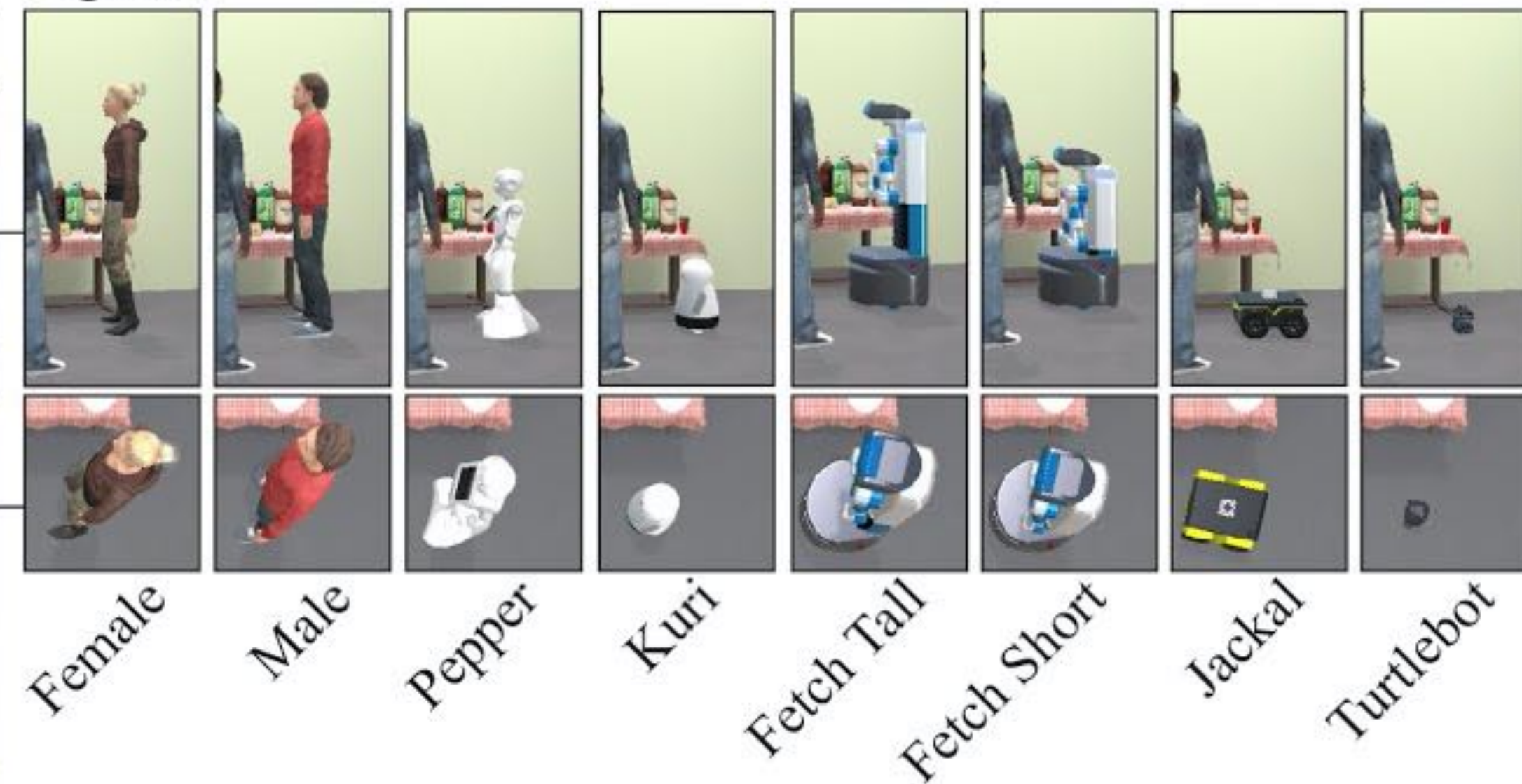


# Perceptions of Group Membership based on Robots' Spatial Positioning: Effects of Embodiment

Real Groups



Agents



a1 and a2 are the same scene viewed from the side and top, respectively.

b1 and b2 are the same scene viewed from the side and top, respectively.

The agents with faces were more easily identified correctly as a member of a conversational group. Further, the width of the robots seemed to affect the perception of appropriate spatial behavior in conversational settings.

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Publications:

M. Swofford, J. Peruzzi, N. Tsoi, S. Thompson, R. Martín-Martín, S. Savarese, M. Vázquez. Improving Social Awareness Through DANTE: Deep Affinity Network for Clustering Conversational Interactants. Proc. ACM Hum.-Comput. Interact. 4, CSCW1, 2020.

J. Connolly, N. Tsoi, M. Vázquez. Perceptions of Conversational Group Membership based on Robots' Spatial Positioning: Effects of Embodiment. Companion of the 2021 ACM/IEEE International Conference on Human-Robot Interaction. (to appear)