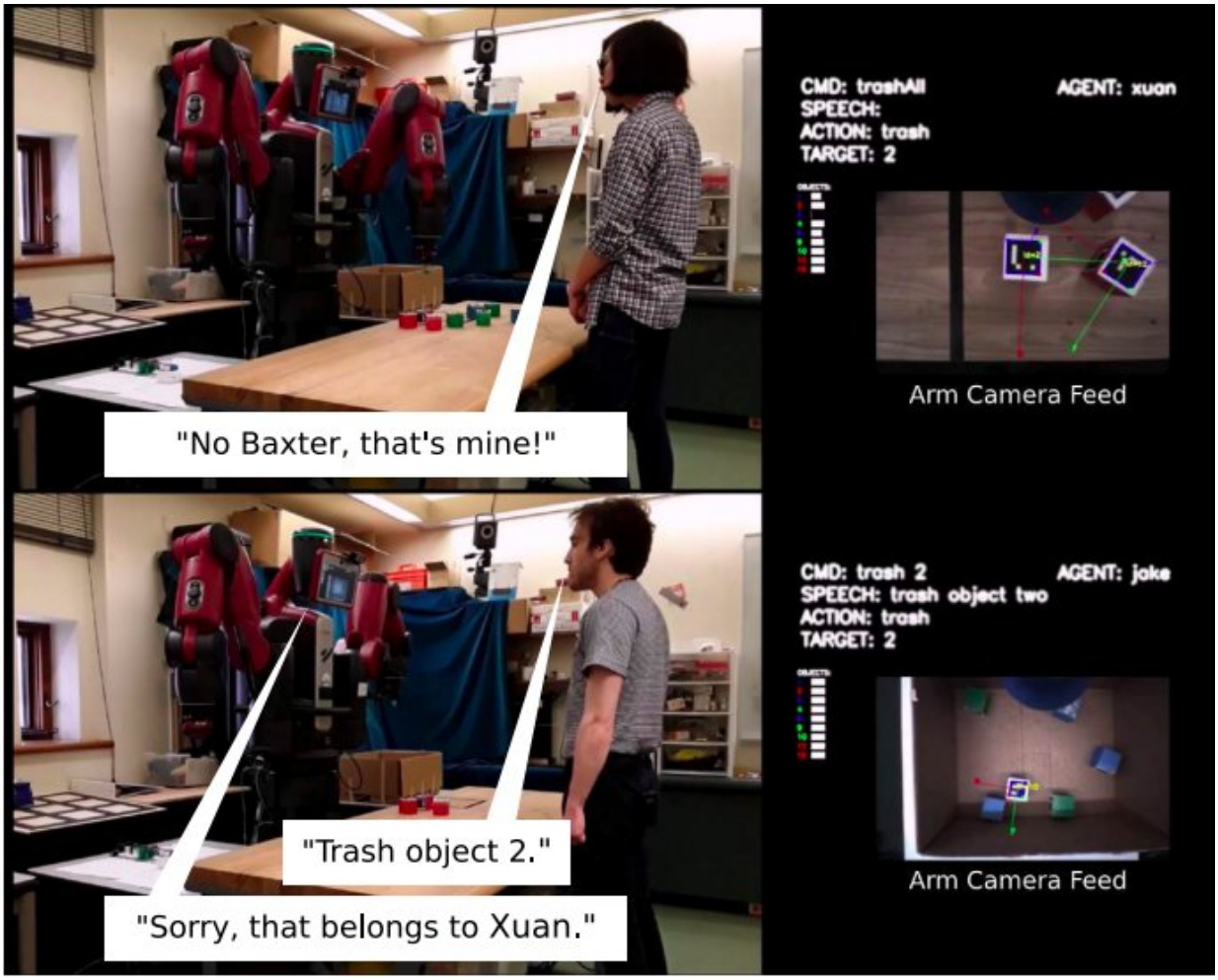
A new robot capable of learning ownership relations and norms

December 21 2018, by Ingrid Fadelli



Ownership learning via human-robot interaction. Top: The robot is verbally halted mid-action by Xuan from discarding object 2. Bottom: Having learned the ownership relations and action permissions by interacting with Xuan, the robot denies Jake's request to discard object 2. Credit: Tan, Brawer & Scassellati.

A team of researchers at Yale University has recently developed a robotic system capable of representing, learning and inferring ownership relations and norms. Their study, pre-published on arXiv, addresses some of the complex challenges associated with teaching robots social norms and how to conform with them.

As robots become more prevalent, it is important for them to be able to communicate with humans both effectively and appropriately. A key aspect of human interactions is understanding and behaving according to social and moral norms, as this promotes positive co-existence with others.

Ownership norms are a set of social norms that helps to navigate shared environments in ways that are more considerate towards others. Teaching these norms to robots could enhance their interactions with humans, allowing them to distinguish between un-owned tools and owned tools that are temporarily shared with them.

"My research lab focuses on building robots that are easy for people to interact with," Brian Scassellati, one of the researchers who carried out the study, told TechXplore. "Part of that work is looking at how we can teach machines about common social concepts, things that are essential to us as humans but that are not always the topics that attract the most attention. Understanding about object ownerships, permissions, and customs is one of these topics that hasn't really received much attention but will be critical to the way that machines operate in our homes, schools, and offices."

In the approach devised by Scassellati, Xuan Tan and Jake Brawer, ownership is represented as a graph of probabilistic relations between objects and their owners. This is combined with a database of predicate-

based norms, which constrain the actions that the robot is allowed to complete using owned objects.

"One of the challenges in this work is that some of the ways that we learn about ownership are through being told explicit rules (e.g., 'don't take my tools') and others are learned through experience," Scassellati said. "Combining these two types of learning may be easy for people, but is much more challenging for robots."

The system devised by the researchers combines a new incremental norm-learning algorithm that is capable of both one-shot learning and induction from examples, with Bayesian inference of ownership relations in response to apparent rule violations and percept-based prediction of an object's likely owners. Together, these components allow the system to learn ownership norms and relations applicable in a variety of situations.

"The key to the work that Xuan and Jake did was to combine two different kinds of machine learning representation, one that learns from these explicit, symbolic rules and one that learns from small bits of experience," Scassellati explained. "Making these two systems work together is both what makes this challenging, and in the end, what made this successful."

The researchers evaluated the performance of their robotic system in a series of simulated and real-world experiments. They found that it could effectively complete object manipulation tasks that required a variety of ownership norms to be followed, with remarkable competency and flexibility.

The study carried out by Scassellati and his colleagues offers a notable example of how robots can be trained to infer and respect social norms. Further research could apply similar constructs to other norm-related

capabilities and address complex situations in which different norms or goals are in conflict with one another.

"We're continuing to look at how to build robots that interact more naturally with people, and this study merely focuses on one aspect of this work," Scassellati said.

More information: That's mine! Learning ownership relations and norms for robots. arXiv:1812.02576 [cs.AI]. arxiv.org/abs/1812.02576