Guiding principles that regulate choice of grasp type during a human-robot exchange of objects

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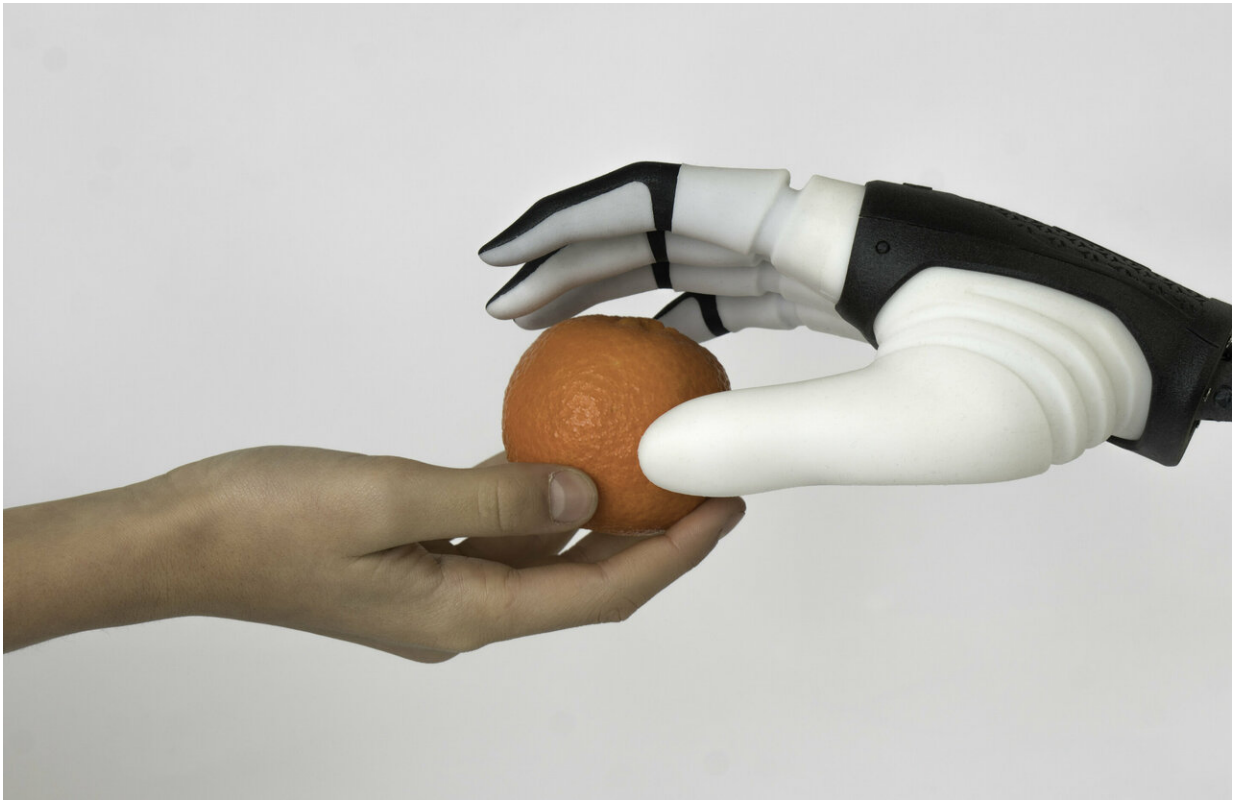

The passage of object between human hand and robot hand Credit: © Scuola Superiore Sant'Anna

There is a time when successful cooperation between humans and robots

has decisive importance—when one is required to hand an object to the other, and therefore, to coordinate their actions accordingly. Researchers are interested in making this interaction more natural for robots.

A new study titled "On the choice of grasp type and location when handing over an object," published in *Science Robotics* by a research team of The BioRobotics Institute of Scuola Superiore Sant'Anna and the Australian Centre for Robotic Vision, reveals the guiding principles that regulate the choice of grasp type during an exchange of objects, encouraging cooperation between a robotic system and a person.

The study, conducted in 2018, analysed the behavior of people when grasping an object and handing it to a partner. The researchers investigated the grasp choice and hand placement on those objects during a handover when subsequent tasks are performed by the receiver. Passers tend to grasp the purposive part of the objects and leave "handles" unobstructed for the receivers. Intuitively, this choice allows receivers to comfortably perform subsequent tasks with the objects.

"We realised that, to date, insufficient attention has been given to the way a robot grasps an object in studies on human-robot interaction," explains Francesca Cini, Ph.D. student of The BioRobotics Institute and one of the two principal authors of the paper. "This aspect is very pivotal in this field. For example, when we pass a screwdriver knowing that the receiver should use it, we leave the handle free to facilitate the grasp and the subsequent use of the object. The aim of our research is to transfer all these guiding principles onto a robotic system so that they will be used to select a correct grasp type and to facilitate the exchange of objects."

The impact of the collaborative study opens new scenarios of technological innovation, bringing benefits to various social activities in which human-robot cooperation is well established and yet to be

established. This could improve production steps in industrial contexts, and robots could assist patients with more natural and effective results in rehabilitative contexts.

"Collaborative robotics is the next frontier of both industrial and assistive robotics," says Marco Controzzi, researcher of The BioRobotics Institute and principal investigator of Human-Robot Interaction Lab. "For this reason, we need a new generation of robots designed to interact with humans in a natural way. These results will allow us to instruct the robot to manipulate objects as a human collaborator through the introduction of simple rules."

"Perhaps surprisingly, grasping and manipulation are regarded as very intuitive and straightforward actions for us humans," says Valerio Ortenzi, a research fellow at the Australian Centre for Robotic Vision and the other principal author of the paper. "However, they simply are not. We intended to shed a light on the behavior of humans while interacting in a common manipulation task, and a handover is a perfect example where little adjustments are performed to best achieve the shared goal to safely pass an object from one person to the other."

More information: F. Cini el al., "On the choice of grasp type and location when handing over an object," *Science Robotics* (2019). robotics.sciencemag.org/lookup … /scirobotics.aau9757

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