Reading object properties from human and humanoid action observation
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Human collaboration is characterized by an astounding coordination and efficiency, even without the use of verbal instructions. The key element of this ability is the mutual implicit understanding of the two partners. Just by observing someone moving or passing an object, we can infer not only his goals, but also some properties of that object which would not be otherwise accessible, as for example its temperature or its weight. This important capability allows the partners in an interaction to be always prepared in advance and to achieve a fluid and timely coordination. An important question is therefore how to translate this human social skill into human-robot interaction. We suggest that an essential step consists in the achievement of an action-based mutual understanding, deriving from the implicit communication associated to human motion, also when the manipulator is a humanoid robot.

In a series of experiments we have investigated whether the ability to read an invisible property of a manipulated object (i.e., its weight) can be extended also to the observation of a humanoid action. In particular, we have designed a simple set of lifting behaviors for the humanoid robot iCub and we have measured in which conditions human subjects could correctly judge object weight from robot observation. Moreover, we have asked subjects to lift themselves the object passed to them by the robot, to assess whether, after robot observation, they could anticipatorily plan the appropriate manipulation of the same object.

The results suggest that if robot motion is appropriately designed, also considering its understandability by a human collaborator, the transfer of implicit information can be as efficient as that typical between humans. Indeed, the estimation of object weight after the observation of a lifting action was characterized by a similar accuracy when a human or a humanoid was the lifter. More importantly, after lifting observation, subjects planned more accurately their own lifting action, in a way more similar to that exhibited for an object of known weight.

As robots are more and more employed in unconstrained human environments, the designers have progressively less control on who will interact with the robot and how. Our findings suggest that designing intuitive robot motion could be a possible path to extend human fluid interaction also to human-robot collaborations with non-expert users.