Neuroscience contributions to human-robot cooperation

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Abstract -

Cooperation is one of the highlights of human cognition. True cooperation requires the ability to understand and share the goals of another individual and to create and share a coordinated plan of action to achieve the common goal. This places strong requirements on perceptual and cognitive functions. In this context we can consider that human beings are the ultimate example of cooperative agents. We can thus adopt the strategy of understanding human cooperation both from the perspective of behaviour, and in terms of the underlying neurophysiology.

Keywords – ***sensory motor systems, human-robot cooperation, language***

I. Introduction

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The current research is the result of interaction between research in neuroscience, computational neuroscience and robotics on the one hand, and developmental psychology on the other. One of the key findings in the developmental psychology context is that with respect to other primates, humans appear to have a unique ability and motivation to share goals and intentions with others [1-2]. This ability is expressed in cooperative behavior very early in life, and appears to be the basis for subsequent development of social cognition. Here we attempt to identify a set of core functional elements of cooperative behavior and the corresponding shared intentional representations [3]. We then look to primate neuroscience for data on how different aspects of intentional action are implemented in the brain [e.g. 4] and begin to specify how these capabilities can be implemented in a robotic system [5], and tested in human-robot interaction experiments [5-6]. A crucial component of cooperative interaction involves the use of language to negotiate the cooperation. We have thus assembled a variety of neurophysiological results in the development of neurocomputational models of language processing [7-8]. We tested these mechanisms in the context of robot language acquisition [9], and then used the resulting grammatical constructions to teach robots new, generalized behaviours [10]. These results are reviewed in the context of neuroscience contributions to human-robot cooperation.

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