Do robots have goals? How agent’s morphology influences goal attribution in marmoset monkeys

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Introduction

The understanding of goals is a basic precondition for interpretation and prediction of actions of other individuals and for planning one’s own action [1]. In young infants, goal attribution to inanimate agents seems to be coupled to presence of human-like features. Likewise, infants attribute goals to humans, humanoid robots [3] and puppets [4], but not to geometrical shapes [3], or mechanical devices [2].

The purpose of our study was to investigate the role of agent’s appearance for the goal attribution mechanism in monkeys. We used the expectancy violation method used in preverbal studies with infants [2] to test whether common marmosets (Callithrix jacchus) (s. Fig 1) attribute goals to their conspecifics (experiment 1), monkey-like robots (experiment 2) and abstract geometrical shapes (experiment 3).

Methods

Stimuli Experiment 1

Habituation  
Congruent Event
Incongruent Event

Table 1: After three habituations, the subjects were presented with the congruent and the incongruent test events in a randomized order.

Results

In the first and the second experiments, the monkeys looked longer at the incongruent test event than at the congruent test event (Repeated measures ANOVA: F(1,2)=27, p<0.001 and F(1,2)=5.7, p<0.044) respectively. Thus, the monkeys seemed to habituate to the goal of action, and not to its peripheral properties (e.g. path) (s. Fig 6, right, middle).

In the third experiment (s. Fig. 6, left), the monkeys looked longer at the congruent event (ANOVA(1,2)=6.87; p<0.028), suggesting that they did not attribute goals to the moving box. In all three experiments, we could demonstrate a decrease of looking times over three habituation trials: [F(1,2)= 68; P<0.001], [F(1,2) = 7.6; P<0.03] and [F(1,2)=7.8 p<0.003] respectively.

Discussion and Outlook

The data from the first experiment confirmed the results from a previous study with human agents [5], providing additional evidence that common marmosets might be endowed with a capability to recognize goals. Although this capacity can be extended to non-human entities which exhibit human-like features or human-like behaviour in older infants and adults [6, 7], in preverbal infants, this mechanism fails if the actions are performed by inanimate objects with abstract features [2, 8].

Results from the second experiment suggest, that this extension of psychological reasoning works also for non-human primitives, at least if the inanimate agents show animal-like features (like quadruped motion). The third experiment demonstrated, that in spite of self-propelled movement, the generalization mechanism for goal attribution requires at least some resemblance to a conspecific. Together with previous studies [3, 4, 6] our results provide indications that robots designed for human-robot interaction should exhibit at least some human-like features. A certain degree of anthropomorphism will enable people to use their experience from social interaction with other people and make their interaction with robots more intuitive.

REFERENCES