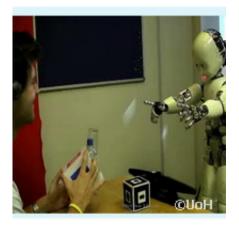# Researchers investigate early language acquisition in robots

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(Phys.org)—Research into robotics continues to grow in Europe. And the introduction of humanoid robots has compelled scientists to investigate the acquisition of language. A case in point is a team of researchers in the United Kingdom that studied the development of robots that could acquire linguistic skills. Presented in the journal *PLoS ONE*, the study focused on early stages analogous to some characteristics of a human child between 6 and 14 months of age, the transition from babbling to first word forms. The results, which shed light on the potential of human-robot interaction systems in studies investigating early language acquisition, are an outcome of the ITALK ('Integration and transfer of action and language knowledge in robots') project, which received EUR 6.3 million under the 'Information and communication

technologies' (ICT) Theme of the EU's Seventh Framework Programme (FP7).

Scientists from the Adaptive Systems Research Group at the University of Hertfordshire in the United Kingdom have discovered that a robot analogous to a child between 6 and 14 months old has the ability to develop rudimentary linguistic skills. The robot, called DeeChee, moved from various syllabic babble to various word forms, including colours and shapes, after it 'conversed' with humans. The latter group was told to speak to the robot as if it were a small child.

'It is known that infants are sensitive to the frequency of sounds in speech, and these experiments show how this sensitivity can be modelled and contribute to the learning of word forms by a robot,' said lead author Caroline Lyon of the University of Hertfordshire.

In their paper, the authors wrote: 'We wanted to explore human-robot interaction and were deliberately not prescriptive. However, leaving participants to talk naturally opened up possibilities of a wide range of behaviour, possibilities that were certainly realised. Some participants were better teachers than others: some of the less good produced very sparse utterances, while other talkative participants praised DeeChee whatever it did, which skewed the learning process towards non-words.'

The researchers said one of the reasons that the robot learnt the words is because the teacher said the words repeatedly, an already anticipated response. The second reason is that the non-salient word strings were variable, so their frequencies were spread about. According to the team, this phenomenon is the basis of a number of automated plagiarism detectors, where precise matches of short lexical strings indicate copying. Lastly, they said the phonemic representation of speech from the teacher to the robot is not a uniformly stable mapping of sounds.

'The frequencies of syllables in words with variable phonemic forms may be attenuated compared with those in salient content words, or parts of such words,' they wrote. 'It has long been realised that there is in practice a great deal of variation in spontaneous speech. This work shows the potential of human-interaction systems to be used in studies of language acquisition, and the iterative development methodology highlights how the embodied nature of interaction may bring to light important factors in the dynamics of language acquisition that would otherwise not occur to modellers.'

More information: Lyon, C., et al. 'Interactive Language Learning by Robots: The Transition from Babbling to Word Forms'. *PLoS ONE* 7(6): e38236. doi:10.1371/journal.pone.0038236

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