Acquiring an Early Peekaboo Communication Based on Reward Prediction

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Abstract

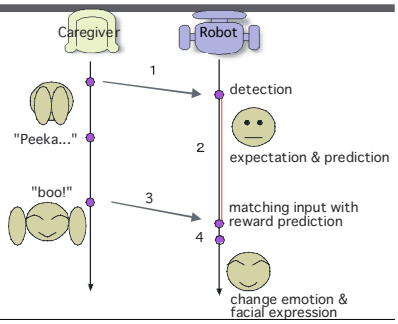
Infants become sensitive to the regular behavior of their caregivers by the end of 4 months old. In this paper, we propose a system for a robot to acquire early communication. The acquisition of the communication is proceeded by the interactions of the three components; the memory module, the reward prediction module and the internal state module. The emotional change triggers the transfer of the sensor data stored in the short-term memory to the long-term memory. Once the memory segments are formed, the sensor data are compared with them. When the coincidence of the starting signal of stored data with the sensor data is detected, the prediction of the reward begins. The responses of the simulated robot with the proposed system are examined with and without the memory module when the caregiver takes the regular and irregular peekaboo communication. The results partly explain the behaviors observed in infants.

Introduction

Infants become to sensitive to the regular behaviors of caregivers by 4 months. In the same month of development, infants begin to adjust the timing of the communication of their own mothers. When the interchange begins between infants and caregivers, the infants develop an ability to predict interactions with social partners. These experiments indicate that after 4 months

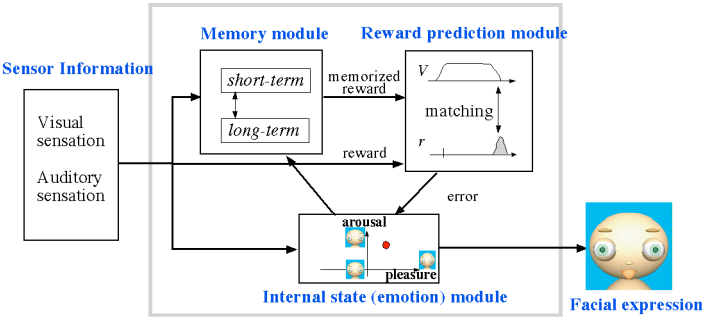
(1) infants memorize the behavior of caregivers

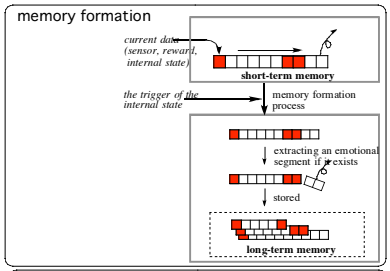
(2) infants adjust the timing with expectation of the next behavior based on the memory.

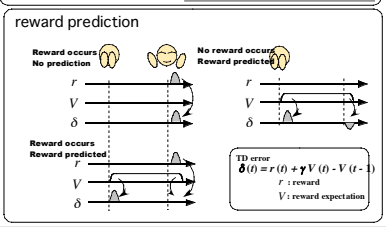


Infant system

The proposed system consists of three modules: memory module, internal state module and reward prediction module. The memory module records sensor data like a flight record as short-term memory. When the arousal value changes largely, the internal state module triggers the memory formation so that short-term memory is stored as long-term memory. After that, reward is predicted based on long-term memories.







Experiment

Rochat et al. investigated the responses of 2, 4 and 6 month infants to regular and irregular peekaboo communications. Two month old infants show equal attention and smile levels both to regular and irregular peekaboo communications. However, 4 and 6 month old infants show less attention and more smiles to regular peekaboo than to irregular peekaboo.

In the same way, wew present the baby system the following peekaboo with and without memory module,

1) regular peekaboo: The caregiver hides the face by the hands and waits some moments with saying "peeka...". After that, the caregiver exposes the face with saying "..boo!". The caregiver repeats this behavior twice.

2) irregular peekaboo: The caregiver hides the face by the hands and exposes the face without saying "peekaboo". Or the caregiver only says "peekaboo" without hiding the face.

The right figure shows the responses of the system with the memory module to the regular peekaboo. The robot shows the arousal to the first peekaboo, while it shows the pleasure to the second peekaboo thanks to the matching of the sensor data with the stored memory. Without memory module, the robot does not show smiles.