Proceedings of the 3rd
International Conference on Development and Learning
October 2004

Detecting Contingency between Self and Other Triggers Social Behavior

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Human infants develop and learn their social capabilities through interactions with their environment. Gradual changes in their capabilities are significant for their own development. Joint attention, which is a social capability to look at an object that someone else is looking at, is known to be acquired through a staged developmental process [1]. 6-month-old infants have a tendency to look at a salient object in their views based on their own focus of interest. In contrast, infants at 12- to 18-month-old start attending to their caregivers to find an interesting object to be gazed at. In the developmental process, however, it has not been well understood why infants start attending to others instead of relying on their internal motives. In other words, what triggers the shift of infants' behavior from a self-centered behavior (ScB) to an other-depended one (OdB) is not clear. It is conjectured that only a shift of behavior at an appropriate timing allows infants to acquire well-structured social capabilities.

This study investigates the relationship between the shift of behavior from ScB to OdB and the learning convergence of social capabilities. The authors [2] have proposed a constructivist model by which a robot learns joint attention with a human through experiences of visual attention (see Figure 1). Visual attention is a ScB that a robot looks at a salient object in an environment based on its embedded interest. In contrast, an OdB in our model means that a robot shifts its gaze direction based on not its interest but a mechanism to follow human gaze. Employing the model, our robot acquired the joint attention ability by detecting a contingency between the direction of human gaze and a motor command to look at an interesting object through a gradual change of its behavior from ScB to OdB like an infant. Analysis of the relationship between the shift of behavior and the convergence of contingency learning showed that: (a) when gradually shifting behavior from ScB to OdB according to the contingency detection, a robot can acquire the joint attention ability without any external evaluation; (b) when producing only ScB without shifting to OdB over learning, a robot cannot find a consistent sensorimotor coordination to perform joint attention; (c) when adopting only OdB that has not fully developed from the beginning of learning without experiencing any ScB, a robot gets into the acquisition of a behavior biased to past experiences, not joint attention. These results suggest that an appropriate shift of behavior from ScB to OdB synchronized with the convergence of contingency learning enables a robot to acquire the joint attention ability.

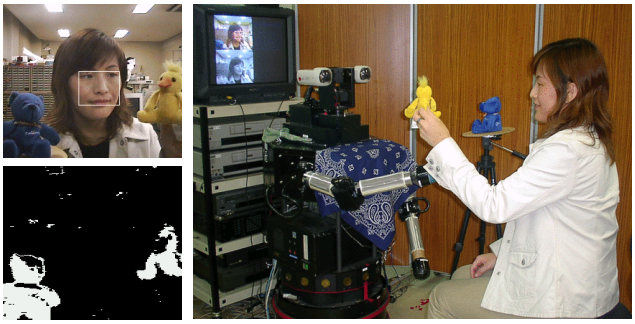

Figure 1. Joint attention between a robot and a human caregiver.

References

[1] George Butterworth and Nicholas Jarrett. What minds have in common is space: Spatial mechanisms serving joint visual attention in infancy. *British Journal of Developmental Psychology*, 9:55–72, 1991.

[2] Yukie Nagai, Koh Hosoda, Akio Morita, and Minoru Asada. A constructive model for the development of joint attention. *Connection Science*, 15(4):211–229, 2003.