Detecting Contingency between Self and Other Triggers Social Behavior

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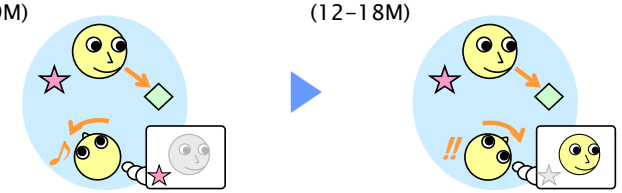
Joint Attention in Human Infant

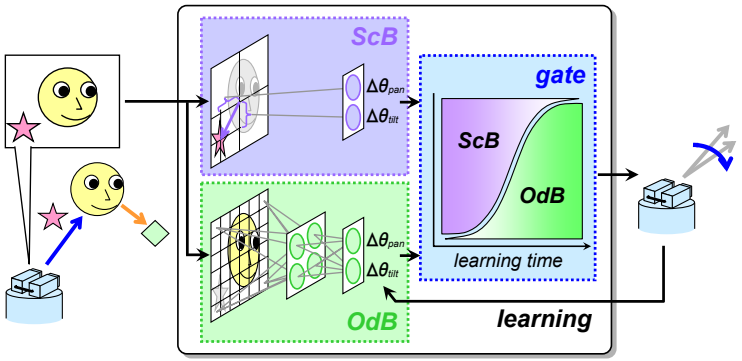
Human infants develop joint attention ability through:

ScB: Self-centered Behavior (6-9M) ▶ **OdB**: Other-depended Behavior (12-18M)



[Butterworth and Jarrett, 1991]

Learning Model for Joint Attention



[Nagai et al., 2003]

Contingency Learning:

A robot learns the sensorimotor coordination of OdB when gazed at a salient object by ScB.

Modules:

ScB: produce a motor command to gaze at a salient object ← embedded in advance

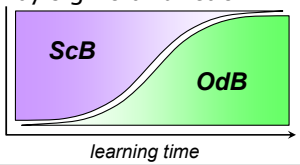
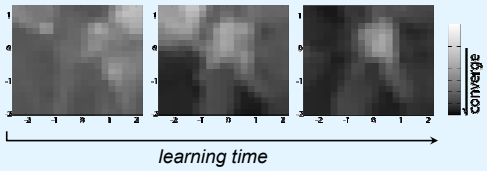
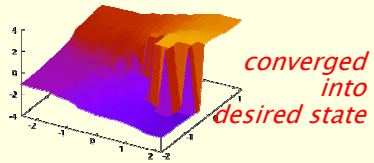
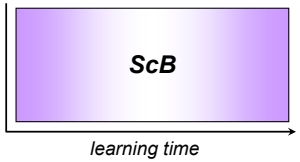
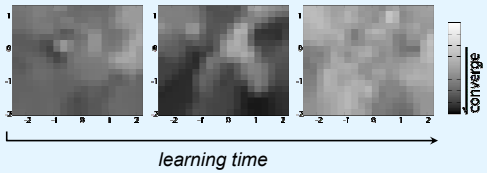
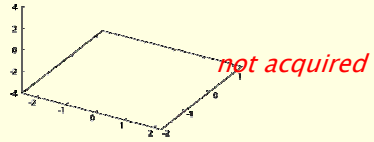
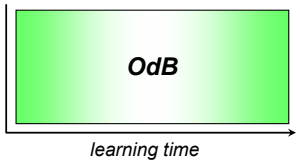
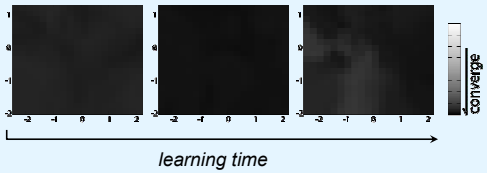
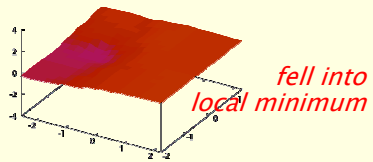
OdB: produce … to follow human gaze ← acquired through learning

gate: shift behavior from ScB to OdB through learning

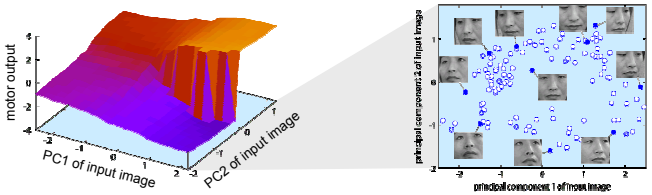
> **Q.** What triggers the shift of behavior?
>
> **A.** Detecting **contingency** between ScB and other's behavior triggers the shift from ScB to OdB. ← True or not?

Experiment

To analyze how the sensorimotor coordination of OdB converges through contingency learning based on ScB according to behavioral shift:

behavioral shift	*the change of the convergence of sensorimotor coordination*	*acquired sensorimotor coordination*
(a) shift from ScB to OdB by sigmoid function 		 converged into desired state
(b) produce only ScB 		 not acquired
(c) adopt only OdB 		 fell into local minimum

- desired sensorimotor coordination for joint attention
  - x-y plane: structured by principal components of input human face image
  - z axis: motor output to change gaze direction



Conclusion

An appropriate shift of behavior that **synchronized with the convergence of contingency learning** enables a robot to acquire joint attention ability.

Ongoing Work:

To design an autonomous behavioral shift mechanism

References

- G. Butterworth and N. Jarrett. "What minds have in common in space: Spatial mechanism serving joint visual attention in infancy," British Journal of Developmental Psychology, Vol. 9, pp. 55-72, 1991.
- Y. Nagai, K. Hosoda, A. Morita and M. Asada. "A constructive model for the development of joint attention," Connection Science, Vol. 15, No. 4, pp. 211-229, 2003.

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