Predictive Learning: A computational theory of social cognitive development

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My talk presents computational models that reproduce human-like social cognitive development in robots. Human children acquire various social abilities such as self-other cognition, reading others' intention, imitation, and so on in the first few years of life. Although developmental studies have revealed when and what abilities children acquire, the mechanisms underlying their development are not fully understood yet. An open challenge is to discover a unified theory that can account for the diversity and the continuity of cognitive development.

We have been suggesting that predictive learning of sensorimotor signals plays a key role in cognitive development. Predictive learning is a process to minimize the prediction error in the human brain, where the prediction error is calculated as the difference between an actual sensory feedback and a predicted signal. We hypothesize that two ways of minimizing the error lead to continuous development: updating an immature predictor (i.e., an internal model) through own sensorimotor experiences and acting on the environment using the acquired predictor (i.e., active inference).

My talk shows several robotic models based on predictive learning hypothesis. Our robots equipped with computational neural networks acquired primal social abilities such as reading intention of other individuals, helping others, and sharing emotion with others, etc. The internal model acquired through own sensorimotor experiences enabled the robots to simulate others' intention and emotion as if they were their own as well as to achieve their own goal. My talk further presents our hypothesis about a neural cause for developmental disorder such as autism spectrum disorder (ASD). Atypical tolerance for the prediction error would result in different internal models of ASD from those of typical development. I discuss to what extent the theory of predictive learning can account for the diversity of development.