Synthetic approach for understanding internal state change in subordinate cricket in fighting

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Male crickets show intensive aggressive behavior when they encounter another male. The previous agonistic interaction between males had influence over the following behavior in subordinates. We focused on the subordinate behavior to understand how animals alter their behavior dependent on previous experience. Pharmacological experiments demonstrated that nitric oxide (NO) signaling plays a crucial role in the behavioral decision making in fighting. We then examined a role of octopamine (OA) in the brain to understand how it mediates aggressiveness. We found that OA level in the brain is modulated by NO signals, suggesting that NO signal is somehow link to OA signal in the brain. We also found that NO has an inhibitory effect on aggressiveness whereas OA has a facilitating effect on aggressiveness. This suggests that NO and OA signals mediate internal state of the cricket. Based on these results, we designed dynamic behavior models and neurophysiology model. Both of the behavior experiments and our models demonstrated that social interactions constantly improve internal state of animals. These result make us conclude one of the important mechanisms underlying behavior adaptability is multiple feedback structure that is composed of feedback loop in the nervous systems and feedback loop through the social environment.