A Computational Model of Social Observance and Cognitive Difficulty Accounts for Development of Ownership Behavior

Youngjo Song[1*], Jerald Kralik[1], Il-Hwan Choe[2], Sol Park[2], Hee-Sup Shin[2], Jaeseung Jeong[1,3]

[1]*Bio and Brain Engineering, KAIST, Daejeon, Korea*
[2]*Center for Cognition and Sociality, IBS, Daejeon, Korea*
[3]*Program of Brain and Cognitive, KAIST, Daejeon, Korea*

Conflicts between individuals are common in nature. Since conflict adversely affects survival, each species has a social strategy for reducing conflict. Choe et al. (2017) have developed new experimental design to investigate rodent's social strategy in conflict, and observed that rodents resolved social conflict using ownership behavior called 'zone-allocation.' To account for motivation of zone-allocation in mice, here we developed to assess computational models based on four behavioral motives: reinforcement learning, altruism, tit-for-tat and position-preference. We found that reinforcement learning model was the most suitable model for explaining the zone-allocation behavior in mice. Furthermore, we proposed a new model combining reinforcement learning and position-preference, which demonstrated that this model explained all features of zone-allocation behavior including the overwhelming ratio of zone-allocation rodent pairs. Since 'position-preference' property reflects cognitive limitation of the individual, these findings suggest that ownership behavior should be a good strategy to save cognitive resources. In addition, we speculate that the percentage of individuals which uses zone-allocation strategy is potentially reduced if the task is not cognitively demanding. To test this hypothesis, we developed a human computer game mimicking the rodent experiment previously designed by Choe et al. (2017). We conducted human experiment with seven pairs (7 females and 7 males), and we observed that none of them showed ownership behavior in this easy task condition. Instead of ownership strategy, the human subjects used turn-taking strategy to resolve this conflict, which is a potential outcome of altruism and tit-for-tat computation models.

Keywords: Ownership, Computational neuroscience, Reinforcement learning, position-preference, Task difficulty

Email:syj1455@kaist.ac.kr