Winner effect and serotonin on the formation of crayfish dominance hierarchy

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Crayfish as well as other crustaceans form social dominance hierarchies. Dominants have access to good shelter, food and a mating partner, while subordinates can be rescued from severe injury. Hierarchy formation and its maintenance, thus, serve to maintain social stability and enable peaceful populations.

When two previously unacquainted crayfish encounter each other, conflict occurs immediately and dominant-subordinate relationship determined within several contacts. Physical differences like a size or weight is the major determining factor for victory as the larger crayfish usually win in agonistic encounters. Here, we analyzed the effect of social experience and whether an animal won or lost in a previous fight upon the next conflict, and found that hysteresis of crayfish was also important in determining the dominance hierarchy. Moreover serotonin levels are closely related to the change of a crayfish's internal state. The fight winner of the first pairing was more likely to win their subsequent conflict with naive crayfish the following day, even if an opponent was larger in size. As with the winner effect, injection of serotonin also affected the results of agonistic encounter. The winning probability of smaller crayfish was significantly increased when 1 μM serotonin was injected before pairing with larger crayfish.