Maturation of escape circuit function during the early adulthood of cockroaches Periplaneta americana.

By lcohen
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By lcohen May 11, 2011

Abstract:

During postembryonic development of insects, sensorimotor pathways, which generate specific behaviors, undergo maturational changes. It is less clear whether such pathways are typically stable, or undergo further maturation, during the adult stage. In the present study, we have examined this issue by multilevel analysis of a simple model system, the escape behavior of the cockroach, from identified synapses to behavior. We show that the escape system is highly responsive immediately after the molt to adulthood, but that the latency of escape responses was not at its typical value immediately after the molt to adult. The latency of escape behavior increased over the first 30 days of adult life, perhaps indicating maturational adjustments of the escape sensorimotor pathway. The first station in the escape circuitry is the synaptic connections between the cercal wind receptors and the giant interneurons. We measured unitary excitatory synaptic potentials between single sensory neurons and an identified giant interneuron (GI(2)). We found a decrease in the synaptic strength between identified cercal hairs from a single column and GI(2) over the first month after the adult molt. Consequently, the latency and the number of action potentials of GI(2) in response to natural stimuli increased and decreased respectively during this time. Thus, we show that both behavioral performance and the wind sensitivity of GI(2) decreased over the first month after molt. We conclude that the cockroach escape system undergoes further sensorimotor maturation over a period of 1 month, and that cellular changes correlate with, or predict, some changes in behavioral performance.

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