Circadian regulation of olfactory learning and memory in the cockroach

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We investigated the circadian modulation of memory formation in the cockroach *Leucophaea maderae* in an odor discrimination test. When odor preference was tested by allowing animals to choose between two odors (peppermint and vanilla), untrained cockroaches showed a clear preference for vanilla at all circadian phases. After differential classical conditioning in which peppermint odor was associated with a positive unconditioned stimulus of sucrose solution and vanilla odor was associated with a negative unconditioned stimulus of saline solution, cockroaches conditioned in the early subjective night showed a strong preference for peppermint and retained the memory for at least two days. Animals trained and tested at other circadian phases showed significant deficits in performance for both short-term and long-term memory. Deficits in memory formation in the early subjective day were rescued with injections of octopamine while memory formation in the early subjective night was blocked by octopamine antagonists. The results raise the possibility that circadian regulation of memory acquisition involves circadian regulation of octopaminergic signaling pathways. Interestingly, we found no evidence of circadian regulation of memory formation when animals were trained via operant conditioning. This suggests there significant differences between operant and classical conditioning in the mechanism and regulation of memory acquisition.