The composition of short term and long term memory components in free-flying honeybees

Uwe Greggers and Juliane Mauelshagen

Institut für Neurobiologie,Königin-Luise-Str. 28-30, 14195 Berlin
Freie Universität Berlin

Single honeybees were trained to collect sucrose solution from four artificial feeders. In this experimental paradigm various behavioral parameters were analyzed to unravel the role of short term and long term memory components with respect to the natural foraging behavior. The duration of proboscis extension was found to be an excellent measure of both the bee´s expectancy and evaluation of the momentary sucrose stimulus. The duration of proboscis extension at any visit partially depends on the duration of proboscis extension at earlier visits in sequence. This demonstrates that the momentary response to sucrose depends on the recruitment of memories reflecting the bee´s experience at feeders visited previously. The strength of this correlation is, however, a function of the time interval elapsing between two consecutive visits (intervisit interval) or two successive visits to the same particular feeder (revisit interval).
This analysis allowed us to determine the time course of different memory components:
For intervisit intervals less than 30 sec, a short-lived unspecific memory component was found which is induced by the last visit in sequence. Specific for revisits (visits to the same particular feeder) a long-lasting memory component was identified which is characterized by two different temporal phases. During the first 120 sec (phase 1) the recruitment of the feeder-specific memory is more limited as compared to much longer revisit intervals (phase 2). If the intervisit interval of the last alternative feeder visited inbetween is less than 30 sec, the unspecific component interferes with both phases of the specific component. If the unspecific component has declined (> 30 sec), we have access to the isolated form of the consolidation phases 1 and 2. Consolidation phase 1 is characterized by the additional recruitment of the specific long term memories of the alternative feeders while during phase 2 this recruitment is minimal. Thus we interpret phase 1 as highly susceptable to interference by other memories and phase 2 as the reflection of a stable long-term store. The isolation of short term and long term memory components and their exact time courses will allow to develop a mechanistic model about the formation and interaction of different memories.
The temporal composition of the memory components described above agrees with the time courses described for short and long term memories of restrained bees. On the basis of these results we can design experiments in order to test the hypothesis that both behavioral methods are mutually supportive. This would help to integrate not only behavioral but also physiological data into the framework of a complex natural behavior.

Greggers and Menzel 1993 Memory dynamic and foraging strategies of honeybees, Behav. Ecol.Sociobiol,32:17-29