

THE FIRST INTERNATIONAL SYMPOSIUM AND WORKSHOP ON HONEY BEE BEHAVIORAL PLASTICITY

Ankara, Turkey - September 7-9, 2010

This note describes the goals and highlights of the first symposium-workshop specifically designed to explore honey bee behavioral plasticity from nervous system to the ecosystem. The symposium-workshop was held as part of the IV Biennial European Honey Bee Conference at Ankara, Turkey during September 7-9, 2010 (www.eurbee2010.org).

The symposium-workshop was divided into two symposia. One, titled “**Mechanisms of learning and memory in honey bees**” consisted of 8 papers and the other; “**Development and behavioral plasticity in eusocial bees**” contained 9 papers. For those readers interested in obtaining full versions of the papers, the titles of the papers and their authors are provided. The abstracts have been published in the Conference Proceedings and are available from the authors.

The symposia were organized with support from National Science Foundation, Middle East Technical University which served as host institution, and the European Association for Bee Research, through the EurBee Board comprised of the host Dr. Aykut Kence, and Dr. Dorothea Bruckner and Robert Paxton. Funding from local sponsors were also utilized through the Local Organizing Committee chair Dr. Meral Kence. The basic format of the symposium-workshop included both formal presentations and two evening workshops organized around the themes of the conceptual model outlined in figure 1.

The formal presentations were preceded by an introductory session in which two pioneering scientists studying honey bee behavioral plasticity (Dr. Brian H. Smith and Dr. Monique Gauthier) gave overviews of their work on olfactory processing, and invertebrate cognition, respectively. The first evening workshop was devoted to learning about the different behavioral plasticity assays. The second evening workshop was used to discuss a concept paper that we plan to submit to *Science* or *Nature*, and outline a strategic program that we hope will guarantee the sustained growth of integrative study of honey bee behavioral plasticity. Many of the participants were well known scientists in their respective fields both in Europe and in the United States. Students and junior faculty

members were included and encouraged to attend both the formal presentations and workshops.

The symposium focused on the question of mechanisms of behavior, where principles, links between behavior units, and at times molecular mechanisms, appear to be conserved and relevant to general understanding of behavioral plasticity. We also focused on how social context, such as demography, could influence the developmental, partly experience-expectant plasticity that results in large scale neural plasticity, and examined its regulation and integration of individuals of the colony.

A unique aspect of the symposium was a tour of several Turkish honey bee research centers. This opportunity arose because the IV Biennial European Honey Bee Conference was held in Ankara, Turkey. Turkey has much to recommend it for honey bee research including the presence of at least five subspecies of *Apis mellifera* including *syriaca*, *anatoliaca*, *meda*, *caucasica*, and a subtype *carnica*. For the later two subspecies there are government protected honey bee population sites, and research facilities that maintain pure lines. The honey bee research facilities visited were those at the Middle East Technical University in Ankara, Namık Kemal University in Tekirdag, and the protection area for the Turkish subtype of *A. mellifera carnica* in Kırklareli.

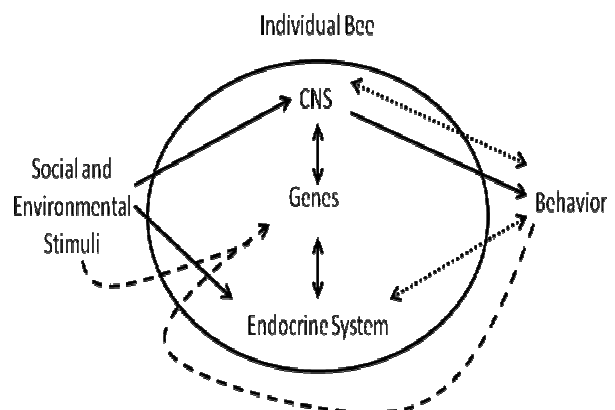


Figure 1. Interactions between physiological (solid lines), developmental (dotted lines), and evolutionary (dashed lines) time scales in honey bee behavioral plasticity (see also Robinson *et al.*, 2008, Genes and social behavior, *Science*, 322: 896-900). CNS stands for central nervous system.

The symposium-workshop had several goals including:

1. Exposing the honey bee community to a conceptual model that emphasizes deep connections between ecology and behavioral processes, and the resulting dynamics of social behavior (figure 1). Bringing together experts with diverse backgrounds to think about their own behavioral plasticity work in a broader context is a first step towards integration across disciplines.

2. Sharing the diverse work on honey bee behavioral plasticity, extending from ecology, to development to learning and memory to search for a common language and understanding of approaches to probe bee behavioral plasticity. This sharing focused on an audience coming from nations in which honey bee biology is a key research area (see for instance, COLOSS and BEE-DOC, in response to current crisis in bee health). The honey bee community members participating in this symposium-workshop use diverse techniques (field and laboratory work, behavioral assays such as proboscis and sting extension response, artificial flower choice, radar remote tracking; molecular techniques ranging from neural Ca signal imaging to endocrine biochemistry to gene expression microarrays, and computer modeling) to examine a diverse array of questions in honey bee behavioral plasticity.

3. Outlining a strategic program that will contribute to a sustained integrative growth of the field of honey bee behavioral plasticity, and more broadly speaking of emerging approaches linking analyses at neural, developmental, and evolutionary levels.

The specific outcomes of the symposium-workshop were to:

- Establish a global network of people interested in the honey bee behavioral plasticity.
- Publish the proceedings of the symposium online and as a book.
- Outline a strategic program to move ahead the field of integrative study of honey bee behavioral plasticity.

In conclusion, the symposium-workshop was a good experience and much work was accomplished. The participants voted to hold another meeting in about three years, either at another Eurbee meeting or a different venue. For those readers who would like to participate in the next meeting, please contact one of us.

Symposium I - Mechanisms of learning and memory in honey bees, Session heads Charles I. ABRAMSON and Tuğrul GIRAY

1. Mechanisms of learning and memory in honey bees, Tuğrul GIRAY
2. Optic flow informs distance but not profitability for honey bees, Sharoni SHAFIR and Andrew B. BROWN
3. Some issues in the cognitive interpretation of invertebrate behavior, Charles I. ABRAMSON
4. Modification of olfactory learning and memory induced by siRNA targeting nicotinic acetylcholine subunits in the honeybee, Thierry LOUIS, Pierre-yves MUSSO, Sabrina OLIVEIRA, Lucile GARREAU, Arnaud ATHIER, Martin GIURFA, Colette DISSOUS, Valérie RAYMOND-DELPECH, Monique GAUTHIER
5. Foraging preference and flower handling in honey bee subspecies, İbrahim ÇAKMAK, Tuğrul GIRAY, Charles I. ABRAMSON, Harrington WELLS
6. Memory dynamics of honey bees, Martin GIURFA
7. Operant conditioning protocols in honey bees, Michel SOKOLOWSKI and Charles I. ABRAMSON
8. Olfactory learning in honey bees, Brian H. SMITH

Symposium II - Developmental and behavioral plasticity in eusocial bees. Session heads: Osman KAFTANOGLU and Florian WOLSCHIN

1. Behavioral plasticity underlies the solitary-eusocial transition in the socially polymorphic sweat bee *Halictus rubicundus*. Robert PAXTON, Antonella SORO, Cathy BRIDGE, Jeremy FIELD
2. Functional Genomic approaches to unravel the physiological basis of honey bee caste development. Klaus HARTFELDER
3. Flexibility of division of labor in honey bees: all explained by a simple model. Zachary Y. HUANG
4. Proteotyping division of labor in worker honey bees. Florian WOLSCHIN
5. Effects of carbohydrates on the development and sugar responsiveness of honey bees (*Apis mellifera* L.) reared *in vitro*. Osman KAFTANOGLU, Julie A. MUSTARD, Ethem AKYOL, Timothy A. LINKSVAYER, Robert E. PAGE Jr.
6. The putative role of male sex pheromones in bumblebee cuckoo-host interactions. Patrick L'HOMME
7. Larval and nurse worker control of developmental plasticity in honey bee queens and workers. Timothy A. LINKSVAYER, Osman KAFTANOGLU, Ethem AKYOL, Gro V. AMDAM, Robert E. PAGE
8. Socially-mediated plasticity in circadian rhythms and the molecular clockwork. Guy BLOCH
9. Functional mapping of the circadian network and its role on the sleep-like state. Jose Luis AGOSTO

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