

Alexandros Papachristoforou¹, ILANIDIS ILANIDIS¹, Sotiris Pastras², Anastasis Stefanopoulos², Konstantinos Gardikis², Anagnosti John Choukalas²

¹Laboratory of Applied Apiculture "ApisLab", Department of Animal Science, University of Thessaly. Geopolis 41334, Larissa, Greece

²Research and Development Department, APIVITA SA, Industrial Park Markopoulo Mesogaias, 19003 Athens, Greece

Despite the desire of individuals with autism spectrum disorder (ASD) to work, there are still several obstructions limiting their professional opportunities. The majority in Greece (and other countries) remain unemployed or underemployment. Beekeeping, in combination with supported employment, could provide an alternative and beneficial training and professional field for people with ASD. Furthermore, supported employment is a method that supports the employment integration of people who, due to their disability, are unable to work. Therefore, a common action between the Laboratory of Applied Apiculture at the University of Thessaly, Greece and the Autism Association of Larissa, is taking place in Greece, aiming to turn five young persons with ASD to professional beekeepers. The trainees, never involved with apiculture before the BeeAutism project, received theoretical and practical training from the scientific personnel of ApisLab on observing and maintaining bee colonies, under the supervision and support of their assistants. After the first observations the group was enriched with students without ASD aiming in the interaction of all trainees under a common environment. The new beekeepers with ASD, received their first colonies and gradually reached the number of 20 for each one. They developed high interest for bees and beekeeping, and they are about to extract and bottle their first quantities of honey in early summer. The APIVITA SA company, supporting this project, provided all the necessary material for the project has prepurchase the quantities of honey at a high price. During the project, trainees' progress is monitored by the research assistants regarding their ability to complete tasks as observing both sides of 10 frames, identifying the presence of the queen, eggs, brood, food supplies and pathogens. Furthermore, the "level of satisfaction" (Minnesota Satisfaction Questionnaire) and the "autonomy and level of functionality" (Vineland Adaptive Behavior Scales) are used to assess the impact of this project on the individuals with ASD. Results will be carried out in late summer.

BEEAUTISM



Individuals with autism spectrum disorder have been trained to become professional beekeepers in Greece



APIMONDIA
SCANDINAVIA
SWEDEN | DENMARK | NORWAY
2025
23-27 SEPTEMBER

COPENHAGEN



BIODLARN

**Papachristoforou, A.¹, Ilanidis, K.¹,
Pastras, S.², Stefanopoulos, A.²,
Gardikis, K.², Tsoukalas, J.C.²**



**¹Laboratory of Applied Apiculture “ApisLab”, Department of Animal
Science, University of Thessaly, Larissa, Greece**

²Research and Development Department, APIVITA SA Athens, Greece









Supported Employment Project

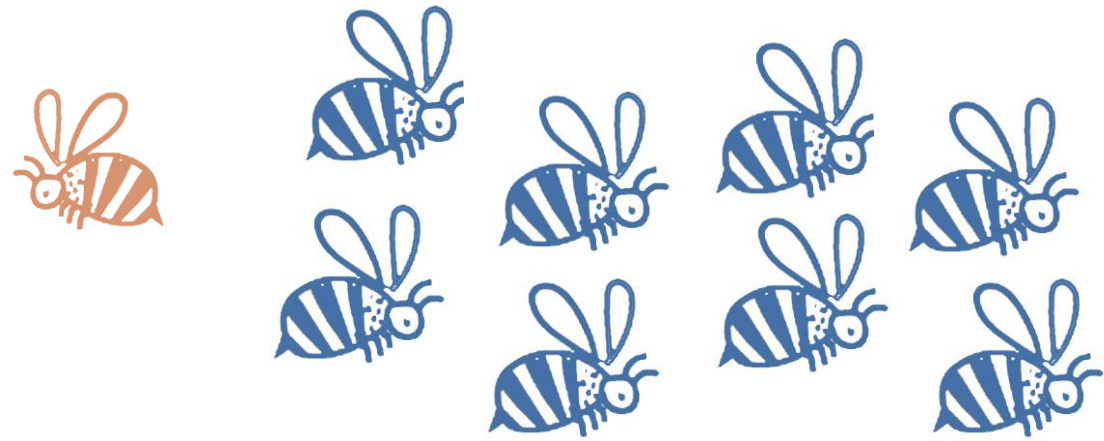
BEEAUTISM



“An invisible disability”

- Autism influences how people experience and interact with the world. Autistic people are different from each other, but for a diagnosis they must share differences from non-autistic people in how they think, feel and communicate
- Being autistic means you may feel things and react to them differently to non-autistic people.
You may find socialising confusing or tiring, and you may become overwhelmed in loud or busy places.
You may have intense interests, prefer order and routine, and use repeated movements or actions to calm yourself or express joy

Surprisingly...



Deep evolutionary conservation of autism-related genes

Hagai Y. Shpigler^{1,2}, Michael C. Saul^{1,3}, Frida Corona⁴, Lindsey Block⁴, Amy Cash Ahmed⁵, Sihai D. Zhao^{1,6}, and Gene E. Robinson^{1,2,4,6,7}

¹Carl R. Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign, Urbana, IL 61801; ²Department of Statistics, University of Illinois at Urbana-Champaign, Urbana, IL 61801; ³Neuroscience Program, University of Illinois at Urbana-Champaign, Urbana, IL 61801; ⁴Department of Entomology, University of Illinois at Urbana-Champaign, Urbana, IL 61801

Contributed by Gene E. Robinson, June 26, 2017 (sent for review May 17, 2017; reviewed by Daniel H. Geschwind and Maria R. Sokolowski)

E. O. Wilson proposed in *Sociobiology* that similarities between human and animal societies reflect common mechanistic and evolutionary roots. When introduced in 1975, this controversial hypothesis was beyond science's ability to test. We used genomic analyses to determine whether superficial behavioral similarities in humans and the highly social honey bee reflect common molecular mechanisms. Here, we report that gene expression signatures for individual bees unresponsive to various salient social stimuli are significantly enriched for autism spectrum disorder-related genes. These signatures occur in the mushroom bodies, a high-level integration center of the insect brain. Furthermore, our finding of enrichment was unique to autism spectrum disorders; brain gene expression signatures from other honey bee behaviors do not show this enrichment, nor do datasets from other human behavioral and health conditions. These results demonstrate deep conservation for genes associated with a human social pathology and individual differences in insect social behavior, thus providing an example of how comparative genomics can be used to test sociobiological theory.

autism | evolution | honey bee | social behavior | transcriptomics

To accomplish what is necessary to survive and reproduce—such as obtaining food and shelter, finding mates, and protecting and caring for offspring—animals must often engage in diverse interactions with members of their species. Although some animal species live solitary lifestyles with minimal social interactions, others like humans and honey bees live in sophisticated societies marked by regular and extensive social interactions. In addition, individuals within the same species differ in social responsiveness, with well-documented variation among humans (1), primates (2), and other mammals (3).

Individual variations in social interactions and the biological factors driving them represent major constituents of human mental health. For example, autism spectrum disorders (ASDs) are primarily characterized by a lack of the capacity to engage in reciprocal social interactions (4). ASDs are a key focus in contemporary psychiatric genomics, and studies have revealed the complexity of these disorders: genetic factors, epigenetics, developmental deficits, and environmental factors are all thought to contribute to ASDs (5, 6).

E. O. Wilson proposed in *Sociobiology* (7) that similarities between the social structures of human and nonhuman animal societies reflect common evolutionary origins. When introduced in 1975, this controversial hypothesis was beyond science's ability to test (8). In addition, specific questions about whether these similarities might have arisen from common ancestry or from convergent evolution were not explicitly considered in the development of early sociobiological theory. However, this type of information is particularly important to our understanding of the relationship between animal behaviors and human mental health disorders. Emerging evidence for conserved molecular mechanisms for social behaviors between invertebrates and vertebrates

(9–14) suggests that there are similar connections to mental health disorders.

Honey bees have highly sophisticated and well-described social behaviors, including symbolic communication (15), alloparental care (16), and kin recognition (17). They have been used extensively in sociogenomic analyses of normal behavior (18), but never before for explorations of social deficits. Because honey bees show strong individual differences in social behaviors, we used them to explore molecular mechanisms underlying differences in social responsiveness.

Results and Discussion

We first hypothesized there are individual bee differences in responsiveness to various social stimuli, associated with unique neurogenomic signatures. To test this hypothesis, we exposed groups of 10 7-d-old honey bee nestmates to a social responsiveness assay in the laboratory, which involved exposures to two different social stimuli. One stimulus provided a social challenge: an unrelated bee as a territorial threat, which provokes an aggressive response (10, 17). The other stimulus provided a social opportunity: a queen larva, which provokes alloparental care (19). We tested 246 groups from seven genetically distinct source colonies. To rigorously test for stable individual differences in social

Significance

Sociobiological theory proposed that similarities between human and animal societies reflect similar evolutionary origins. We used comparative genomics to test this controversial idea by determining whether superficial behavioral similarities between humans and honey bees reflect shared molecular mechanisms. We found unique and significant enrichment for autism spectrum disorder-related genes in the neurogenomic signatures of a high-level integration center of the insect brain in bees unresponsive to two different salient social stimuli. These results demonstrate deep conservation for genes implicated in autism spectrum disorder in humans and genes associated with social responsiveness in honey bees. Comparative genomics thus provides a means to test theory on the biology of social behavior.

Author contributions: H.Y.S., M.C.S., and G.E.R. designed research; H.Y.S., M.C.S., F.C., L.B., and A.C.A. performed research; M.C.S. and S.D.Z. contributed new reagents/analytic tools; H.Y.S., M.C.S., and S.D.Z. analyzed data; and H.Y.S., M.C.S., and G.E.R. wrote the paper. Reviewers: D.H.G., University of California, Los Angeles; and M.B.S., University of Toronto. The authors declare no conflict of interest.

Freely available online through the PNAS open access option.

Data deposition: The RNA-seq files reported in this paper have been deposited in the Gene Expression Omnibus (GEO) database, <https://www.ncbi.nlm.nih.gov/geo/> (accession no. GSE87001). Raw FASTQ files have been deposited in the Sequence Read Archive (accession no. SRR589594).

See Commentary on page 9552.

¹H.Y.S. and M.C.S. contributed equally to this work.

²To whom correspondence should be addressed. Email: gene@illinois.edu.

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Research suggests parallels between the molecular basis of a honey bee's social unresponsiveness and the genetic factors associated with autism in humans.

Studies found that honey bees failing to respond to social cues shared a similar gene expression profile to those linked with autism spectrum disorders, even while showing no overlap with genes for other human disorders.

BEEAUTISM



Objective of the Project

- ❖ **Indivizualized Support**
- ❖ **Professional Beekeepers Training**

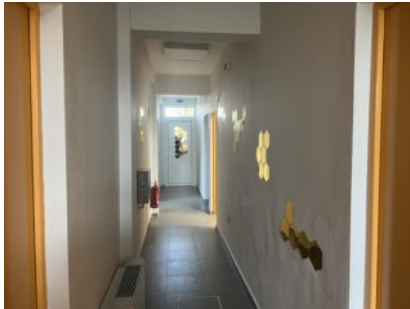
The place: Laboratory of Applied Apiculture (ApislaB)



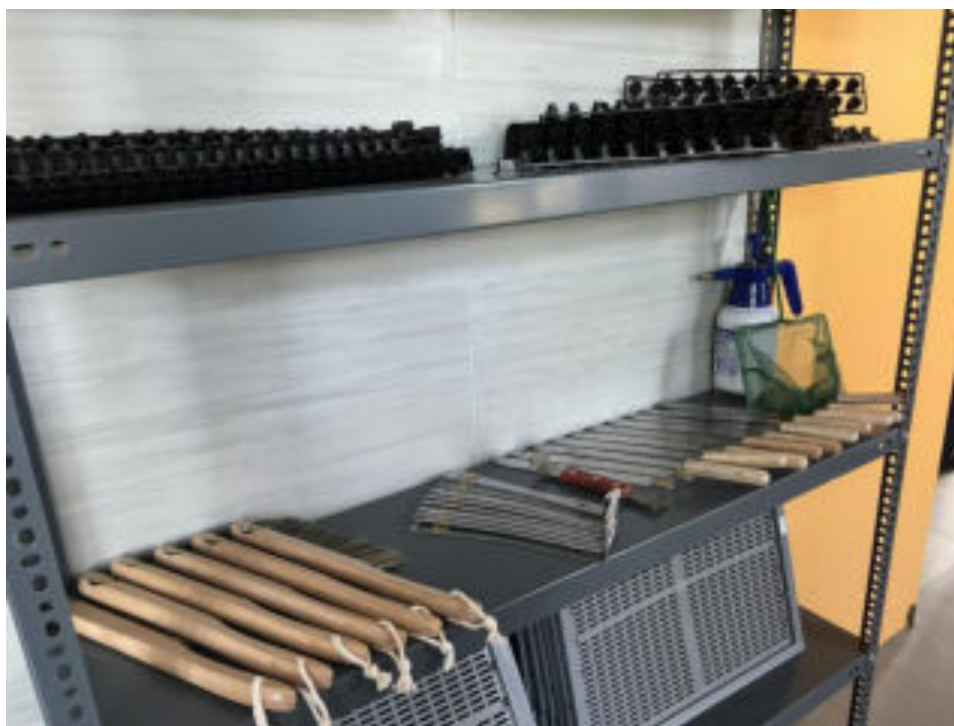
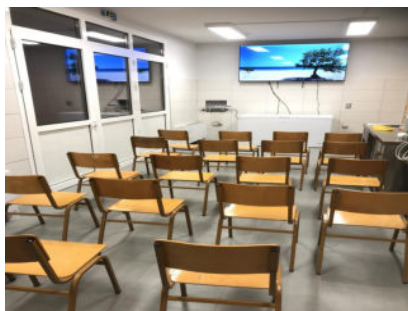
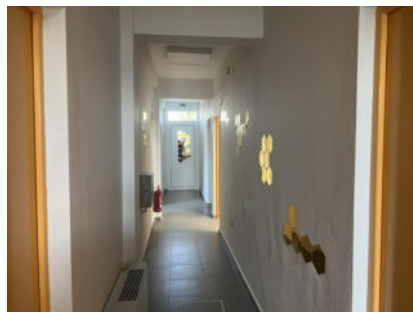
The place: Laboratory of Applied Apiculture (ApislaB)



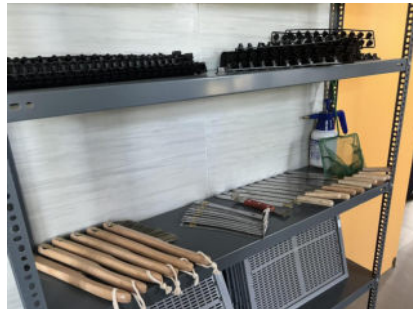
Setting up the perfect environment for the project



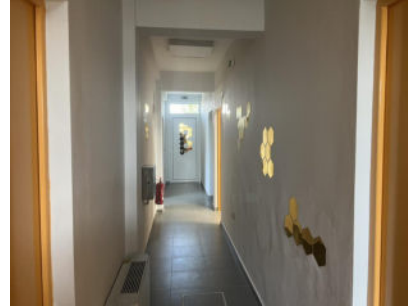
Suitable Equipment



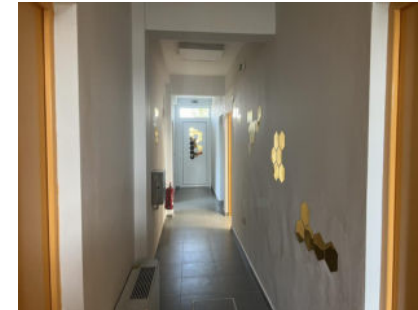
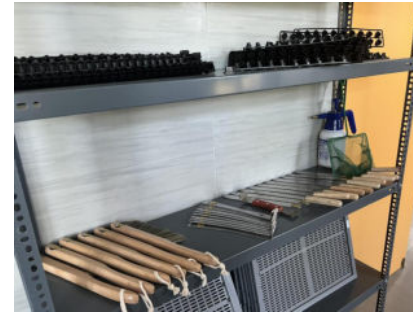
Realistic conditions of learning and practicing



Intriguing participants interest



80 – 100 colonies for training and production



PARTICIPANTS



PARTICIPANTS

**TRAINEES -
EMPLOYEES**

**INSTRUCTORS /
TRAINERS**

**MENTOR -
KEY WORKER**

JOB COACHES

PSYCHOLOGIST

TRAINEES - EMPLOYEES

- ✓ Age: 22-28 y.o.
- ✓ Training on apicultural practices
- ✓ Practical training on:
 - Use & maintenance of apicultural equipment
 - Colonies observation and maintenance
 - Honey production
 - Honey packing
- ✓ Development of social skills and social networking



TRAINEES - EMPLOYEES



TRAINEES - EMPLOYEES



PARTICIPANTS



INSTRUCTORS / TRAINERS

- Assistant Professor of Applied Apiculture
- Associated Professor of Genomics, Evolution and Biodiversity (Themistoklis Giannoulis)
- Professional Beekeeper (BSc, MSc) (Konstantinos Ilanidis)

ADAPTATION!





**Adaptation of
teaching to the
special needs of
the project**

Adaptation of teaching to the special needs of the project

- Attract their interest
- Attract their attention
- Make them feel comfortable
- Efforts to avoid Attention deficit hyperactivity disorder (ADHD) behaviours



PARTICIPANTS

**TRAINEES -
EMPLOYEES**

**INSTRUCTORS /
TRAINERS**

**MENTOR -
KEY WORKER**

JOB COACHES

PSYCHOLOGIST

MENTOR – KEY WORKER

Eftychia Evangelopoulou, Special Education Teacher

- Organizing teaching procedure
- Implementation of educational adaptations
 - Curriculum adaptation
 - Teaching differentiation
- Development of theoretical and practical material
- Implementing adjustments in the workplace
 - Friendly environment for sensory needs
 - Flexible timetables, frequent breaks
 - Differentiated tasks
- Informing instructors / trainers

ΥΛΙΚΟ ΜΕΛΙΣΣΟΚΟΜΙΑΣ ΠΡΑΚΤΙΚΟΣ ΟΔΗΓΟΣ ΧΕΙΡΙΣΜΟΥ ΜΕΛΙΣΣΙΩΝ

ΠΕΡΙΕΧΟΜΕΝΑ

ΕΙΣΑΓΩΓΗ	2
ΕΞΟΠΛΙΣΜΟΣ ΕΠΙΘΕΩΡΗΣΗΣ	3
ΒΗΜΑΤΑ ΑΝΑΜΜΑΤΟΣ ΚΑΠΝΙΣΤΗΡΙΟΥ	6
ΒΗΜΑΤΑ ΕΠΙΘΕΩΡΗΣΗΣ ΚΥΨΕΛΗΣ	7

ΕΞΟΠΛΙΣΜΟΣ ΕΠΙΘΕΩΡΗΣΗΣ

Τι θα χρειαστούμε κατά την επιθεώρηση ενός μελισσιού;

1. Στολή μελισσοκόμου

Η στολή διαθέτει ενισχυμένες ραφές και φερμουάρ, για αποφυγή εισόδου μελισσών. Ενσωματωμένη, στη στολή, μάσκα-προσωπίδα προστασίας, μαύρου χρώματος, που προσφέρει ορατότητα και προστασία του κεφαλιού και του λαιμού.



2. Γάντια μελισσοκόμου

Χρησιμοποιούνται για την αποφυγή κεντρισμάτων στα χέρια.



PARTICIPANTS

**TRAINEES -
EMPLOYEES**

**INSTRUCTORS /
TRAINERS**

**MENTOR -
KEY WORKER**

JOB COACHES

PSYCHOLOGIST

JOB COACHES

Dimitris Karanastasis, Thomas Patouliotis (Health Professionals)

- ✓ Information seminar for instructors / trainers
- ✓ Employees personal profile
- ✓ Professional guidance and support
- ✓ Targeted individual support in the workplace
- ✓ Individual sessions for skill development
- ✓ Evaluation, encouragement and feedback



PARTICIPANTS

**TRAINEES -
EMPLOYEES**

**INSTRUCTORS /
TRAINERS**

**MENTOR -
CONTACT PERSON**

MEDIATORS

PSYCHOLOGIST

PSYCHOLOGIST

Hatzouli Vaso

- Observation, recording, analyzing data
- Evaluation of the project
- Preparation of scientific reports



Results – Trainees / Employees





Skills and abilities



Tasks	Accomplishment
Use of apicultural clothing and hive tool	★★★★★
Lighting the smoker	★★★★★
Opening the beehive	★★★★★
Discriminating brood area, queen cels, honey, pollen etc.	★★★★★
Discriminating workers, drones, queens	★★★★★
Removing frames from the beehive	★★★☆☆
Identifying swarming queen cells	★★★★★
Uncapping wax seals	★★★★★
Using an extractor	★★★★★
Store frames	★★★★★
Application of varroa treatments	★★★★★
Colony inspection from A to Z	★★★☆☆

★ Alone ★ With supervision ★ With assistance

Accomplished tasks

- Understanding the bee society
- Handling apicultural equipment
- Observing bee colonies
- Honey harvesting





Questionnaire (16/9/2025)

General Self-Efficacy Scale (GSE)



	T	G	I	V	E	Score
Did you find the project interesting?	★★★★	★★★★	★★★★	★★★★	★★★	95%
Are you satisfied from your experience?	★★★★	★★★★	★★★★	★★★★	★★★	95%
Are you satisfied from the trainers?	★★★★	★★★★	★★★★	★★★★	★★★★	100%
Did you feel comfortable expressing your queries?	★★★★	★★★★	★★★★	★★★★	★★★★	100%
Did you like the place of the project (the Lab)?	★★★★	★★★★	★★★★	★★★★	★★★	95%
Were the facilities of the Lab convenient?	★★★★	★★★★	★★★★	★★★★	★★★	95%
Was the work at the apiary easy for you?	★★★	★★★★	★★★	★★	★	65%
Would you like to continue this project for an additional year?	★★★★	★★★★	★★★★	★★★	★★	85%

★ Not at all true / ★★ Hardly true / ★★★ Moderately true / ★★★★ Exactly true

Most importantly



TEAMWORK!



FRIENDSHIP!



SOCIALIZATION!



INCLUSION!



There can't be social integration without inclusion in work life!

Their comments...



- **Thanos:** ***“I want to become a beekeeper”***
- **George:** ***“Our Lab is the best”***
- **Vivian:** ***“I still can’t believe that these tiny creatures can be so creative”***
- **Elias:** ***“I loved the extraction of honey. And I made new friends”***

Their comments...



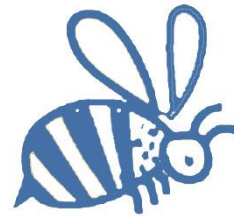
- ***Elias: “I was afraid of bees. I was really scared because I was stung by two bee on my neck”***
- ***“Now, I know it was my fault because I approached the colony without any protection”***
- ***“Now, I love the bees”***

Their comments...



- **Thanos:** ***“I didn’t like working when its too hot”***
- **Vivian:** ***“I didn’t like the beekeeping gloves. I need something more elegant. Smaller sized with sharp edges”***
- **Ezra:** ***“I’ve learned many new things, but I don’t want to participate net year. It’s not for me”***

Results – Instructors / Trainers





Welcome

AUTISM ASSOCIATION OF LARISSA



Those of us who live or work with children and adults with autistic disorders

- we must try to get into their world as they can not find the way that leads them to ours.
- we need to learn to understand and sympathize with their autistic experiences so that we can find ways to help each person overcome them with a system of social rules that are foreign to him.

The reward for the effort required is a deeper understanding of human social interaction and recognition of the miracle of the person's development.

The key to autism is the key for the tenor of human life.

Lorna Wing, 1996

Supporters



Dimitris Papanikolaou

Supporters



Kyrka Apicultural Company



**Beekeepers Union of Ellassona
(Sotiris Soulios)**



**Beekeepers Union of Larissa,
(Kostas Kalapoutis)**



**Beekeepers Cooperation of
Thessaly**

The BeeAutism Honey

- Jars of 450mL
- Read the story on the supplementary card
- Plant the supplementary card
- Scan the QR-code





Thank you for your attention!