Biography

Professor Barron is the Director of the Macquarie Minds and Intelligences Initiative. He is a neuroethologist, which is a discipline of neuroscience studying the neural mechanisms of natural animal behaviour. Most of his research focuses on insects, especially honey bees. Using advanced techniques to visualise, manipulate, map and record from the insect brain Barron’s team has made important contributions to the understanding of fundamental behavioural systems such as cognition, navigation, social behaviour and learning and memory. He also conducts research to improve honey bee health and welfare. He is studying how bees and bee colonies are impacted by pesticide and disease stressors, and how to best intervene to help bee colonies under stress.

Employment

**Professor**
School of Natural Sciences
Macquarie University
1 Jan 2022 → present

**Leverhulme Visiting Professor: The University of Sheffield**
1 Jan 2018 → 1 Jan 2019

**Australian Research Council Future Fellow**
Australian Research Council
Canberra, Australia
1 Jan 2015 → 1 Jan 2022

**President, Australasian Society for the Study of Animal Behaviour**
AUSTRALASIAN SOCIETY OF THE STUDY OF ANIMAL BEHAVIOUR
Australia
1 Jan 2012 → 1 Jan 2014

**Vice-President, Australasian Society for the Study of Animal Behaviour**
AUSTRALASIAN SOCIETY OF THE STUDY OF ANIMAL BEHAVIOUR
Australia
1 Jan 2010 → 1 Jan 2012

**Treasurer, Australasian Society for the Study of Animal Behaviour**
AUSTRALASIAN SOCIETY OF THE STUDY OF ANIMAL BEHAVIOUR
Australia
1 Jan 2008 → 1 Jan 2010

**Postdoctoral Fellow, Research School of Biological Sciences**
Australian National University
Canberra, Australia
1 Jan 2004 → 1 Jan 2007

**Fullbright Postdoctoral Fellow**
University of Illinois at Urbana-Champaign
**Research output**

The diverging epigenomic landscapes of honeybee queens and workers revealed by multiomic sequencing


Vision: flies move their eyes


Heavy metal pollutants: the hidden pervasive threat to honey bees and other pollinators


Bumblebees retrieve only the ordinal ranking of foraging options when comparing memories obtained in distinct settings


The best of both worlds: dual systems of reasoning in animals and AI


Honey bees cannot sense harmful concentrations of metal pollutants in food


The involvement of a floral scent in plant-honeybee interaction


Extent and complexity of RNA processing in honey bee queen and worker caste development


Evaluating the foraging performance of individual honey bees in different environments with automated field RFID systems


EchoVPR: Echo State Networks for visual place recognition


Non-additive gene interactions underpin molecular and phenotypic responses in honey bee larvae exposed to imidacloprid and thymol


Traces of a neonicotinoid pesticide stimulate different honey bee colony activities, but do not increase colony size or longevity
Did prosociality drive the evolution of homosexuality? Response to Luoto (2021)

Current permissible levels of metal pollutants harm terrestrial invertebrates

A model of resource partitioning between foraging bees based on learning

Don't kill, repel

Metal pollutants have additive negative effects on honey bee cognition

Chronic exposure to trace lead impairs honey bee learning

Effects of late miticide treatments on foraging and colony productivity of European honey bees (Apis mellifera)

Non-numerical strategies used by bees to solve numerical cognition tasks

Effects of commercial queen rearing methods on queen fecundity and genome methylation

Pesticide dosing must be guided by ecological principles

Transcriptomic, morphological, and developmental comparison of adult honey bee queens (Apis mellifera) reared from eggs or worker larvae of differing ages

Transgenerational accumulation of methylome changes discovered in commercially reared honey bee (Apis mellifera) queens

Response to Luoto’s (2020) “Did Prosociality Drive the Evolution of Homosexuality?”

Honeybees solve a multi-comparison ranking task by probability matching
Vertical lobes of the mushroom body are essential for view-based navigation in Australian *Myrmecia* ants

The miticide thymol in combination with trace levels of the neonicotinoid imidacloprid reduces visual learning performance in honey bees (*Apis mellifera*)

A hybrid compact neural architecture for visual place recognition

Prosociality and a sociosexual hypothesis for the evolution of same-sex attraction in humans

First-person interventions and the meta-problem of consciousness

How experimental neuroscientists can fix the hard problem of consciousness

The capping pheromones and putative biosynthetic pathways in worker and drone larvae of honey bees *Apis mellifera*

Long-term dynamics of honey bee colonies following exposure to chemical stress

Traces of a neonicotinoid induce precocious foraging and reduce foraging performance in honey bees

A maternal effect on queen production in honeybees

A comparison of honeybee (*Apis mellifera*) queen, worker and drone larvae by RNA-Seq

Honey bees increase their foraging performance and frequency of pollen trips through experience

Effects of thymol on European honey bee hygienic behaviour

Biogenic amine modulation of honey bee sociability and nestmate affiliation

The development of honey bee colonies assessed using a new semi-automated brood counting method: Combcount
Abstract concept learning in a simple neural network inspired by the insect brain

Short-term exposure to lambda-cyhalothrin negatively affects the survival and memory-related characteristics of worker bees Apis mellifera

Using within-day hive weight changes to measure environmental effects on honey bee colonies

Relationship between brain plasticity, learning and foraging performance in honey bees

Cocaine directly impairs memory extinction and alters brain DNA methylation dynamics in honey bees

Honey bee (Apis mellifera) sociability and nestmate affiliation are dependent on the social environment experienced post-eclosion

Stress decreases pollen foraging performance in honeybees

Cooperative defence operates by social modulation of biogenic amine levels in the honey bee brain

The evolution of honey bee dance communication: A mechanistic perspective

Experience during early adulthood shapes the learning capacities and the number of synaptic boutons in the mushroom bodies of honey bees (Apis mellifera)

The effects of fat body tyramine level on gustatory responsiveness of honeybees (Apis mellifera) differ between behavioral castes

The frontiers of insect cognition

Inter-individual variability in the foraging behaviour of traplining bumblebees
Drosophila divalent metal ion transporter Malvolio is required in dopaminergic neurons for feeding decisions

Different roles for honey bee mushroom bodies and central complex in visual learning of colored lights in an aversive conditioning assay

Learning, gustatory responsiveness and tyramine differences across nurse and forager honeybees

Epigenetics and the evolution of instincts: instincts may evolve from learning and share the same cellular and molecular mechanisms

Why bees are so vulnerable to environmental stressors

Making a queen: an epigenetic analysis of the robustness of the honeybee (Apis mellifera) queen developmental pathway

A Computational model of the integration of landmarks and motion in the insect central complex

Neuropharmacological manipulation of restrained and free-flying honey bees, apis mellifera

A horizon scan of future threats and opportunities for pollinators and pollination

Reply to Adamo, Key et al., and Schilling and Cruse: crawling around the hard problem of consciousness

What insects can tell us about the origins of consciousness

A systems approach to animal communication

Starving honey bee (Apis mellifera) larvae signal pheromonally to worker bees
Accelerated behavioural development changes fine-scale search behaviour and spatial memory in honey bees (Apis mellifera L.)

Physiology of reproductive worker honey bees (Apis mellifera): insights for the development of the worker caste

Insect consciousness: commitments, conflicts and consequences

Insects have the capacity for subjective experience

Current progress in understanding the functions of the insect central complex

Decision-making and action selection in insects: inspiration from vertebrate-based theories

Death of the bee hive: Understanding the failure of an insect society

Embracing multiple definitions of learning

Effects of the juvenile hormone analogue methoprene on rate of behavioural development, foraging performance and navigation in honey bees (Apis mellifera)

The value of artificial stimuli in behavioral research: making the case for egg rejection studies in avian brood parasitism

Pheromonal control: reconciling physiological mechanism with signalling theory

Rapid behavioral maturation accelerates failure of stressed honey bee colonies

Negative impact of manganese on honeybee foraging

Insect reward systems: Comparing flies and bees
Behavior and molecular physiology of nurses of worker and queen larvae in honey bees (Apis mellifera)

Peak shift in honey bee olfactory learning

The effects of brood ester pheromone on foraging behaviour and colony growth in apicultural settings

Epigenomics and the concept of degeneracy in biological systems

Cocaine affects foraging behaviour and biogenic amine modulated behavioural reflexes in honey bees

Differences in the phototaxis of pollen and nectar foraging honey bees are related to their octopamine brain titers

Genital evolution: why are females still understudied?

Honey bees selectively avoid difficult choices

Invertebrate models in addiction research

Dynamic modelling of honey bee (Apis mellifera) colony growth and failure

A comparison of digital gene expression profiling and methyl DNA immunoprecipitation as methods for gene discovery in honeybee (Apis mellifera) behavioural genomic analyses

Invertebrate learning and cognition: Relating phenomena to neural substrate

Altruistic behavior by egg-laying worker honeybees

Cocaine tolerance in honey bees

Modelling food and population dynamics in honey bee colonies
Neural mechanisms of reward in insects

Assessment of flight activity and homing ability in Asian and European honey bee species, Apis cerana and Apis mellifera, measured with radio frequency tags

Effect of honey bee queen mating condition on worker ovary activation

Age- and behaviour-related changes in the expression of biogenic amine receptor genes in the antennae of honey bees (Apis mellifera)

Let's talk about sex

General stress responses in the honey bee

Neurogenomic and neurochemical dissection of honey bee dance communication

Plenty of sex, but no sexuality in biology undergraduate curricula: How sexuality and variation in sexual behaviour are addressed in current biological teaching in relation to recent research findings

A quantitative model of honey bee colony population dynamics

The roles of dopamine and related compounds in reward-seeking behavior across animal phyla

Optic flow informs distance but not profitability for honeybees

Effects of cocaine on honey bee dance behaviour

Effect of age, behaviour and social environment on honey bee brain plasticity

From social behavior to molecules: models and modules in the middle
Learned host preferences

The utility of behavioral models and modules in molecular analyses of social behavior

Comparing injection, feeding and topical application methods for treatment of honeybees with octopamine

Octopamine modulates honey bee dance behavior

Division of labor in the honey bee (Apis mellifera): The role of tyramine β-hydroxylase

Visual regulation of ground speed and headwind compensation in freely flying honey bees (Apis mellifera L.)

Influence of flight time and flight environment on distance communication by dancing honey bees

Selective modulation of task performance by octopamine in honey bee (Apis mellifera) division of labour

Measuring the cost of worker reproduction in honeybees: Work tempo in an ‘anarchic’ line

Octopamine modulates responsiveness to foraging-related stimuli in honey bees (Apis mellifera)

Genetic control of the honey bee (Apis mellifera) dance language: Segregating dance forms in a backcrossed colony

A role for octopamine in honey bee division of labor

Policing of adult honey bees with activated ovaries is error prone

Social regulation of ovary activation in ‘anarchistic’ honey-bees (Apis mellifera)

The life and death of Hopkin’s host selection principle
**Worker policing and worker reproduction in Apis cerana**


**Worker policing in the bee Apis florea**


**Worker reproduction in honey-bees (Apis) and the anarchic syndrome: A review**


**Anaesthetising Drosophila for behavioural studies**


**Behavioural induction in Drosophila: timing and specificity**


**Preimaginal conditioning in Drosophila revisited**


**Garden flowers: Insect visits and the floral reward of horticulturally-modified variants**


**Pre-exposure affects the olfactory response of Drosophila melanogaster to menthol**


**Overwintering survival in the seven spot ladybird, Coccinella septempunctata (Coleoptera:Coccinellidae)**


**Awards**

**Projects**

**ActiveAI - active learning and selective attention for robust, transparent and efficient AI**

Barron, A. & Philippides, A.

1/11/19 → 31/10/22

**Analysing the neural mechanisms of animal cognition and behaviour**

Narendra, A., Barron, A., Cheng, K., Hart, N. & Cornish, J.

1/01/16 → 31/12/16

**An analysis of the distribution of degrees of intelligence across animal groups**

Barron, A.

4/06/18 → 3/06/20

**A new understanding of complex systems through study of self-assembled swarm architecture in ants**

Reid, C. & Barron, A.

30/06/17 → …

**Automated Fluorescence Stereo Microscope**

Narendra, A., Taylor, P., Lindsay, S., Barron, A., Herberstein, M., Hart, N., Williamson, J., Griffith, S., Whiting, M., Brock, G. & Jacob, D.
Best practices for evaluation of bee health technology
Barron, A. & Colin, T.
1/05/23 → 31/10/26

Biomolecular Discovery and Design Research Centre
1/01/17 → ...

Biosecurity Futures Research Centre
1/07/15 → ...

Combined gas chromatography/electroantennogram detector for insect olfaction research
Taylor, P., Jamie, I., Herberstein, M., Kemp, D., Barron, A., Jamie, J., Akter, H., Adnan, S., Moadeli, T., Masud, K., Bakshi, D. & MQRES, M.
1/01/15 → 31/12/15

Comprehending and modelling the workings of the animal brain
Barron, A., MQRES (International), M. & MQRES, M.
1/06/15 → 31/12/20

MQRIS Small: Enhancing electrochemical recording techniques in the animal research facility
Cornish, J., Baracz, S., McMullan, S., Goodchild, A., Barron, A. & Hildreth, C.
1/01/18 → 31/12/18

Exploring neurogenomic adaptations to repeated cocaine exposure in honey bees
Barron, A.
22/10/08 → 21/10/09

Gene expression analysis system
1/01/08 → 31/12/08

High quality ultramicrotome for precision specimen preparation for optical and electron microscopy
Deng, W., Chung, R., Nevalainen, H., Phillips, J. K., McMorran, B. & Barron, A.
1/01/14 → 31/12/14

High Throughput Molecular Sample Processing Facility
4/02/15 → 31/12/15

Integrative analysis of honey bee colony function and performance (58-5342-3-004F: Developing the use of sensors to model bee colony dynamics and to monitor bee health, productivity and performance)
Barron, A. & Meikle, W.
1/07/13 → ...
Invertebrate olfaction facilities
1/01/09 → 31/12/09

Knowing what you don't know: analyzing the biology of metacognition and uncertainty in a simple model system
Solvi, C. & Barron, A.
1/06/11 → 1/06/14

Macquarie University Species Spectrum Research Center
Herberstein, M., Gillings, M., Jacob, D., Saintilan, N., Barron, A., Westoby, M., Sofronov, G. & Tetu, S.
1/01/17 → …

Microbalance for integrative behavioral research
Taylor, P., Barron, A. & Weldon, C.
1/01/10 → 31/12/10

Molecular memory: how DNA methylation contributes to spatial memory
Maleszka, R., Cornish, J. & Barron, A.
1/01/10 → 31/12/12

Navigating brains: the neurobiology of spatial cognition
Cheng, K., Zeil, J., Narendra, A., Barron, A., Wehner, R. & MQRES, M.
30/06/15 → 29/06/19

Navigating brains: the neurocomputational foundations of insect spatial cognition
Cheng, K., Barron, A. & Wehner, R.
1/01/14 → 31/12/14

Neural adaptations for social harmony in bees
Barron, A.
1/01/08 → 31/12/08

Operant behavioural chambers for rat research
Cornish, J., Clemens, K., Staples, L., Goodchild, A., Haynes, P., Barron, A., Baillie, A. & Pilowsky, P.
1/01/11 → 31/12/11

Origin of Consciousness and it's Computational Applications in Machines (MQ Discretionary Scheme)
Barron, A., Klein, C., Balleine, B. W., Bell, G., Millford, M. & Van Swinderen, B.
12/02/18 → 31/12/18

Protecting Australia’s honey bee pollinators
Barron, A.
1/11/21 → 31/10/23

Protecting vulnerable Australian honey bees
Barron, A.
25/07/17 → …

Real-time qPCR system for gene detection, gene expression analysis and single nucleotide polymorphisms genotyping in Biology research
Hart, N., Ponton, F., Narendra, A., Barron, A., Shine, R. & Clulow, S.
1/01/20 → 29/05/20
The bionic bee brain
Barron, A.
19/06/15 → 24/08/15

The genomic response to colony disease stress in honey bees
Barron, A. & Gillings, M.
1/07/12 → 30/06/14

MTEC: The major transitions in the evolution of cognition
Barron, A.
1/11/20 → 31/10/23

The molecular and cellular basis the memory in the honey bee
Barron, A.
1/08/09 → 30/07/11

Towards a Bionic Brain
Barron, A.
30/04/14 → 25/12/14

Understanding colony collapse: a social analysis of honey bee colony failure
Barron, A.
1/07/11 → 31/12/14

Understanding the functions of neural circuit changes in visual navigation
Kamhi, F., Narendra, A. & Barron, A.
1/01/17 → 31/12/18

Vulnerability to cocaine use: discovering common mechanisms conserved across animal phyla
Barron, A., Cornish, J. & Maleszka, R.
1/01/09 → 31/12/12