

NVG Meeting

27-29 November 2013

Kontakt der Kontinenten, Soesterberg



Wednesday, 27 November

17:30 Registration

18:00 Dinner

20:00 BRILL Baerends lecture – sponsored by BRILL Publishers

Chair: Simon Verhulst

Jacques Balthazart (Université de Liège)

Rapid changes in brain estrogen production and behavioral action

21:00 Posters; bar open

Thursday, 28 November

7:30 Breakfast

Session Chair: Katharina Riebel

9:00 **Gabriël Beckers** (Utrecht University) *Traveling slow-waves in the avian brain*

9:30 **Pralle Kriengwatana** (Leiden University) *Effect of nutritional stress at different developmental periods on HPA axis and cognition in the zebra finch*

9:50 **Bin-Yan Hsu** (University of Groningen) *Preparing for changing environments: maternal testosterone deposition and the differential effects under different environmental contexts in the Rock Pigeon (Columba livia)*

10:10 **Wouter Halfwerk** (Smithsonian Tropical Research Institute) *Robofrogs & Risky Ripples*

10:30 Coffee/tea

Session Chair: Hans Slabbekoorn

11:00 **Camilla Hinde** (Wageningen University) *Negotiation in parental care*

11:30 **Invited talk: Ulrika Candolin** (University of Helsinki)

Behavioural responses to human-induced environmental change in sticklebacks

12:25 Message from the Dobberke Stichting

12:30 Lunch

13:40 Poster session + Coffee/tea

Session Chair: Ruud van den Bos

15:00 **Martijn Egas** (University of Amsterdam) *Human cooperation by reciprocity*

15:30 **Elferra Swart** (VU University of Amsterdam) *Mating role choice in a simultaneous hermaphrodite: towards integrating pre- and post-copulatory processes*

15:50 **Machteld van Dierendonck** (Ghent University) *Acute stress responses of dressage horses ridden in three different head and neck positions*

16:10 **Nele Zickert** (University of Groningen) *Finding the function of brain lateralization*

16:30 Coffee/tea & Huishoudelijke vergadering/general meeting

17:30 Bar open

18:00 Dinner (Steyl)

20:00 **Invited talk** *Chair: Bas Rodenburg*

Georgia Mason (University of Guelph)

Of mice and mink: how different forms of captivity affect behaviour

21:00 Drinks in the Winter Garden sponsored by Noldus Information Technology

Friday 29 November

7:30 Breakfast

Session Chair: Kees van Oers

9:00 **Invited talk: Piter Bijma** (Wageningen University)

Genetics of behaviour: Magnitude of Indirect Genetic Effects in livestock, and prospects for improvement of animal welfare by genetic selection

9:50 **Ivan Puga-Gonzalez** (University of Groningen) *Empathy versus Parsimony in Understanding Post-Conflict Affiliation in Monkeys: Model and Empirical Data*

10:10 **Jelle Boonekamp** (University of Groningen) *Reproductive effort accelerates actuarial senescence in wild birds: an experimental study*

10:30 Coffee/tea

Session Chair: Gabriël Beckers

11:00 **Rebecca Nordquist** (Utrecht University) *Neuroanatomy in laying hen welfare*

11:30 **Charlotte Hemelrijk** (University of Groningen) *The increased efficiency of fish swimming in a school*

11:50 **Andrew Spink** (Noldus Information Technology) *New technologies for animal tracking and behaviour detection*

12:10 **Michelle Spierings** (Leiden University) *Prosodic cue weighting by Zebra finches*

12:30 Lunch

Session Chair: Jean-Christophe Billeter

13:30 **Ralf Kurvers** (Leibniz-Institute of Freshwater Ecology and Inland Fisheries) *Collective cognition in human crowds. Decision making under uncertainty*

14:00 **Reinaldo Marfull** (University of Groningen) *The effect of anthropogenic noises on the vocal behaviour of *Pleuroderma thaul*, a frog from South America*

14:20 **Irene Voellmy** (University of Bristol) *Holding-tank acoustic conditions can affect behavioural responses of fish during playback experiments*

14:40 **Invited talk: Peter Brennan** (University of Bristol)
Chemosensory recognition of individual identity in mice

15:30 Poster prizes and closure

Coffee/tea + end of meeting



BRILL



Noldus
Information Technology

Posters

Association of egg mass and egg sex in layer hens (*Gallus gallus*): gene expression analysis from germinal disc region of F1 follicle around time of meiosis

M. Aamir Aslam (1), D.J. Schokker (1), Ton G.G. Groothuis (2), Agnes A.C. de Wit (1), Mari A. Smits (1) and Henri Woelders (1)

(1) Animal Breeding and Genomics Centre, Wageningen UR Livestock Research, Lelystad, The Netherlands.
(2) Behavioural Biology, University of Groningen, The Netherlands

Large daily temperature ranges increase zebra finch mortality

Michael Briga, Simon Verhulst
Behavioural Biology, University of Groningen

DO NOT DISTURB - Does aquatic noise affect sexual selection in a sound producing fish?

Karen de Jong (1), Eva-Lotta Blom (2), Katja Heubel (1) and Ola Svensson (2)
(1) University of Tuebingen (2) Gothenburg University

Artificial light at night affecting avian behaviour

M. de Jong (1), A. Da Silva (2), R.H.A. van Grunsven (3), K.G. van Geffen (3), B. Kempenaers (2), F. Berendse (3), E.M. Veenendaal (3), M.E. Visser (1), K. Spoelstra (1)
(1) Netherlands Institute of Ecology, Wageningen; (2) Max Planck Institute for Ornithology, Seewiesen; (3) Wageningen University, Wageningen

Reducing R/R-behavior in captive orangutans through dietary treatments: A case study

Paul Koene, Jan-Willem Haeke and José Kok
Wageningen University

Lateralized memory-related neuronal activation during sleep in juvenile zebra finches

S. Moorman (1), S. M. H. Gobes (2), F. C. van de Kamp (1), M. A. Zandbergen (1), J. J. Bolhuis (1)
(1) Cognitive Neurobiol., Utrecht University, The Netherlands; (2) Wellesley College, Neurosci. Program, Wellesley, MA.

The Effect of the Temporal Structure of Noise on the Swimming Behaviour of the European Seabass

Y. Y. Neo (1), J. Seitz (1), R.A. Kastelein (2), H. V. Winter (3), C. ten Cate (1), H. Slabbekoorn (1)
(1) Behavioural Biology, Institute of Biology Leiden (IBL), Leiden University, Leiden, The Netherlands; (2) Sea Mammal Research Company (SEAMARCO), Harderwijk, The Netherlands; (3) Institute for Marine Resources and Ecosystem Studies (IMARES), IJmuiden, The Netherlands

The effect of temporal variation in experimental noise exposure on swimming and foraging behaviour of captive zebrafish

Saeed Shafiei Sabet, Yik Yaw Neo, Hans Slabbekoorn
Department of Behavioural Biology, Institute of Biology Leiden, University of Leiden

Noise impact on fish: complementary need for indoor and outdoor studies

Hans Slabbekoorn
Department of Behavioural Biology, Institute of Biology Leiden, University of Leiden

Do females of mute sticklebacks like males that court with sound?

Tilquin A. (1), Candolin U. (2), Slabbekoorn H. (1)
(1) University of Leiden; (2) Helsinki University

Neighbour effects on dawn singing behaviour in Great tits (*Parus major*)

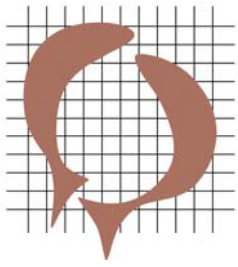
J.A.J. van der Eijk (1), L. Snijders (1,2), K. van Oers (2), M. Naguib (1,2), E.P. van Rooij (1)
(1) Wageningen University; (2) Netherlands Institute of Ecology (NIOO-KNAW)

To sing or not to sing: personality is associated with singing activity in great tits (*Parus major*)

Erica P. van Rooij (1), Lysanne Snijders (1,2), Piet de Goede (2), Kees van Oers (2) & Marc Naguib (1)
(1) Wageningen University, Behavioural Ecology Group, Wageningen, The Netherlands; (2) NIOO-KNAW, Department of Animal Ecology, Wageningen, The Netherlands

Severe feather pecking and cannibalism by "friendly" hens

Jeroen van Rooijen
Former poultry behaviour researcher at the Centre for Applied Poultry Research "Het Spelderholt" Beekbergen, The Netherlands. Present adress: Churchillweg 37c, 6707 JB Wageningen, The Netherlands.



NVG Meeting

27-29 November 2013

Kontakt der Kontinenten
Soesterberg

Abstracts

Invited Talks

Rapid changes in brain estrogen production and behavioral action

Jacques Balthazart

GIGA Neurosciences, University of Liège, Belgium

The aromatization of testosterone (T) into estradiol (E2) in the medial preoptic nucleus (POM) is a critical limiting step in the activation of male copulatory behavior in quail as in many other vertebrates. This behavioral effect is thought to rely mainly on genomic actions of locally produced E2. However, besides their long-term control over physiology and behavior that is mediated through nucleus-initiated signaling, estrogens also activate membrane-initiated signaling characterized by its shorter latency and transient nature. These faster actions have mostly been studied at the cellular level and little is known about the functional implications of such events for the whole organism. Moreover, the mechanism(s) that would be able to produce fluctuations in brain estrogen concentrations in a time frame congruent with their rapid actions is (are) poorly understood. Recent studies in our laboratory focusing mainly on reproductive behavior addressed these questions. These experiments were mostly conducted in Japanese quail, a species known for its robust responses to steroids and its very high brain aromatase activity (the rate-limiting enzyme for estrogen synthesis) compared to mammals. A first set of experiments demonstrated that brain-derived estrogens modulate within minutes measures of sexual motivation through membrane-initiated events without affecting copulation whose control exclusively depends on estrogen genomic activity. A second series of experiments focused on the control of brain estrogen synthesis. *In vitro* studies identified a novel mechanism of regulation of aromatase activity involving post-translational modifications of the enzyme rather than modulations of its concentration. Rapid and reversible changes in aromatase activity were also shown to occur *in vivo* following social encounters or exposure to acute restraint stress. These sex-, region- and stimulus-specific enzymatic fluctuations thus provide a mechanism of acute regulation of local estrogen provision with a time and spatial resolution that fits with the rapid effects observed on male sexual behavior. Furthermore, studies in mice confirmed that the rapid stimulation (within 10-15 min) by estrogens of male quail sexual behavior also takes place in mice. Together, these results support the notion that brain-

derived estrogens should be considered as neuromodulators. Furthermore, they suggest that two distinct mechanisms of action of estrogens (membrane- vs. nucleus-initiated) acting in different time frames (short- vs. long-term) interact to control different components (motivation vs. performance) of the same behavioral response and improve reproductive fitness.

Genetics of behaviour: magnitude of Indirect genetic effects in livestock, and prospects for improvement of animal welfare by genetic selection

Piter Bijma

Department of Animal Sciences, Wageningen University

Behavioural interactions among animals are a key determinant of welfare in livestock. Damaging behaviours such as tail biting in pigs and cannibalism in laying hens are serious welfare issues in livestock. Until recently, genetic solutions for such problems have been very difficult because they would require large-scale routine collection of behavioural observations, which is simply not feasible. The recently developed theory of Indirect Genetic Effects (IGE) now offers the opportunity to estimate the genetic effect of an individual on the trait values of its social partners, without the need to observe the causal behavioural interactions. For mortality due to cannibalism, for example, IGE-models allow to estimate the genetic propensity of individuals to cannibalize their group mates, without observing the cannibalism. Applications to laying hens show that genetic effects of both the actor and the victim contribute to cannibalism, and that the resulting heritable variation is substantial, indicating good prospects for genetic solutions. This prediction is confirmed by results of a selection experiment, in which selection for IGEs has substantially reduced mortality. A selection experiment in pigs shows that pigs selected for positive effects on growth rate of their pen mates show less biting behaviour and require less interventions to limit tail biting. Similar results have been found in mink, Tilapia and in Eucalyptus trees.

Chemosensory recognition of individual identity in mice

Peter Brennan

University of Bristol

Humans take their sense of smell for granted, but it is the major sensory system for most animals. There has recently been a molecular genetics-led revolution in our understanding of this previously neglected sense. Now a major focus of research effort is devoted to understanding the processing of odour information and the role of learning in odour perception. In particular, recent findings have shed light on the diversity of specialised chemosensory subsystems that mediate innate behavioural and physiological responses to pheromones. My group's research is focused on investigating the neural basis of learning in the olfactory

bulb, at the first stage of olfactory processing of odour information. We are particularly interested in the neural basis of mate recognition in mice, which is one of the few mammalian examples in which learning at the behavioural level can be explained by changes at synapses between identified neurons in the brain. Previous work has shown that memory formation depends on the association of chemosensory input to the vomeronasal system and the high levels of noradrenaline that occur in the olfactory bulb at mating. These are associated with dramatic changes in the functioning of the accessory olfactory neural network that selectively gates transmission of the learned information. Current work is aimed at understanding the receptor mechanisms by which noradrenaline imprints the neural system and how changes in feedback inhibition shape synchronized oscillatory activity of the accessory olfactory bulb mitral cells to gate sensory transmission to central brain areas, such as the medial amygdala and hypothalamus.

Behavioural responses to human-induced environmental change in sticklebacks

Ulrika Candolin

Department of Biological and Environmental Science, University of Helsinki

Humans are presently altering habitats at an unprecedented rate and scale. The first response of animals to these rapid changes is often behavioural. However, the consequences that these responses have at both the individual and the population level are poorly known. In this talk, I will discuss the consequences of behavioural responses to human-induced rapid environmental changes, drawing on examples from our work on the effects of eutrophication on the reproductive behaviour of the threespine stickleback. I will mainly consider effects at the individual and the population level, but also consider the consequences that behavioural responses may have for the ecosystem, through effects on the food-web and the top-down and bottom-up regulation of ecosystems.

Of mice and mink: how different forms of captivity affect behaviour

Georgia Mason

Animal and Poultry Science, University of Guelph

Compared to wild conspecifics, captive animals often have reduced morbidity/mortality and better reproductive success, but show behavioural changes that raise concerns about psychological welfare and reduce their abilities to succeed if released back into nature. Their movements are greatly restricted; they also spend far less time foraging, experience reduced opportunities for choice and learning, may spend more time inactive, and commonly display stereotypic pacing, head-twirling, rocking and over-grooming. The magnitudes of all these effects vary across species;

with the number of generations in captivity; and with the design of the captive environment, especially its size and complexity. Primarily using mink, with some additional experiments on mice, my group has been using captive environments differing in degree of "enrichment" to investigate why captivity affects behaviour in the way that it does, and the welfare significance of these various responses. Compared to small barren cages, we find that large, complex cages are preferred. They also reduce physiological stress and fluctuating asymmetry; reduce boredom-like hyper-responsiveness to novel stimuli; boost males' ability to copulate with females and increase the number of infants that females wean; increase spontaneous alternation, suggesting better hippocampal development; decrease functionless repetition in tests sensitive to 'perseveration', suggesting more normal functioning of cortical-basal-ganglia pathways; and decrease stereotypic behaviours. We have found that whether an individual reacts to barren conditions by becoming stereotypic or inactive seems a matter of response style more than differential welfare. Finally, we have found some limitations in the effectiveness of enrichment: it is easy to offer "too little, too late", and individual animals also show stable differences in enrichment-use reflecting variations in age, neophobia, and strengths of motivation for the resources on offer. The contrasts between wild and captive environment are thus very likely to alter brain and behaviour, and perhaps reduce animal welfare. Solutions may lie in individually-tailored enrichments, and a zero tolerance of both stereotypic behaviour and profound inactivity.

Contributed Talks

Traveling slow-waves in the avian brain

Gabriël J. L. Beckers (1,2), Jacqueline van der Meij (1), John A. Lesku (1,3) and Niels C. Rattenborg (1)

(1) *Avian Sleep Group, Max Planck Institute for Ornithology, Seewiesen, Germany*; (2) *Cognitive Neurobiology and Helmholtz Institute, Departments of Psychology and Biology, Utrecht University, The Netherlands*; (3) *Department of Zoology, La Trobe University, Melbourne, Australia*

Most studied animals have been found to sleep, yet the function of the brain activity that characterizes sleep remains one of the great unresolved questions in biology. It has been proposed that in mammals these brain rhythms play a role in processing information acquired during prior wakefulness. Most attention has focused on the slow-oscillations, which have been recently shown to propagate through the laminar neocortex largely as two-dimensional traveling waves. This phenomenon is thought to be critically important for integrating spatially distributed information. Using high-density intra-cerebral recordings of slow-oscillations in zebra finches, we demonstrate that action and field potential activity propagate in a traveling fashion in the avian brain. However, importantly – and unlike mammals – these waves travel through the brain as local, expanding plumes of activity in three dimensions. The finding of traveling slow-waves in birds is remarkable because the cytoarchitectonic organization of the avian forebrain, which diverged from that of the mammalian brain ~300 million years ago, is organized in a fundamentally different manner from that of mammals. Our findings show that the traveling aspect of the slow-oscillation is a shared and fundamental property of both mammalian and avian brains, and is therefore not dependent upon mammalian cortical cytoarchitecture and associated computational properties. Our results may also have implications for understanding why during the course of evolution birds 'replaced' the laminar dorsal cortex present in their reptile ancestors with nuclear neuronal cytoarchitecture. 3D propagation may confer greater computational freedom than in the laminar mammalian neocortex and contribute to the complex (and in some cases, primate-like) cognitive abilities of birds.

Reproductive effort accelerates actuarial senescence in wild birds: an experimental study

Jelle J. Boonekamp, H. Martijn Salomons, Cor Dijkstra, and Simon Verhulst

Behavioural Biology, University of Groningen

Optimality theories of aging predict that the balance between reproductive effort and somatic maintenance determines the rate of aging. Laboratory studies find that increased reproductive effort shortens lifespan, but through increased short-term mortality rather than aging. In contrast, high fecundity in early-life is

associated with accelerated senescence in free-living vertebrates, but these studies were non-experimental. We performed lifelong brood size manipulation in free-living jackdaws. Actuarial senescence – the increase of mortality rate with age – was 3-fold higher in birds rearing enlarged- compared to reduced broods, confirming a key prediction of the optimality theory of aging. Our findings contrast with the results of single year brood size manipulation studies carried out in many species, in which overall there was no discernible manipulation effect on mortality. We suggest that our and previous findings are in agreement with predictions based on the reliability theory of aging and propose further tests of this proposition.

Human cooperation by reciprocity

Lucas Molleman (1), Eva van den Broek (2), Violet Swakman (3), Aljaž Ule (2), Martijn Egas (3)

(1) *Theoretical Biology, University of Groningen, The Netherlands*; (2) *CREED – Center for Research in Experimental Economics and Political Decision Making, University of Amsterdam, The Netherlands*; (3) *IBED – Population Biology, University of Amsterdam, The Netherlands*

Explaining the evolution and maintenance of cooperation among unrelated individuals is one of the fundamental problems in biology and the social sciences. There is ample evidence by now that human cooperative behaviour towards other individuals is often conditioned on information about previous interactions. This information derives both from personal experience (cf. direct reciprocity) and from experience of others, i.e. reputation (cf. indirect reciprocity). Direct and indirect reciprocity have been studied separately, but humans often have access to both types of information. Also, virtually no insight exists about the moral rules humans use in such situations, e.g. is not helping a nonhelper justified? To address these issues, we experimentally investigated information use in various versions of a repeated helping game. We find that information from direct interactions weighs more heavily in decisions to help and participants tend to react less forgivingly to negative personal experience than to negative reputation. Moreover, effects of personal experience and reputation interact in decisions to help. If a recipient's reputation is positive, the personal experience of the donor has a weak effect on the decision to help, and vice versa. Yet, if the two types of information indicate conflicting signatures of helpfulness, most decisions to help follow personal experience. Hence, to understand the roles of direct and indirect reciprocity in human cooperation, they should be studied in concert, not in isolation. With a different set of experiments, we show that most people do consider their peers' motivations, and many reward those individuals who refuse to help defectors. However, striking qualitative differences in individual morals were found. Understanding human cooperation through reciprocal helping requires better understanding of the way reputational information is

integrated with personal experience and of the way humans use moral rules to judge such information.

Robofrogs & Risky Ripples

Halfwerk, W. Page, R. Ryan, M.

STRI/University of Texas

Elaborate sexual displays are favoured by sexual selection, but are often opposed by predation risk. Displaying animals produce signals with multiple components that are received through a variety of sensory modalities. Primary and secondary signal components can interact to induce novel receiver responses and become targets of sexual selection as complex signals. However, predators can also use these complex signals for prey assessment, which may limit the evolution of elaborate sexual signals. Here we demonstrate the risks involved with the production of multimodal sexual displays, namely that the call-induced water ripples of male túngara frogs (*Physalaemus pustulosus*) provide cues to the frog-eating bat (*Trachops cirrhosus*). Water ripples are a by-product of calling from a water surface, but function as important secondary component of the frog's sexual display: male vocal responses increase two-fold when ripples are added to the acoustic component of a mimicked calling rival. We show that hunting bats also make use of the frog's multimodal display, as bats preferred to attack model frogs with ripples added to sound playback in two-choice experiments. Our data demonstrate that a trait that evolved as a production constraint of a primary signal component can be under strong sexual and natural selection as a secondary component in a multimodal display. The co-option of multiple components in sexual displays can be beneficial to signallers and intended receivers, but costs such as increased predation risk, have to be taken into account when reconstructing the evolution of multimodal communication.

The increased efficiency of fish swimming in a school

C.K. Hemelrijk (1), D.A.P. Reid (1), H. Hildenbrandt (1) and J.T. Padding (2)

(1) *Behavioural Ecology & Self-organization, Rijksuniversiteit Groningen, The Netherlands*, (2) *Multiscale Modeling of Multiphase Flows, Eindhoven University of Technology, The Netherlands*

There is increasing evidence that fish gain energetic benefits when they swim in a school. The most recent indications of such benefits are a lower tail (or fin) beat at the back of a school and reduced oxygen consumption in schooling fish versus solitary ones. How such advantages may arise is poorly understood. Current hydrodynamic theories concern either fish swimming side by side or in a diamond configuration and they largely ignore effects of viscosity and interactions among wakes and individuals. In reality, however, hydrodynamic effects are complex and fish swim in many configurations. Since these hydrodynamic

effects are difficult to study empirically, we investigate them in a computer model by incorporating viscosity and interactions among wakes and with individuals. We compare swimming efficiency of mullets of 12.6 cm travelling solitarily and in schools of four different configurations at several inter-individual distances. We show that these fish always swim more efficiently in a school than alone (except in a dense phalanx). We indicate how this efficiency may emerge from several kinds of interactions among wakes and individuals. Since individuals in our simulations are not even intending to exploit the wake, gains in efficiency are obtained more easily than previously thought.

Negotiation in parental care

Camilla A. Hinde

Behavioural Ecology, Wageningen University

When provisioning young, parents must negotiate over how much care to provide, since each would benefit if the other did more of the work. I will present some of my work on great tits, showing that parents respond directly to the work rate of their partner. This responsiveness is apparent when partner work rate is manipulated, as well as when observing patterns of care at the nest. Observing the visits of great tits to the nest over time shows that parents alternate more than expected by chance, which predicts a reduction in conflict between parents and an increase in overall levels of care. The extent to which parents are responsive to each other's work rate is also affected by signals of quality, since parents are more responsive to ornamented partners.

Preparing for changing environments: maternal testosterone deposition and the differential effects under different environmental contexts in the Rock Pigeon (*Columba livia*)

Bin-Yan Hsu, Martina S. Müller, Cor Dijkstra, Christophe L. Gahr and Ton G.G. Groothuis

Behavioural Biology, Centre for Behaviour and Neurosciences, University of Groningen

In many animal species mothers differentially bestow their eggs with hormones. The increasing pattern of yolk testosterone (T) concentrations over the avian laying sequence is interpreted as mitigating effects of hatching asynchrony by boosting the later hatching chicks. However, why would avian mother first produce hatching asynchrony, classically regarded as an adaptation, and then compensate its effect by maternal T? We hypothesized that maternal T is only beneficial for the chick under good food conditions, when mothers aim to raise the full brood, but detrimental under poor food conditions when brood culling is needed. We did two experiments aiming to test this hypothesis in the rock pigeon, in which first eggs contain much lower T concentrations than last and second eggs. First we tested the yolk testosterone contents in the eggs laid by mothers housed in either good or food conditions. Intriguingly we hardly found any evidence that the yolk T

deposition was adjusted. Second, we created clutches of two first eggs, one injected with T to the level of the second egg (T chicks), and one injected with vehicle (C chicks). Pairs were then housed under either good or poor food conditions. Only in the good condition T chicks grew faster than C chicks. Only in the poor condition, T chicks had a much higher early mortality than C chicks. These results solve the above paradox, and may explain contradictory results of in ovo T injections in the literature.

Effect of nutritional stress at different developmental periods on HPA axis and cognition in the zebra finch

Kriengwatana B., Brooymans-Quinn J.F., Wada H., Schmidt K.L., Taves, M.D., Soma K.K., & MacDougall-Shackleton S.A.

Developmental environments can have long-term effects on cognition. Elevated glucocorticoids could be the mechanism by which developmental stress affects cognition. We investigated the effects of nutritional stress at different stages of development on HPA axis, song, and associative learning in a songbird. Zebra finches (*Taeniopygia guttata*) were raised in consistently high (HH) or low (LL) food conditions until post-hatch day (PHD) 62, or were switched from high to low conditions (HL) or vice versa (LH) at PHD 34. A standardized restraint stress protocol was used to measure corticosterone (CORT) at PHD 30 and 60. Adrenocorticotrophic hormone (ACTH) and dexamethasone (DEX) challenges were used to assess HPA axis function in adulthood. Song and associative learning were measured in adulthood. We found that nutritional stress increased baseline CORT levels during development only. Birds in the LL group had lower CORT levels after injection of ACTH compared to the other groups, however there was no effect of nutritional stress on the response to DEX. Although LH conditions impaired learning ability of females, none of the nutritional manipulations affected song learning or vocal performance of males.

Collective cognition in human crowds. Decision making under uncertainty

Ralf Kurvers, Max Wolf & Jens Krause

Department of Biology and Ecology of Fishes, Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany

Decision accuracy is a key factor shaping the evolution of behaviour. Decision accuracy in many contexts depends on two dimensions: a high rate of stimulus specific responses in the presence of a particular stimulus (true positives) and a low rate of such responses in its absence (false positives). For instance, animals under predation danger need to escape when a predator is approaching, but do not need to escape when a non-dangerous animal is approaching. Increasing sensitivity to stimuli (e.g., a smell or sound) increases true positives but comes at the cost of

increased false positives, posing a fundamental limitation to decision accuracy. Here we investigate individual and collective decision making in human crowds under uncertainty to study if groups can outperform individuals in the framework of true and false positives.

The effect of anthropogenic noises on the vocal behaviour of *Pleuroderma thaul*, a frog from South America

Reinaldo Marfull (1) & Mario Penna (2)

(1) *Behavioural Ecology and Self-organization, University of Groningen*; (2) *Program of Physiology and Biophysics, University of Chile*

Anthropogenic noise has become a new source of interference for animals that rely on acoustic communication. Few studies have investigated the importance of such interference in anurans, which strongly rely on acoustic communication to establish the territory in male-male interactions and search for and choice of mating partners. So far, it is not well understood which characteristics of this type of noise affect the vocal behavior of frogs in the social context. In this field study, males of *Pleuroderma thaul* inhabiting breeding sites in areas with low and high levels of anthropogenic noise were exposed to seven synthetic noises (i.e. train, low and high highway, conspecific chorus, and three mixed stimuli composed of each anthropogenic noise with chorus noise) in a within-individual design. Males of both sites showed similar basal vocal activity and a relatively strongly increased pulse rate in presence of chorus noise. Individuals inhabiting the low-noise site only modified their pulse rate in the presence of anthropogenic noises and decreased their vocal activity in response to exposure to train-chorus and high highway-chorus noises compared to the isolated chorus noise treatment. Our results suggest that the different behavioural responses between sites are probably mediated by short-term vocal adjustments related to masking of conspecific sounds, according to the frequency composition and amplitude of anthropogenic noises. More attention on the auditory properties may contribute proximate explanations to the behavioral responses in this and other groups.

Neuroanatomy in laying hen welfare

Nordquist, RE (1), Zeinstra, EC (1), Rodenburg, TB (2), van der Staay, FJ (1)

(1) *Emotion & Cognition Group, Department of Farm Animal Health, Faculty of Veterinary Medicine, Utrecht University, The Netherlands*; (2) *Behavioural Ecology Group, Wageningen University, the Netherlands*

A major challenge in modern animal welfare research is the question of how to measure animal welfare. One approach that may aid in identifying underlying causes of welfare issues, is using neuroanatomical approaches to examine the brains of (farm) animals exposed to genetic or environmental interventions. We have

examined brains from laying hens selected for low early mortality (LML), which show low feather pecking, and have compared them with a control line of adult laying hens selected for production characteristics only (CL). The effect of mother hen rearing on the two genetic lines and their neuroanatomy was also investigated. We demonstrated an increase in the number of neurons positive for the rate limiting enzyme in dopamine production, tyrosine hydroxylase (TH), in the periventricular area of the hypothalamus in the LML hens compared to CL hens, and a decrease in TH levels in the nidopallium caudolaterale. Hen-reared chicks showed more vasotocin positive neurons in the medial pre-optic area compared to the hens raised without a hen, as well as less lateralization in the hippocampus, as measured by absolute difference in cell soma size between hemispheres. Our results demonstrate that both early life and genetic influences can affect laying hen neuroanatomy in structures relevant to cognition and emotion. The potential and the limitations of the use of neuroanatomy in animal welfare will be discussed.

Empathy versus Parsimony in Understanding Post-Conflict Affiliation in Monkeys: Model and Empirical Data

Puga-Gonzalez, I.; Butovskaya, M.; Thierry, B.; Hemelrijk, C.K.

University of Groningen; Russian Academy of Science; University of Strasbourg

Affiliation after a fight between former opponents and bystanders has been demonstrated in several species of non-human primates. This behavior is classified in four categories, from which 'consolation', the post-conflict affiliation received by the former victim, has received most attention. The two hypotheses used to explain its occurrence, the cognitive constraint hypothesis and the social constraint hypothesis, are insufficient. Although the cognitive constraint hypothesis suggests that consolation is confined to apes, because only apes not monkeys have sufficient cognition for empathy, it has recently been found in monkeys. The social constraint hypothesis suggests that consolation depends on the type of society (tolerant or intolerant), but this does not explain why it happens. Here, we investigate in a combination of a computational model and empirical study the minimum cognitive requirements for displaying post-conflict affiliation. We parameterize the model after empirical data of a tolerant species, the Tonkean macaque (*Macaca tonkeana*). In the individual-based model, called GrooFiWorld, individuals are steered by cognitively simple behavioural rules. Individuals group and when nearby each other they fight if they are likely to win, otherwise, they may groom, especially when anxious. We find evidence for the four categories of post-conflict affiliation in empirical data and in the model. We explain how in the model these patterns emerge from the combination of a weak hierarchy, grooming as tension reduction mechanism, social

facilitation, risk-sensitive aggression, and preferred interactions with partners close-by. The model-based explanation is a useful starting point for studying post-conflict affiliation further in real primates.

Prosodic cue weighting by Zebra finches

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Paralinguistic information such as pitch, intensity and rhythm is a crucial part of human communication. Not only does it reveal our emotional state, infants also use these prosodic cues as tools to help learn about words and syntax (Johnson & Seidl, 2009; Jusczyk, 1999). To support the suggestions that sensitivity to prosodic cues is a prerequisite for language evolution and linguistic development and is therefore not human specific, rats and tamarin monkeys have been tested on prosodic perception for human speech (Toro et al., 2003; Ramus et al., 2000). Both species discriminated between Japanese and Dutch sentences based on their prosodic patterns. These results are promising in showing prosodic cue sensitivity in non-human animals. Nevertheless, it does not yet tell us which prosodic cues are important and how, or if, they outweigh each other. We tested prosody perception in a controlled experiment with zebra finches. Songbirds, such as the zebra finch, learn their vocal patterns from conspecifics in a similar way as human infants do. Being such comparable vocal learners to us makes them well suited for research in the basics of language acquisition. We added prosodic cues to XYXY and XXYY structures. Zebra finches have been shown to be able to discriminate between these sequential structures (van Heijningen et al., 2009) and this design provides the possibility to look at the trade-off between sequential and prosodic information. The prosodic cues that we used are changes in pitch, intensity and duration of speech elements. With a go/no-go procedure, the zebra finches were trained to discriminate between XYXY patterns with initial prosody and XXYY patterns with prosody on the final element. To systematically determine the influence of all prosodic cues together as well as separately, the zebra finches were subjected to five tests. 1) The prosodic pattern was added to similar sequential structures as during training, but now consisted of new elements, in order to test if the birds could abstract and generalize the prosodic pattern. 2) Here the prosodic pattern was contradicting with the underlying sequential structure. The birds were subjected to XYXY structures with final prosody and XXYY structures with initial prosody. 3) Only one prosodic cue – pitch, intensity or duration – was added to the sequential structures in the same contradicting fashion as in test 2. 4) In this test one of the prosodic cues was coherent with the underlying sequential structure, the remaining two were contradicting. 5) Finally, we presented the birds with XYXY and XXYY structures without any change in prosody to see if the birds could also discriminate the underlying patterns without the aid of prosody.

The results from these different tests show that zebra finches are very sensitive to prosodic patterns. Remarkably, they were able to generalize the prosodic pattern to new element sequences with the same prosodic pattern as the training ones. The other tests revealed that the different prosodic cues were not all of the same weight. Together our findings show that the zebra finches seem to have abstracted the prosodic patterns. These results show that the sensitivity to prosodic cues is not specific to humans but shared with a songbird species. This indicates a broader evolutionary context for this crucial part of human communication.

New technologies for animal tracking and behaviour detection

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Tracking animals with the Global Navigation Satellite Systems (GNSS), of which GPS is the most commonly used, has become an important research method for studying wildlife behaviour. Frequently this is for studying large-scale movements such as migration or resource use within a territory. However, more recent developments in technology such as light-weight batteries and more accurate positioning have opened up possibilities to get more information out of GPS data including detection of certain behaviours. TrackLab is new software which enables an integrated solution of various sensors and data analysis as well as tools to enable detection of behaviours from the tracking data.

Mating role choice in a simultaneous hermaphrodite: towards integrating pre- and post-copulatory processes

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In contrast to separate sexed animals, simultaneous hermaphrodites have different reproductive strategies, as they are both male and female at a same time. For instance, simultaneous hermaphrodites that copulate unilaterally, make a unique decision: whether to mate as a male or a female. Previous studies have indicated that several factors affect mating role choice, which are often confounded. Moreover, the influence of this choice on post-copulatory processes and overall reproductive success is rarely investigated. Therefore, we here examined the relationship between mating role choice and several life history traits (size, age, and mating history) in the great pond snail, *Lymnaea stagnalis*. First, we conducted a field survey of a wild population to estimate natural variations in size and age. Experimentally, within these natural variations, we found that young and small snails mate as males first. Both size and age significantly affected their pre-copulatory choice of mating role, with age having a dominant effect. Second, because this species substantially reduces its male investment after

receiving seminal fluid, post-insemination they may be reluctant to mate as males. However, our results indicate that recently inseminated snails remain motivated to inseminate their mates. Hence, post-copulatory effects of seminal fluid proteins do not seem to reduce male motivation. In sum, the pre-copulatory choice of mating role in *L. stagnalis* is largely determined by size and age (under our experimental conditions), while post-copulatory effects on mating propensity seem absent. Based on these conclusions, we discuss the importance of integrating pre- and post-copulatory processes in order to understand a reproductive strategy.

Acute stress responses of dressage horses ridden in three different head and neck positions

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The effects of hyperflexion on the welfare of dressage horses has been debated. In previous studies, different Head-and-Neck-Positions (HNP) were assessed on a treadmill or on a lunge. This study aimed to investigate short-term stress responses of horses ridden in three different HNP. After a warm-up period of 20 minutes, 15 Danish dressage horses (intermediate to Grand Prix level; routinely trained in hyperflexion) rode a pre-determined 10-minute program in walk, trot and canter. All horses were ridden 3 times by their usual rider in respectively a long frame (unrestrained; LF); competition frame ("on-the-bit"; CF) or Low-Deep-and-Round (LDR) in a balanced order across three test days. Heart rate, heart rate variability (HRV), salivary cortisol, behaviour and rein-tension (RT) (SignalScribe™, sensor limit=5kg) were recorded during the 10-minute test period. Responses were analysed for a correlation between RT and ethological and physiological stress measurements across treatments. Average RT in CF (2.6 ± 0.70 kg) and LDR (2.6 ± 0.65 kg) were equivalent, but different from LF (1.6 ± 0.50 kg; RM ANOVA: $F_{2,14} = 15.19$; $p < 0.001$). Unfortunately, a ceiling effect (tension measurements above the upper detection level) was present for a considerable amount of the time measured: $14.6 \pm 10.25\%$ for the CF; $15.3 \pm 10.67\%$ for the LDR and $1.8 \pm 1.29\%$ for the LF ($F_{14,2} = 11.3$; $p < 0.001$), therefore RT averages should be considered underestimations. Variation of the tension (measured as mean variation of the RT) differed between treatments ($F_{2,14} = 25.8$; $p < 0.001$), with LF being the most stable (1.2 ± 0.16 kg) and CF (1.5 ± 0.22 kg) and LDR (1.6 ± 0.21 kg) equal. Poll flexion correlated to average RT ($r_s = -0.48$; $p < 0.01$) and tension variation ($r_s = -0.41$; $p < 0.01$). Head waving correlated with the period the RT was above the ceiling ($r_s = 0.36$; $p < 0.05$) and tension variation ($r_s = 0.36$; $p < 0.05$) across treatments. Rein tension and head waving could be

added factors to the stress responses of horses during CF and LDR.

Conclusion: Rein tension between the rider-horse partnerships varied between horses and Head-and-Neck-Positions. The rein-tension was above the detection limit of 5 kg for a considerable amount of time and correlated to poll flexion and head waving, even during the unrestrained frame. The rein tension had low correlation with physiological stress parameters.

Holding-tank acoustic conditions can affect behavioural responses of fish during playback experiments

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Ambient noise differs considerably between habitats. There is increasing evidence that elevated noise levels can affect physiology and behaviour in a variety of taxa. Moreover, previous acoustic experience can modify behaviour. Noise levels in holding conditions of animals kept in captivity for food production, as pets and for research, can also vary greatly. This could potentially affect not only animal welfare, but also research conclusions in natural and in laboratory environments. In our laboratory study, we explored how noise levels in holding tanks affected the impact of short-term playbacks of noise derived from ship-noise recordings on anti-predator and feeding behaviour in European minnows (*Phoxinus phoxinus*). Noise playbacks reduced effective anti-predator behaviour in minnows from quiet holding tanks, but not those from louder holding tanks. In feeding experiments, minnows consumed less food and showed more startle responses during noise playbacks compared to silent controls, irrespective of holding conditions. However, while minnows from louder holding tanks made more foraging errors, the ones from quiet holding conditions tended to interact more with their companion fish instead of showing foraging behaviour. Thus, different ambient noise levels in holding tanks can affect conclusions from experimental research. Minimising noise levels in animal facilities is established as important from an ethical and welfare perspective, but we suggest this subject also needs careful consideration in experimental research.

Finding the function of brain lateralization

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Brain lateralization (the differential control of functions by the two hemispheres) is now known to be a fundamental property of the organization of brain and behaviour but its function is poorly understood. One

hypothesis postulates enhancement of cognitive performance by lateralized processing, due to hemispheric specialization and increased scope for parallel processing when two tasks are each processed in a different hemisphere. We tested this in human subjects by examining the performance of two cognitive tasks in a single and dual (i.e. simultaneous) condition in relation to strength and direction of lateralization of these functions. Language function (left hemispheric dominance) was tested by a word generation task whereas visuo-spatial functioning (right hemispheric dominance) was tested by a mental rotation task.

Strength and direction of both functions were established independent of performance by using functional transcranial Doppler (fTCD), measuring blood flow to both hemispheres. Interestingly, many subjects did not show lateralization patterns according to text books. Nevertheless, in both the single and dual condition, strength of lateralization was indeed positively related to performance. These results provide for the first time evidence that human brain lateralization is advantageous for cognitive performance and thus relevant for understanding the evolution of brain lateralization.

Posters

Association of egg mass and egg sex in layer hens (*Gallus gallus*): gene expression analysis from germinal disc region of F1 follicle around time of meiosis

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We investigated effects of hen body mass and egg mass on offspring sex ratio in groups of feed restricted and control hens, using 45 ISA brown layer hens per group. Feed restriction hens received 80% feed of ad lib for 7 days and 70% of ad lib for an additional 9-11 days. Hens were inseminated twice a week with pooled extended semen from 15 cocks. Unincubated eggs were sexed by PCR methods. On average, egg mass decreased in the feed restriction group and not in the control group, but in both groups, individual hens varied strongly in the change of egg mass over time. In the subset of hens in which egg mass clearly decreased over time, the average egg mass per hen was negatively associated with sex ratio per hen. From the 27 (out of 45) feed restricted hens with clear decrease of egg mass over time, two groups of eight hens each were selected with highest and lowest egg mass (i.e. lowest and highest sex ratio), respectively, and used for genome wide gene expression analysis in the germinal disc region of F1 follicles that had been collected from hens sacrificed at the end of the feed restriction treatment at the calculated time of occurrence of meiosis-I (i.e. around 26-28 hours before oviposition). No significant differential expression of individual genes between these groups was found. However, gene set enrichment analysis showed that a number of processes related to cell cycle progression, mitotic/meiotic apparatus, chromosomal movement and DNA packing were enriched only in the group of hens with female sex ratio bias with high egg mass. These findings support the concept of meiotic drive (asymmetric sex chromosome segregation during meiosis) as mechanism for sex ratio bias.

Large daily temperature ranges increase zebra finch mortality

Michael Briga, Simon Verhulst

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Climate change affects mean and interannual variability of climatic variables but also their daily variability. For example, since the seventies, various areas around the globe have experienced an increment in daily temperature range (DTR) of up to 1°C per decade. While the ecological consequences of changes in mean and interannual variability of temperature are well

under investigation, we know almost nothing about the consequences of changes in DTR, particularly in endotherms. Here, we use high resolution mortality data of a small passerine bird, the zebra finch, *Taeniopygia guttata*, to report that increases of 1°C in the natural variation in DTR can cause up to a threefold increase in adult mortality rate. These results indicate that short term temperature variability is a concern for the survival of endothermic species, even when changes in mean temperatures are negligible. More generally, understanding species' response to climate change requires the consideration of climatic changes on short timescales and especially the nonlinear responses to such changes.

DO NOT DISTURB - Does aquatic noise affect sexual selection in a sound producing fish?

Karen de Jong (1), Eva-Lotta Blom (2), Katja Heubel (1) and Ola Svensson (2)

(1) *University of Tuebingen* (2) *Gothenburg University*

The noise level in the world's oceans is rising. It is therefore of the utmost importance to assess how ambient noise will affect sea-living animals before any effects become irreversible. One of the most likely impacts of ambient noise is the disruption of acoustic communication. Many fish species use sound in courtship and a disruption of these signals may severely hamper reproduction. Furthermore, changes in the display or reception of a courtship signal may affect both the direction and the strength of sexual selection by female choice. The current project investigates the effects of ambient noise on 1. male courtship, 2. female mate preferences, 3. sexual selection and 4. population reproductive success in a small marine fish, the sand goby (*Pomatoschistus minutus*). Here, we present preliminary data from two experiments testing effects of aquatic noise on male courtship behaviour and male mating success.

Artificial light at night affecting avian behaviour

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Economic growth and the increase in urbanization has led to an increase of anthropogenic illumination in large parts of the world. Effects of artificial light have been reported in different ecosystems, on many species and species groups. With excellent vision, and – in many species – a dependence on day length information for seasonal timing, birds are potentially strongly affected by disturbances of their natural light environment. Relatively little is however known about the long-term consequences of these disturbances, and even less about the effects of light of different colour. To study this, we have set up a large-scale monitoring project in

natural habitat in the Netherlands. At eight study sites we experimentally illuminate 100 m long transects at the forest edge with white, green and red LED light, one transect is left dark. Every year, we assess the presence, density and activity of many species at these sites according to rigid protocols. In order to have a dark reference of all sites, we started the monitoring routine a year before the artificial illumination was installed. All nest sites of breeding bird species are located, as well as song posts. Birds are frequently netted and banded in order to monitor residence, recruitment and dispersion. We measure timing and success of reproduction in nest box breeding birds at and around the transects, as well as daily activity patterns in feeding behaviour. We present effects of light on breeding bird species, including the advance of lay date of great tits (*Parus major*) breeding at the green and white illuminated transects. We link effects on territories, survival, daily and seasonal timing. Experimental, long term studies are essential for the mitigation of the impact of artificial light on birds.

The ability of zebra finches, budgerigars and humans to generalize abstract rules

Arne Dits, Michelle Spierings & Carel ten Cate
University of Leiden

The faculty of language is a prominent feature that differentiates humans from other animals. However, comparative research has shown that features that were once considered unique to human language, such as vocal learning and categorical perception, are also found in other animals such as songbirds. Findings like these provide insight in the processes involved in vocal learning, language and the evolution of language. Our study investigates if humans, zebra finches (*Taeniopygia guttata*) and budgerigars (*Melopsittacus undulatus*) can generalize a syntactic structure. Both zebra finches and budgerigars were trained to discriminate between two sets of triplets; one structured according to the rule XXY, the other to the rule YXY. When the birds were able to discriminate between the sets, they were tested on two sets that were structured accordingly to the trained rules (XXY and YXY), but consisted of new elements or known elements in a new combination.

Subjects of both species were able to discriminate between the two training sets. However, while none of the zebra finches made a clear distinction between the two test sets, the budgerigars did. When known elements were presented in a new combination, the budgerigars discriminated them according to the trained rules.

This research is part of a comparative study of syntax generalization mechanisms in zebra finches, budgerigars, human adults and infants. This poster will give our preliminary findings which involve the main results of the experiments done with zebra finches and budgerigars.

Reducing R/R-behavior in captive orangutans through dietary treatments: A case study

Paul Koene, Jan-Willem Haeke and José Kok
Wageningen University

A group of eight orangutans (*Pongo pygmaeus*) is kept at Ouwehand Zoo. One particular individual, Tjintah, performs regurgitation and reingestion or R/R behavior, which is often found in primates. This behavior is defined as a self-induced movement of food or liquid from the esophagus or stomach to the floor, the hands or retained in the mouth, subsequently followed by reingestion. It is still unclear why this behavior occurs and how it is triggered. One of the potential causes is the difference between wild fruits and domestic fruits. Domestic fruits lack fibre and contain three times more sugars.

This study aimed to reduce R/R in Tjintah through dietary treatments. The standard zoo diet was used as the control treatment (A) and compared with a newly formed vegetable diet (C: high fibre, low in sugar). In two additional treatments the standard fruit and the vegetable diet were fed every hour (B and D). The fifth treatment was a vegetable diet with additional browse (E). All diets fulfilled nutritional demands from the SSP Husbandry Manual and were fully consumed. In a randomized alternating treatment design (RATD), treatments were presented for 35 days with every day ten observations of 30 minutes focal continuous recording. During this period the average R/R frequency was 6.88 ± 8.58 per 30 minutes. Single case randomization tests (SCRT) showed that the dietary treatment had a significant effect on the occurrence of R/R (SCRT, RATD, $P = 0.002$). R/R frequency was highest when Tjintah was provided fruit diets ($A=11.94$, $B=10.89$) compared to the vegetable diets ($C=4.94$, $D=4.30$ and $E=4.34$; SCRT, RATD, $P = 0.001$).

This study showed that removing fruit from the orang-utan diet and replacing it with vegetables resulted in a reduction of R/R behaviour. Whether lower sugar or increased fibre content has caused this decline should be studied in future.

Lateralized memory-related neuronal activation during sleep in juvenile zebra finches

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Like other songbirds, zebra finches learn their songs from an adult conspecific (a 'tutor') early in life, much like human infants learn to speak. The caudal medial nidopallium (NCM), the avian analog of Wernicke's area in the human auditory association cortex, is a likely neural substrate for the representation of tutor song memory in male zebra finches. In contrast, the HVC (a letter-based name) is important for song production and sensorimotor learning, and may thus be functionally analogous to Broca's area in the human frontal lobe.

We previously demonstrated left-sided dominance in the HVC and memory-specific (i.e., only in response to tutor song, and proportional to the strength of learning) left-sided dominance in the NCM of juvenile zebra finches, which is similar to the memory-specific speech-induced lateralization found in the temporal lobe of human infants. These birds were in the developmental phase in which they are learning their songs. It is widely believed that sleep is important for memory consolidation. We have shown previously that there is memory-related neuronal activation in the NCM of juvenile zebra finches during sleep. Here, we investigated whether such activation is lateralized. To this end, juvenile male zebra finches (54-59 days post hatching) were exposed to song of their tutor, an unfamiliar conspecific song, or no song. The expression of Zenk, the protein product of the immediate early gene ZENK (a marker for neuronal activation) was measured bilaterally in the NCM and HVC during subsequent sleep. We found a general (i.e., independent of stimulus) correlation between left-sided dominance of spontaneous neuronal activation in the NCM and the degree of song imitation of the juveniles. When the results of 'good learners' (similarity score > 55%) were compared to those of 'poor learners' (similarity score < 55%), we found that the former were left NCM dominant while the latter were right NCM dominant. In addition, we found right-sided dominance in the HVC, which was independent of the strength of learning. In contrast, we previously showed that juveniles that are awake display a left-sided dominance of HVC activation. These findings are consistent with a role for the left NCM in tutor song memory processing, while the right NCM may be involved in tutor song learning, in interaction with the right HVC, during sleep. Alternatively, it may be that birds that have more left-lateralized activation are better learners. Thus, we found lateralization of neuronal activation during sleep in juvenile songbirds that were in the song-learning phase. This indicates a role for lateralization during birdsong learning and memory formation during sleep.

The Effect of the Temporal Structure of Noise on the Swimming Behaviour of the European Seabass

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Human activities in and around waters have generated substantial amount of underwater noise, which may negatively affect aquatic life including fish. In order to better predict and assess the consequences from the variety of anthropogenic sounds, it is essential to examine what sound features contribute to an impact. In this study, we tested if sound intermittency and amplitude fluctuation contribute to behavioural

changes in European seabass. Groups of four fish were exposed to a series of four sound treatments in an outdoor basin and their behavioural changes were analysed by a video-tracking system. We found that all sound treatments elicited anxiety related behavioural changes in fish, including startle response, increased swimming speed, increased group cohesion and bottom diving. However, the fish recovered more slowly from intermittent and fluctuating noise exposures than from continuous and consistent ones. Our findings are the first to show that sound temporal structure matters in noise impact assessments: sounds with a lower accumulated exposure level (intermittent compared to continuous) may actually have a stronger behavioural impact. This study urges regulatory authorities and developers to give greater considerations to the influence of sound temporal structures and exposure schemes when assessing noise impacts and devising mitigating measures.

The effect of temporal variation in experimental noise exposure on swimming and foraging behaviour of captive zebrafish

Saeed Shafiei Sabet, Yik Yaw Neo, Hans Slabbekoorn

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Anthropogenic noise underwater is on the rise and may affect aquatic animals of marine and freshwater ecosystems. Many recent studies concern some sort of impact assessment of single species. Few studies addressed noise impact on species interactions underwater, while there are some studies that address community level impact, but only on land in air. Key processes such as predator-prey or competitor interactions may be affected by masking of auditory cues, noise-related disturbance or attentional interference. Noise-associated changes in these interactions can cause shifts in species abundance and modify communities, leading to fundamental ecosystem changes. To gain further insight into the mechanism and generality of earlier findings, we investigated the impact on both a predator and a prey species in captivity, for zebrafish (*Danio rerio*) preying on waterfleas (*Daphnia magna*).

Noise impact on fish: complementary need for indoor and outdoor studies

Hans Slabbekoorn

Leiden University

Anthropogenic noise can be detrimental to aquatic life through physical harm and behavioural impact. Physical harm to fish only occurs very close to typically brief but high power sources. Behavioural impact occurs at more moderate levels and is spatially and temporally much more widespread. More studies are needed to get a better understanding of the behavioural impact on fish. indoor and outdoor studies vary in their acoustic and behavioural validity and in the amount of experimental

control. Although each approach has its limitations, scientific progress and applied insights will depend on the exploitation of their complementary potential.

Do females of mute sticklebacks like males that court with sound?

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Signalling males often exploit several sensory channels during courtship. Multi-modality may allow securing the transmission of information, in spite of fluctuations in environmental noise that differently affect these channels. As most species with uni-modal signals have multiple sensory channels, there is room for the emergence of additional signalling modalities, possibly through the exploitation of biases in the females' sensory system. However, it may be more difficult to extend courtship signals beyond their original range by developing the use of a novel modality, rather than by just adding new components within the usual one. Previous studies have for example shown that zebra-finch females prefer males of which the plumage appearance is extended with artificial crest feathers (Burley and Symanski, 1998). Similarly, Túngara frog females prefer males of which the acoustic whine display is extended with an artificial chuck (Ryan et al., 1990, but see Ron, 2008). Yet, we are unaware of instances where females respond positively to a novel signal component which does not belong to a modality they already use for mate choice. In our study, we added sound to the quiet, highly visual courtship of male three-spined sticklebacks. We also manipulated water transparency, as masking of visual cues may enhance the importance of auditory cues. We measured female interest in male courtship in 64 pairs of sexually mature fish. Each pair was left to interact twice, both with and without sound, in either clear or turbid water. The sound consisted of a simple, short broadband click, played every time the male exhibited a distinct acceleration. We will present our results and discuss the most likely ecological scenarios favouring the evolution of multi-modal communication.

Neighbour effects on dawn singing behaviour in Great tits (*Parus major*)

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Bird song functions in both inter- and intra-sexual contexts and is therefore an ideal model to study sexual selection. Male birds from many species show a peak in singing activity around dawn. Dawn song has multiple functions, of which one could be to adjust social relationships among territorial neighbours. Furthermore, individuals consistently differ in behavioural characteristics, often referred to as animal personality, and such differences could well be reflected in dawn singing. Likewise female personality

traits may affect their mate's singing. In addition, as song is a social connector among neighbours, neighbours are also likely to affect each other. We here show, in a systematic analysis of automatically recorded dawn song of personality-typed great tits (*Parus major*) in the wild, that dawn song characteristics predict fitness in a personality dependent way and that male song traits are affected by both their own as well as their mate's personality. Moreover we found some evidence that neighbours affect each other's singing behaviour. These findings suggest that selection on song varies with personality, which may lead to the maintenance of variation in male song traits. It further shows that song is not only affected by a male's own characteristics but also by those of his mate and his neighbours. These findings highlight the social function of song and provide new insights in the variation of selection pressures on male ornaments.

To sing or not to sing: personality is associated with singing activity in great tits (*Parus major*)

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Sexually selected signals like birdsong, vary among individuals often signaling variation in individual quality or motivation. Additionally, part of the variation among individuals may reflect consistent intrinsic differences, personality. Yet, the interaction between personality and social as well as environmental factors is not well understood. However, these factors together are most likely to affect the decision to sing and thus act as potential selection agents on song. Using a personality-typed field population of great tits we here show that personality affected singing activity, but differently at different reproductive stages and times of day. Bold individuals showed higher singing activity, peaking later in the reproductive stage whereas shy individuals sang more early in the breeding season especially in the evening. These findings indicate that individuals differing in personality have different strategies in using sexually selected signals, allowing conspecifics to extract personality-information from the song. Different singing strategies are also likely to reflect different strategies in social behaviour. It is therefore important to take into account multiple factors when studying singing behaviour.

Severe feather pecking and cannibalism by "friendly" hens

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Beak trimming is painful (sense organs and nerve cells are removed). After trimming neuromas may develop that lifelong cause phantom pains, touch stimuli may lifelong be experienced as pain stimuli. Selection against severe feather pecking and cannibalism is therefore urgently needed. Severe feather pecking is performed by particular individuals. These individuals must be selected out. A possible procedure is to put a hen of a line under selection (selection hen) in a cage with a hen of a line known for little severe feather pecking (standard hen). By establishing which standard hens did not survive it is possible to select out the severe feather pecking selection hens. Also feather scores may be used. Eventually a short fast may be introduced to induce severe feather pecking. When white and brown hens are used simultaneous selection on production traits is possible. This procedure does not imply time consuming behavioral observations. Therefore it may be used under commercial breeding conditions. In the Netherlands hens are selected against mortality, apparently under the assumption that severe feather pecking is a trait of all individuals. A common myth in the agricultural world is that severe feather peckers and cannibalists are "less friendly." Severe feather pecking and cannibalism should be the result of the pecking order. Selection for production traits should have caused selection for severe feather

pecking and cannibalism (aggressive hens should have easier access to the food). However, unselected pheasants and Burmese Red Jungle Fowl also perform severe feather pecking and cannibalism under suboptimal husbandry conditions. Further, aggression is always directed towards the head, severe feather pecking to other parts of the body. Flocks with much aggression do not necessarily have much severe feather pecking. This implies that severe feather pecking and cannibalism may be performed by "friendly" hens. I am afraid that this last method takes too much time because it is unnecessarily complicated.

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