Rodent Behaviour – Session 2

Cooperation among female house mice (*Mus musculus domesticus*) – a case study on social selection

Barbara König

University of Zurich, Department of Evolutionary Biology and Environmental Studies, Zurich, Switzerland, barbara.koenig@ieu.uzh.ch

Social selection is a specific case of natural selection in that an individual's fitness is not only determined by its own phenotype but also by the phenotype of its social partner. Social selection thus refers to any selection resulting from social interactions. Communal nursing in the house mouse is an example of cooperation where females pool litters in the same nest and indiscriminately nurse own and other offspring despite potential exploitation. The direct fitness benefits associated with communal nursing shown in laboratory studies suggest it to be a selected component of female house mice reproductive behaviour, involving choice of a social partner. Here using data from a long-term study of free-living, wild house mice we investigated individual nursing decisions and determined what factors influenced a female's decision to nurse communally. Females chose to nurse solitarily more often than expected by chance, but the likelihood of nursing solitarily decreased when females had more partners available. While finding no influence of pairwise relatedness on partner choice, we observed that females shared their social environment with genetically similar individuals, suggesting a female's home area consisted of related females, possibly facilitating the evolution of cooperation. Within such a home area females were more likely to cooperate when the general relatedness of her available options was relatively high. Females formed communal nests with females that were familiar through previous associations and had young pups of usually less than 5 days old. Social partner choice proved to be an integrated part of cooperation among females, and might allow females to reduce the conflict over number of offspring in a communal nest and milk investment towards own and other offspring. We suggest that social partner choice may be a general mechanism to stabilize costly cooperation.

Rodent Behaviour – Session 2

Rats provide help based on their need of their partner

Karin Schneeberger[1], Gregory Röder[2], Michael Taborsky[3]

[1]University of Potsdam, Germany, schneeberger@uni-potsdam.de
[2]University of Neuchatel, Switzerland
[3]University of Bern, Switzerland

When social partners exchange helpful acts reciprocally, increasing the benefit of the receiver can enhance its propensity to return a favour. Therefore, reciprocally cooperating animals should consider the relative benefit for the receiver when deciding to help a social partner. Norway rats (*Rattus norvegicus*) exchange food reciprocally during an experimental task. Here, we show that they thereby take both the cost of helping and the benefit for the receiver into account. Furthermore, they are able to determine the need of social partners solely by olfactory cues, providing stooges that smell hungry with more food than those that smell satiated. Using chemical analysis by GC-MS, we identified volatile organic compounds that differ in their abundance between hungry and satiated rats. Combined, this "smell of hunger" apparently serves as an honest signal of need in reciprocal cooperation, and thus facilitate the decision of an individual whom to help.

Rodent Behaviour – Session 2

Sex and reproductive state discrimination – are they innate or learned? Dwarf hamster species as a model

Nina Yu. Vasilieva, Irina Yu. Kolesnikova, Anastasia M. Khrushchova

A.N. Severtsov Institute of Ecology and Evolution, Russia, nyv1@yandex.ru

It is obvious that sex and reproductive state discrimination (defined as a preference of an opposite sex conspecific and a receptive female, respectively) are the key events in reproduction and serve an appropriate choice of the sexual partner. The experimental data indicate that animals from different taxonomic groups discriminate sex and breeding condition of a potential partner via chemical signals and prefer odors from an opposite sex conspecifics and receptive females. However, it is still unclear whether such behavioral responses are innate. This study was conducted to clarify this question. Three species of the *Phodopus* genus – the Djungarian hamsters (*Phodopus sungorus*) (SH), the Campbell's hamsters (*Phodopus campbelli*) (CH) and the desert hamsters (*Phodopus roborovskii*) (DH) were used as a suitable model group. The taxonomic distance between the three species differs. SH and CH are closely related and produce the hybrids, as DH differs significantly from them and never bread successfully with any of them. All three species demonstrate sex and reproductive state discrimination via conspecific urine. SH and CH may discriminate sex but not the reproductive state of closely related species. Males of both species demonstrated discrimination of females reproductive state after sexual experience with the heterospecific female. Neither of these species discriminates sex and the reproductive state of DH. Crossfostering hamsters of all three species demonstrate the preference of the odors of opposite sex donors of the foster species and could discriminate breading condition of a female. The data indicate that in dwarf hamsters the ability to discriminate sex and female reproductive state - dependent on a taxonomic distance between species - and that these behavioral patterns are not innate but learnt during an early postnatal ontogenesis.

Rodent Behaviour – Session 2

Habitat characteristics and species interference influence space use and nest-site occupancy: implications for social variation in two rodent sister species

Claire M.-S. Dufour[1], Guila Ganem[2], Neville Pillay[3], Nico L. Avenant[4]

[1]Institut of Evolutionnary Sciences Montpellier and Museum of Comparative Zoology, Department of Organismic and Evolutionary Biology, Harvard University, guila.ganem@umontpellier.fr
[2]Institut of evolutionnary Sciences, University of Montpellier, CNRS, IRD, Montpellier, France
[3]School of Animal, Plant and Environmental Sciences University of the Witwatersrand, Wits, South Africa
[4]Department of Mammalogy, Bloemfontein National Museum, Bloemfontein, South Africa

Nest-site selection is an important component of species socio-ecology, being a crucial factor in establishment of group living. Consequently, nest-site characteristics together with space-use proxies may reveal species social characteristics, a fact particularly interesting when direct observation of social interactions is hindered in nature. We used this approach to assess social variation between two sister species of a southern African rodent (*Rhabdomys bechuanae* and *Rhabdomys dilectus dilectus*) comparing patterns in allopatry and sympatry. Our results indicate that habitat preference and its impact on space-use and nest-site characteristics could act as an important driver of social divergence in our study models, and that interference between sister species could induce new ecological pressures that may influence their social evolution.

Rodent Behaviour – Session 2

Burrow system architecture and use by Thomas' pine vole, *Microtus thomasi* (*Rodentia*: *Arvicolinae*)

Eleni Rekouti[1], Pavlos Avramidis[2], Sofia Spanou[3], Stamatis Vougiouklakis[4], Sinos Giokas[1], George P. Mitsainas[1]

[1]Section of Animal Biology, Department of Biology, University of Patras, GR-26504 Patras, Greece, elrekouti@gmail.com
[2]Section of General, Marine Geology and Geodynamics, Department of Geology, University of Patras, GR-26504 Patras, Greece
[3]Section of Plant Biology, Department of Biology, University of Patras, GR-26504 Patras, Greece
[4]Department of Material Science, University of Patras, GR-26504 Patras, Greece

Microtus thomasi is a fossorial vole, endemic to SW Balkans, which uses a variety of substrates from sea level to high altitudes. Even though the remarkable chromosomal variability of this species is well-studied, very little is known regarding the vole's underground behaviour. This was the goal of this study, starting with the scholastic uncovering of eight burrow systems in different localities of NW Peloponnese, Greece. In particular, several measurement and notes were taken, regarding those burrow systems (e.g. total tunnel length, average tunnel width and depth, number of nests, food caches, soil mounds etc.) and their complexity was calculated in terms of Fractal Dimension, based on the box-counting method (e.g. the Fractal Dimensions of the least and the most complex systems were estimated to 1.1795 and 1.4787, respectively). Moreover, several key coordinates from these systems were recorded with a differential GPS device, allowing their detailed mapping, using the QGIS software. Soil samples from each studied site were used for particle size analysis and estimations of $CaCO_3$, TC, TOC, TN, H and TP content. Also, the vegetation type of each site was described. Our results showed in overall that extension and complexity of the vole's burrow systems are rather more correlated with food availability and neighbouring burrow system density in the regions where they occurred than with altitude or soil composition i.e. in areas with many other already established systems and/or restricted food availability smaller total lengths and more food caches were comparatively observed than in systems of scarcely populated areas and/or with ample food resources. In comparison to older studies, interesting differences were also recorded, regarding the social behaviour of voles that lived together in a single burrow system. Finally, an effort was made to statistically distinguish those parameters that influence the measured burrow system features of *Microtus thomasi*.

Rodent Behaviour – Session 2

Formation of reproductive isolation in hamsters (*Cricetinae*) in allopatry

Alexey V. Surov, Natalia Yu Feoktistova, Maria V. Kropotkina, Ekaterina V. Potashnikova, Anna V. Gureeva, Ekaterina V. Kuznetsova

A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences Moscow, Russia, Allocricetulus@gmail.com

According to the Dobzhansky-Muller model, in the absence of gene flow, conspecific populations can become reproductively isolated, and postzygotic isolation must increase in proportion to the square of the time elapsed since their divergence. On the example of pairs of allopatric species of subfamily *Cricetinae*, characterized by a different level of divergence, by behavioral and physiological methods we estimated the degree of formation of reproductive barriers. The potential prezygotic isolation was based on the results of behavioral tests with the exhibition of female olfactory stimuli to males. A crossbreeding was performed to detect postzygotic isolation. Divergence dates were estimated from molecular phylogenies. We found that complete reproductive isolation was formed in a pair of allopatric hamster species g. *Phodopus* - Roborovski and djungarian in about 5 million years. Sterility of F_1 males, conspecific preferences with minor differences in morphology of chromosomes was formed in djungarian hamsters and Campbell hamsters for 0.8 – 1 myr. In a pair of species, g. *Allocricetulus*, separated about 0.3-0.4 myr ago, postzygotic isolation mechanisms and conspecific preferences are already partly formed together with differences in the structure and number of chromosomes, although in laboratory we could obtaine fertile hybrids. In species (chromosomal forms) of *Cricetullus barabensis* sensu lato diverged later than a pair of *Allocricetulus* species (0.16 – 0.2 myr ago), reproductive barriers are less expressed. Thus, the example of close related species of subfamily *Cricetinae* shows that 1) reproductive barriers developing in allopatry more pronounced in species that last longer in isolation; 2) prezygotic barriers in allopatry can develop as fast as postzygotic ones, which makes the mechanism of "reinforcement" suggested by F.G. Dobzhansky (in case of secondary contact zones occurrence) to be not so actual. This study was supported by the Russian Science Foundation № 16-14-10269.

Rodent Behaviour – Session 2

Oxytocin regulates aggressive behavior in nucleus accumbens in great long-tailed hamsters

Xiuping Sun[1], Lixin Yan[1], Nan Zhang[1], Zuoxin Wang[2], Mingjing Song[3], Zhibin Zhang[4]

[1]Institute of Laboratory Animal Science, Beijing, China, songmj@ioz.ac.cn
[2]Department of Psychology and Program in Neuroscience, Florida State University, Tallahassee, FL 32306, USA
[3]Institute of Laboratory Animal Science, Beijing, China
[4]State Key Laboratory of Integrated Management of Pest Insects and Rodents, Institute of Zoology, Chinese Academy of Sciences, Beijing, China

Human and animal aggressive behavior has been an important research topic in psychology and sociology. Mounting evidence suggests that oxytocin (OXT) and OXT receptor (OXTR) maybe crucial mediators of aggressive behavior. OXT modulates the social behavior within several brain regions including the amygdala, septum, nucleus accumbens (NAcc) hypothalamic paraventricular nucleus (PVN) and supraoptic nucleus (SON). Our study showed that OXT and OXTR are present in high level in NAcc of the great long-tailed hamsters, which maybe contribute to their aggressive behaviors. We proposed that OXT expression and the activation of the OXT receptor (OTR) in NAcc are associated with levels of aggression behaviors of the hamster. To test this hypothesis, we increased OXT level of great long-tailed hamsters in NAcc by infusing exogenous OXT chronically and examined whether hamsters would show a decreased level of aggressive behavior. We found that the hamster group with exogenous OXT infused into the NAcc showed elevated social explorative behaviors. Moreover, both the duration of active attack behavior and the active attacks frequency of the OXT infused hamster group decreased significantly. Immunohistochemistry results showed that the numbers of c-fos-positive cells were significantly decreased in neurons of the NAcc region in the hamster group infused with OXT compared with the hamster group infused with the vehicle only (Cerebro-Spinal Fluid, CSF). In summary, we proved that the elevated OXT level within a certain range in the NAcc region of the great long-tailed hamster could decrease their aggressive behaviors significantly.