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Pheromone distinguishes termite royalty from worker castes

For eusocial insects, caste systems prescribe crucial social and reproductive division of labor. Nestmates primarily recognize one another and their roles within the colony via chemical communication. Termites use organic compounds to distinguish worker from royal castes and to coordinate activities needed to tend to the queen or king. Colin Funaro et al. (pp. 3888–3893) investigated royal recognition pheromones in termites, which evolved eusociality independently from Hymenoptera, an insect order in which pheromones are commonly studied. The authors analyzed cuticular compounds from *Reticulitermes flavipes*, a widespread North American termite species, and isolated the hydrocarbon heneicosane, which is unique to royals, as well as several long-chain alkanes enriched in royals, relative to workers. Using a glass dummy, the authors demonstrate that heneicosane elicits the same behavioral responses in worker termites as a live queen and that the responses are strengthened in the presence of worker cuticular extracts, highlighting the role of context-dependent signaling in the recognition of royals. The findings suggest that termites evolved royal recognition pheromones around 150 million years ago, approximately 50 million years earlier than Hymenoptera, according to the authors. — T.J.

Primary queen of *R. flavipes* with attendant workers. Image courtesy of Matt Bertone (North Carolina State University, Raleigh, NC).

Using mRNA-containing nanoparticles to reprogram cellular protein production

Messenger RNA (mRNA)-based therapeutics have shown promise for targeting hitherto intractable cellular targets. Lipid nanoparticles (LNPs) represent an established method for delivering mRNA into cells, but the approach is challenging. Using a range of biophysical techniques, Marianna Yanez Arteta et al. (pp. E3351–E3360) demonstrated that mRNA-containing LNPs have a disordered inverse hexagonal internal structure irrespective of their size, in contrast to the structure of LNPs without mRNA and previously reported structures of siRNA-containing LNPs. Lipids are not homogeneously distributed across the LNP, and one of the lipid components, distearoylphosphatidylcholine, is localized mainly to the surface of mRNA-containing LNPs. The authors varied LNP size and surface composition and found that size influences cellular protein production, but surface composition is a greater determinant of protein levels. The authors demonstrated the application of this discovery in two clinically relevant human cell types, adipocytes and hepatocytes, resulting in up to 50-fold increase in protein production in both cell types. The results suggest that the release of mRNA from the endosomal compartment, rather than LNP uptake, may be the limiting step in protein production. According to the authors, surface composition of LNPs plays a major role in transfection efficiency, and the findings could help design optimized nanoparticles for efficient mRNA delivery. — S.R.

Vocalization in nonhuman primates

Unraveling how nonhuman primates produce and use vocalizations could lend insight into the evolution of human communication. However, whether nonhuman primate vocalizations are volitional, similar to human speech, or bound to internal states, such as arousal, remains unclear. Diana Liao et al. (pp. 3978–3983) examined the relationship between arousal and vocalization in pair-bonded marmoset monkeys (*Callithrix jacchus*) in a variety of contexts in which physical distance was manipulated to excite different levels of arousal in the monkeys. The authors measured acoustic changes and used noninvasive electromyography to measure heart rate fluctuations—a measure of arousal—in the monkeys and found that monkey vocalization changed systematically with different distances between the monkeys. However, vocalization changes were also influenced by external factors, such as the timing of another monkey's vocalizations.

Common marmoset. Image courtesy of Flickr/Leszek Leszczynski.

The latter finding is contrary to the suggestion that changes in vocal production in monkeys are inextricably linked to arousal levels. According to the authors, the study suggests that, similar to human speech, both internal and external factors influence nonhuman primate vocal production. — C.S.

Mouse model of human pancreatic β-like cells

The autoimmune destruction of insulin-producing pancreatic β cells results in type 1 diabetes. Haiting Ma et al. (pp. 3924–3929) used orthotopic transplantation of stem cell-derived β cells into the pancreas of neonatal mice to develop an in vivo experimental model system of human pancreatic β cells. The authors successfully generated mice with human pancreatic β-like cells in the pancreas. The engrafted β-like cells recruited mouse endothelial cells and expressed several key transcription factors and markers associated with functional maturity. The authors also identified many other human cell types in the pancreas of transplanted mice, suggesting that these cell types could be explored in addition to β cells. Glucose-stimulated release of human insulin occurred for months after transplantation, suggesting that the human β cells that were engrafted into the mouse pancreas remained functional over many months after transplantation. The results indicate that orthotopic transplantation of human stem cell-derived β cells into neonatal mice can generate mice with human β-like cells in the pancreas. The authors suggest that the mouse model can serve as an experimental system to examine the biology and pathology of human pancreatic β cells in vivo and could help develop therapeutic and preventative strategies against type 1 diabetes. — S.R.

Amphibian diversity and habitat modification

Humans have altered natural environments around the globe, precipitating biodiversity loss and restructuring species assemblages. However, how habitat conversion affects the evolutionary history of species assemblages remains understudied. A. Justin Nowakowski et al. (pp. E3454–E3462) used data from 48 studies, which included 438 amphibian species across five continents, to examine the phylogenetic diversity of amphibians in natural and human-altered environments. Using a time-calibrated phylogenetic tree, the authors found that amphibian phylogenetic similarity correlated with species responses to habitat conversion, such that converted habitats supported species within the same taxonomic clades. Habitat conversion was associated with high species and lineage turnover that resulted in global phylogenetic homogenization, indicating that diverse amphibian species in natural habitats were replaced by amphibians from the same phylogenetic clades in converted habitats worldwide. The effect was pronounced in lowland tropical regions, where the authors propose that such patterns might be due to the large number of specialized species in the tropics. On average, habitat conversion resulted in a 13.5% decrease in phylogenetic diversity. According to the authors, the findings might aid conservation planning strategies. — C.S.

***Dendropsophus ebraccatus* and closely related species tend to persist in converted habitats.**