Cross-fostering experiment reveals genetic basis of mouse communication

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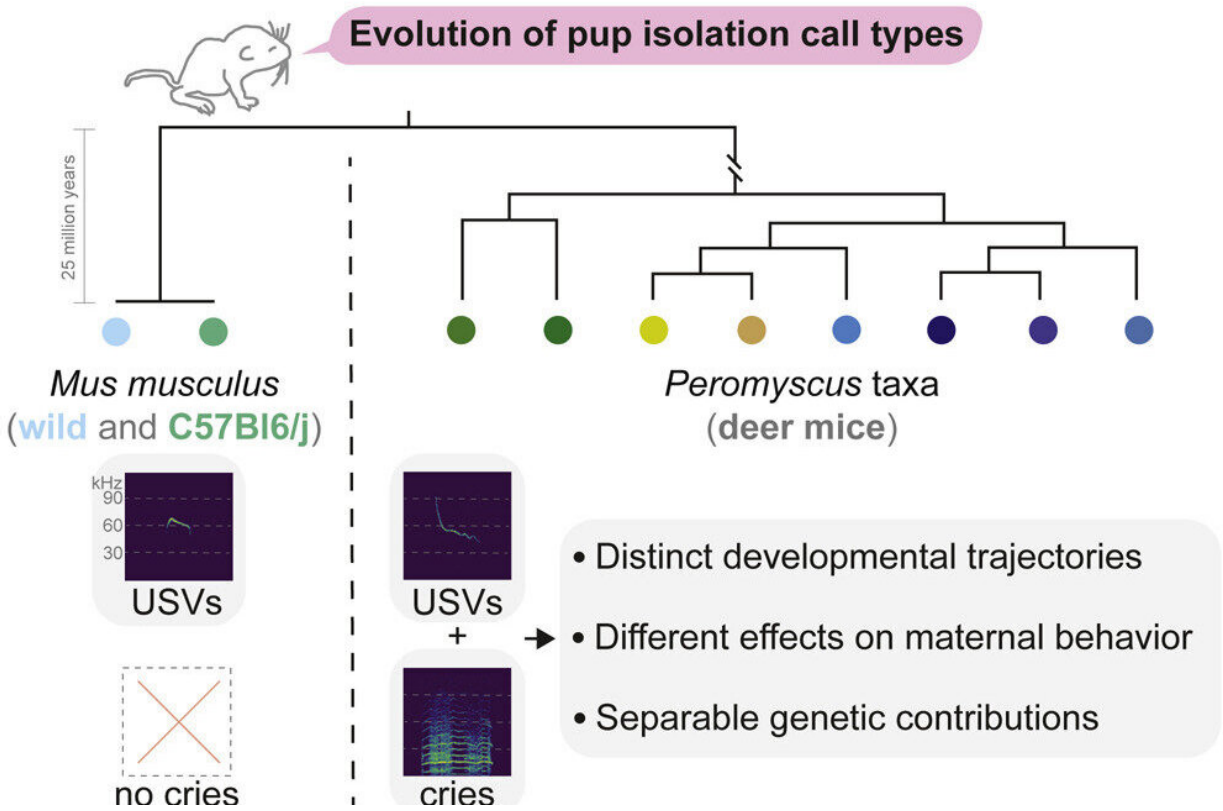

Graphical abstract. Credit: *Current Biology* (2023). DOI: 10.1016/j.cub.2023.02.045

Vocal behaviors in animals are highly conserved, though specific vocalization features can vary within and between species. There are big questions about environmental influences, genetic inheritability, and

social learning aspects around the evolution of these communications.

Postdoctoral Researcher Nicholas Jourjine at Harvard University and colleagues remotely recorded and analyzed the vocalizations of nearly 600 mouse pups to better understand what mice were saying and why. The study has been published in the journal *Current Biology*.

Using automated computational tools to cluster vocalizations into distinct acoustic categories, researchers compared calls of deer mouse pups across neonatal development in eight subspecies within the genus Peromyscus. Additionally, they collected data from laboratory mice and wild house mice.

Whereas both deer mouse and lab mouse pups produced ultrasonic vocalizations, deer mouse pups also made a second call type with acoustic features, temporal rhythms, and developmental trajectories that were distinct from those of ultrasonic vocalizations. These low-frequency tonal "cries" were mostly used in the first nine days of life, while ultrasonic vocalizations were primarily heard after.

Researchers played back the recorded pup cries and found that deer mouse mothers reacted significantly faster and moved more quickly when investigating the low-frequency tonal cries than the ultrasonic vocalizations. Researchers suggest that the tonal cries are specific to eliciting urgent parental care early in neonatal development.

To find out if the features of deer mouse cries and ultrasonic vocalizations were learned or strictly genetic traits, researchers pulled a switcheroo, or cross-foster experiment, between two deer mouse sister species. When pup litters from both species were born on the same day, researchers switched the parents, then recorded the pups nine days later and compared the recordings to litters from each species that were not exchanged.

Cross-fostering did not affect the rate, mean frequency, or duration of the pups' low-frequency cries, suggesting a strong genetic basis. A similar pattern emerged with the ultrasonic vocalizations, except one pup group altered their vocalizations to be closer to that of the foster parent, suggesting that some acoustic features may be sensitive to a parental environment.

Using hybrid crosses between the two sister species, the study found that variation in vocalization rate, duration, and pitch display different degrees of genetic dominance. Cry and ultrasonic vocalization features were found to be separated or merged in second-generation hybrids with different combinations of parent species genes, illustrating that vocalization types are controlled by separate inherited genes.

Unlike the deer mice, isolated lab mice pups almost exclusively vocalized in the ultrasonic range, making the researchers wonder if domestication had reduced the vocal repertoire of laboratory mice (Mus musculus). Using a unique experimental population of wild, free-living Mus musculus, they tested the vocal range of their pup cries.

They found the features largely resembled the ultrasonic vocalizations of the laboratory Mus musculus. Aside from showing domestication has not significantly altered lab mouse communication, it also confirms that the presence of cry vocalizations in deer mice is likely the result of evolutionary divergence in wild populations since their last common ancestor 25 to 40 million years ago.

More information: Nicholas Jourjine et al, Two pup vocalization types are genetically and functionally separable in deer mice, *Current Biology* (2023). DOI: 10.1016/j.cub.2023.02.045