Research group maps receptors in mouse vomeronasal organ

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(PhysOrg.com) -- Science is more often than not a field where very small steps in progress are the norm. Researchers can toil away for years on projects that to some might seem trivial; but it's these small steps by many that lead to big breakthroughs by the few. Nowhere is this more apparent than in neuroscience. Trying to understand how the myriad of nerve cells that exist in living creatures do what they do is like trying to understand the intricacies of love, or the actions of individual molecules in a vast ocean. One example of this is Catherine Dulac, Professor of Molecular and Cellular Biology at Harvard University and Howard Hughes Medical Institute Investigator. Fifteen years ago, she and a group of colleagues discovered the first receptor genes; now she and a new group have developed a way to show which individual sensors in the vomeronasal organ respond to which chemicals. The team has published its results in the journal *Nature*.

The vomeronasal organ resides in the snout of mice (and other animals) and serves as a sort of focal point for dealing quickly with odors sucked in through the nostrils. Because mice are food for such a large variety of other animals, they need to be able to sift through the various chemicals found in the air they breathe and then to react quickly so as to take appropriate action. Thus, the vomeronasal organ is sort of like a pre-processor. Inside of it are thousands of receptors, each designed to react to a different chemical. Once a chemical is detected, that information is immediately sent to the brain so the mouse can decide to run, hide, try to find its source or whatever else is deemed appropriate.

The problem has been in figuring out which receptors react to which chemicals. Now Dulac and her team have figured out a way to do just that, and in so doing have uncovered some surprising results.

To show which receptors were reacting to a specific chemical, the team found a way to mark the individual neurons with a compound that caused the receptor to glow when it was activated. Thus, they could actually watch as a chemical was sensed by noting which receptors lit up. By introducing various chemicals they were able to create a map of sorts showing which receptors react to what.

One thing the team expected to find were lots of receptors reacting to odors of mice of the opposite gender; after all, reproduction for mice, like all other animals, is pretty important for survival of the species. They did find a lot of such receptors, but their numbers were paltry in comparison with the numbers and variety of receptors that reacted to odors from different species, suggesting that for mice at least, being able to figure out who is around, might be more important than mating.

More information: Molecular organization of vomeronasal chemoreception, *Nature* (2011) doi:10.1038/nature10437

Abstract
The vomeronasal organ (VNO) has a key role in mediating the social and defensive responses of many terrestrial vertebrates to species- and sex-specific chemosignals1. More than 250 putative pheromone receptors have been identified in the mouse VNO2, 3, but the nature of the signals detected by individual VNO receptors has not yet been elucidated. To gain insight into the molecular logic of VNO detection leading to mating, aggression or defensive responses, we sought to uncover the response profiles of individual vomeronasal receptors to a wide range of animal cues. Here we describe the repertoire of behaviourally and physiologically relevant stimuli detected by a large number of individual

vomeronasal receptors in mice, and define a global map of vomeronasal signal detection. We demonstrate that the two classes (V1R and V2R) of vomeronasal receptors use fundamentally different strategies to encode chemosensory information, and that distinct receptor subfamilies have evolved towards the specific recognition of certain animal groups or chemical structures. The association of large subsets of vomeronasal receptors with cognate, ethologically and physiologically relevant stimuli establishes the molecular foundation of vomeronasal information coding, and opens new avenues for further investigating the neural mechanisms underlying behaviour specificity.