Olfaction and pheromonal communication in vertebrates: an introduction.

As humans, we think of scents as airborne volatile odorants detected through the main olfactory system. However, most other tetrapod vertebrates also detect scents through the vomeronasal system (VNS) when animals make nasal contact with a scent source, a system that responds to involatile proteins and peptides as well as to volatile pheromones. One of the main challenges for the future is to understand the complementary roles of these two olfactory systems and how they interact to allow the efficient detection, analysis and subsequent recognition of familiar scent signals to regulate social behaviour. Mammalian chemosignals are typically very complex, providing information on fixed genetic identity (species, sex, individual, kinship) as well as variable status (reproductive, social, health). Further, multiple sources including specialised scent glands as well as urine, faeces, saliva and tears, each provide different scents. The discovery of three separate multigene families encoding highly polymorphic communication proteins in mice, each with specific receptors, promises to allow a detailed understanding of how animals recognise and assess conspecifics to regulate complex social behaviours, and the neurophysiological pathways involved. Receptors for MHC peptide ligands in both systems may provide a common mechanism for assessing MHC-type across vertebrates, although the presence and stability of such peptides in scents remains to be characterised. Major urinary proteins (MUPs) provide a species-specific, persistent chemosignal in mouse urine detected through the VNS that underlies sex, individual, heterozygosity and kin recognition between adults, while the binding of volatile pheromones by MUPs directly links information on individual identity and status. Sex and strain-specific expression of exocrine gland secreting proteins (ESPs) released in tear fluid provides separate genetic identity information during close investigation of the facial region. Understanding why there are multiple sources of separate information and how this is integrated is another major challenge.

Inbred and gene-targeted mice provide very powerful tools for such research. However, the extreme loss of genetic variation, abnormal selection and social experience in such animals introduce serious confounds for interpreting the functional significance of responses. Approaches that integrate the functional significance of signals and social responses in wild mice with genetic manipulations to address mechanisms will be
essential for advancing this field.

Further references: