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The Chemosensory World of Pets

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The Chemosensory World of Pets

by Leslie J. Stein, Ph.D.

Cats and dogs are a source of comfort and companionship to many of us; there are currently over 72.6 million cats and 58.5 million dogs living in US households. Pets often are regarded as "part of the family," and owners go to great extent to keep their pets happy. Yet, even though humans are dedicated to our pets, we are also often perplexed by their behavior. Finicky eating habits, odor production, and anti-social behavior are just a few of the problems that can frustrate even the most well-intentioned pet owner.

As is often the case, pet behavior can be better understood by considering the world from their point of view. The chemosensory world of pets, in particular, is in many ways different from ours, and reflects their differing evolutionary origins. Both dogs and cats are disposed to detect odors and tastes associated with meat. Cats are among the most committed meat eaters of all the carnivores, and their taste buds are particularly responsive to amino acids. On the other hand, research conducted at Monell in the 1970's by Dr. Gary Beauchamp demonstrated that cats can't even taste sweet sugars. And, because meat provides a plentiful source of sodium, cats have a poorly-developed sodium appetite and are relatively insensitive to salt. While dogs are also carnivorous, they ingest a wider range of foods and appear to have receptors sensitive to sweet carbohydrates. Dog taste buds are also responsive to amino acids, but the distribution of sensitivity differs from that of the cat.

> **"Every animal lives in its own sensory world."**
> Dr. M.R. Kare, founder of Monell.

When compared to humans, olfaction is particularly important to dogs and cats. Cats are solitary creatures. They use olfactory signals to mark territories and avoid surprise meetings, relying primarily on visual signals (the domestic cat has at least 9 facial expressions and 16 different tail and body postures) to communicate at close range. In contrast, dogs are social animals, and olfactory communication is important to their social nature. Dogs use olfactory information for individual recognition, to maintain affiliations, and to reduce competition.

Advanced technology is helping chemists to identify and synthesize the specific compounds pets use for marking behavior and for individual recognition purposes. This information could be useful in developing deterrents to urine marking behavior and specific antagonists or blockers for urine odor. It may even be possible to directly influence pet social behavior, including reducing antagonistic behavior in cohabiting pets, decreasing aggressive behavior in dogs or even increasing affection from aloof cats!

As in many other vertebrate species, pheromones are most likely involved in the reproductive behavior and territory marking of both cats and dogs. In certain species, some pheromones are detected with the vomeronasal organ. Cat owners are probably familiar with the facial response known as flehmen, consisting of an elevation of the upper lip and a slight opening of the mouth. This behavior, often seen in response to urine, is thought to facilitate transport of chemical stimuli, including, perhaps, pheromones, into the vomeronasal organ. Currently, almost nothing is known of the stimuli, physiology, or function of the vomeronasal organ in either cats or dogs, including whether this chemical sensing organ detects pheromones.

Olfaction plays an important role in food selection by both cats and dogs, but specific knowledge of this sensory system is still incomplete. Even less is known about the canine and feline taste systems. Pet owners spent $9.9 billion on dog and cat food in 1998, an expenditure that is likely to grow as more detailed information on pet sensory systems leads to the development of specialized dietary products. For example, studies in humans, many conducted at Monell, have revealed profound effects of aging on olfactory function, mediated in part by degenerative changes. Such changes are often accompanied by functional declines of dietary intake and nutritional status. Detailed information about olfactory capabilities of aging pets, and how the aging olfactory system interacts with other sensory systems, may permit new strategies to encourage good eating habits and maintain nutritional status in aging animals.

> **Adding a preferred odor to a neutral food increases food intake and can stimulate resumption of a meal after eating has stopped.**

> **Increasing knowledge of the chemical senses will help open the doors into the world inhabited by our pets.**

Similar information on the effects of illness, trauma, and various medications on pet chemosensory function will lead to the availability of specific approaches to encourage and maintain healthy eating habits. Identification of specific blockers to unpleasant tastes and identification of attractive flavors will facilitate administration of medication — a difficult and unpleasant task for both pet and owner — and may help to encourage eating behavior or nutritional supplementation in ill and recovering animals.

Advances in molecular biology are increasing knowledge of pet chemosensation in many ways. Olfactory receptor genes have been characterized from the dog, and are very similar to human olfactory receptor genes. Dogs, however, appear to have many more functional receptors than do humans. Interestingly, the number of olfactory receptor genes appears to be stable across breeds, regardless of whether the breed is specifically known for its olfactory acuity (for example, scent hounds) or not (sight hounds or toy breeds). Once genes for taste receptors are identified, this information may open the doors to developing in vitro (test tube) assays to test new flavors.

Information on individual differences in taste and olfactory sensitivity can explain differing effects of odors and tastes on pet

A Will to Live

by Ursula Wagener and Marvin Lazerson

On January 2, 1995, VHUP's Dr. Dottie Brown saved our cat Rexina's life. Rex had fallen from an icy tree, severing her spinal column. Dr. Brown managed to fuse the column, although the spinal cord itself was severely damaged, resulting in hind leg paralysis.

We were devastated by Rexina's paralysis, but determined to help her live as fully as possible. We learned to express her bladder two to three times daily, able to do so with a minimum of fuss and even some humor. Using a sling under her belly, we learned to walk her around the neighborhood, sometimes for up to an hour as she explored her old haunts. Rex's determination and will to live inspired us. She learned to crawl, using only her front legs, leaping off beds and down stairs whenever she felt like it.

Over the next six years, our family and friends wondered about this strange couple who insisted on caring for their physically challenged cat, while we reshaped our schedules to accommodate Rex's needs. Often uncomfortable in Rexina's handicapped presence, their presumption was that Rex was lucky to have us.

What we discovered was how lucky we were to have Rex. She helped us discover a group of wonderful animal lovers who lived in our house and shared in Rex's care when we had to be away.

She also taught us how to respond to adversity, remaining as feisty during the years of disability as she had always been on four legs. She demanded food when she wanted it, crawled to the door when she thought it was time to go out-and kept us out exploring as long as the mood hit her. Just as she had before the injury, she hissed and swiped with her claws when she did not want to be bothered and continued to terrorize the veterinarians and staff at the Chestnut Hill Cat Clinic.

Most of all Rex taught us to give love unconditionally, teaching us a love unconstrained by the contractual arrangements and negotiations that so shape human relationships. Rex was never going to "get better." She was never going to be anybody else's idea of the right cat. She challenged us to throw away old rules about when to "put the animal down," a euphemism we came to hate.

Rexina gave us more than we could have ever imagined, an enthusiasm for living and giving, an optimism about the possibilities of each day, a joy in making every event a celebration and an ode to life. We loved her immeasurably, but the love she gave us in return was just as great.

At age 14, Rex died on August 4, 2000 in the small animal clinic at the University of Munich, Germany. A large abdominal hernia required surgery and she never recovered from it. She was a once-in-a-lifetime occurrence — the cat who taught us about courage and how to live life more fully.

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behavior. Studies using rodents at Monell and elsewhere have revealed prominent genetically-based strain differences in taste sensitivity, and it is likely that such differences also exist in dogs and cats. Increasing knowledge of differences in taste sensitivity and the effects of taste mixtures on perception may help manufacturers come up with palatable foods that can be readily accepted by particular breeds. Genetically-determined differences in susceptibility to diet-induced obesity have been described in laboratory species and are most likely present in pet animals. In fact, obesity is currently the most common nutritional disease affecting dogs (and cats), with some breeds, such as Labrador retriever, terrier, spaniel, dachshund, basset hound, and beagle, among the most commonly affected.

Food and flavor preferences in humans are determined in large part by experience, and experience also influences the food preferences of pets. Our ability to understand our companion animals and the unique worlds they live in will increase as scientists continue to explore and decipher the chemical senses.

Do species and strain differences — or aging — influence how chemosensory-mediated cephalic reflexes affect food metabolism and digestive function of pets?

Dr. Stein is a Senior Research Associate at the Monell Chemical Senses Center in Philadelphia, where she edits Monell's newsletter, The Monell Connection. *This article is reprinted from the publication.*

The Monell Center is a nonprofit basic research institute dedicated exclusively to the study of taste, smell, and chemosensory irritation. Researchers at Monell work with scientists from government, industry and academia to explore the chemical senses at at every level, from molecular to behavioral. Dr. Stein's current research explores the role of experience in the development of taste preferences in children and adults.