

# Tuning of cortical neurons to behaviorally salient acoustic signals

Your pet cat has run off somewhere. It's time to feed her, but she is nowhere to be found. You call for her, but she doesn't come. It's not the first time that this has happened. You wonder whether your cat is just playing hard to get, or perhaps she is just not neurally equipped to recognize and respond to your voice. Indeed, many animal species seem to depend on species-specific communication sounds for survival and social interactions. These acoustic signals are often unique and they can carry behaviorally relevant information that needs to be preferentially and expeditiously processed within the auditory system. A central issue in sensory neurophysiology is understanding how the auditory cortex differentially processes sounds that carry behavioral relevance to a specific species. Do auditory cortical neurons of some animal species respond more strongly to communication sounds produced by members of the same species as compared with sounds emanating from members of other species?

A study by Wang and Kadia [1] has confirmed this hypothesis. They obtained multi-unit extracellular recordings from the primary auditory cortices (area A1) of anesthetized cats and marmosets during audio playback of taped marmoset twitter calls. Marmosets are highly vocal primates that use twitter calls as part of their intra-species communicative repertoire during social interactions. These twitter calls consist of series of 'phrases' and they can be presented in a natural or reversed version, with the latter composed of

reversed time courses of their amplitudes. In contrast to natural twitter calls, reversed marmoset calls have no behavioral relevance for cats and marmosets. Wang and Kadia reasoned that, because cats never encounter marmoset vocalizations in their acoustic environments, their auditory cortical neurons should fire less briskly when presented with marmoset twitter calls. By measuring the firing rates of A1 neurons, they found that neurons in cat A1 showed no preference for either natural or reversed marmoset calls. In contrast, neurons in marmoset A1 showed higher firing rates for natural, but not for reversed, marmoset calls. On average, marmoset A1 neurons showed mean firing rates that were twice as high as those of cat A1 neurons in response to natural twitter calls. Marmoset and cat A1 neurons responded about equally to time-reversed twitter calls, indicating that the auditory cortices in both species are capable of responding to sounds containing the acoustic complexities found in marmoset twitter calls. The authors concluded that marmoset A1 neurons displayed greater selectivity in their responses to natural marmoset calls than cat A1 neurons. Thus, species-specific, and perhaps also experience-dependent, mechanisms contribute to the processing of behaviorally relevant sounds in the auditory cortex of marmosets.

These findings suggest the existence of species-specific neural mechanisms operating within the cerebral cortex to fine-tune the responsiveness of neurons to

specific temporal patterns of stimuli. It is not yet clear whether additional factors, such as development and behavioral-sensory experience, play important roles in setting the neural template for the type of differential plasticity reported by Wang and Kadia. Numerous studies by M. Merzenich, A. Doupe and their colleagues have shown that other cortical areas, outside of A1, can display experience-dependent plasticity in their representational properties. It is not clear whether the neural circuitry within A1 is developmentally preprogrammed to selectively respond to vocal sounds of members of the same species. Experience probably plays a pivotal role in setting the response selectivity filters of A1 neurons.

It would be interesting to test whether the species-specific responsiveness of A1 neurons can be 'reprogrammed' by repeated exposure to communication sounds emanating from members of other species. Also, on the cognitive level, does preferential firing of A1 neurons in response to intra-species vocal sounds encode intra-species recognition? On a less esoteric note, the answers to these questions might be gainfully applied to vocally coax uncooperative pets.

1 Wang, X. and Kadia, S.A. (2001) Differential representation of species-specific primate vocalizations in the auditory cortices of marmoset and cat. *J. Neurophysiol.* 86, 2616–2620

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# Neurogenetics: white matter matters

A group of inherited syndromes characterized by progressive muscle weakness and atrophy and sensory dysfunction, collectively referred to as Charcot-Marie-Tooth disease (CMT), has proven to be a hotbed for the identification of novel genetic mutations. CMT syndromes are unusually common, affecting one in every 2200 people. They can be dominant, recessive or X-linked, and involve demyelination and axonal damage. In two recent articles, Baxter *et al.* [1] and

Cuesta *et al.* [2] identify the genetic defect responsible for a novel recessive CMT syndrome called CMT4A. The defect responsible for CMT4A was mapped to chromosome 8, and mutations in the gene encoding ganglioside-induced differentiation-associated protein-1 (*GDAP1*) were established as the disease-causing alterations. *GDAP1* is expressed in both the PNS and CNS where it can be present at particularly high levels in Schwann cells and oligodendrocytes;

levels increase during development and are highest in the adult. *GDAP1* encodes a protein with two transmembrane domains and a region that contains a glutathione S transferase (GST) domain. GSTs are known to function in antioxidant pathways and in detoxification, and *GDAP1* appears to contain a glutathione-binding site in a thioredoxin-like fold domain adjacent to an alpha-helical domain that might recognize xenobiotic substrates. Its presumptive antioxidant/detoxification