Genetic basis of vocal communication and its importance for dog domestication

Wolves, coyotes and jackals are the close relatives of domestic dogs, but they remain wild while the dog is "man's best friend". Although studies on dog behavioral evolution have been conducted for many years, its genetic basis still remains poorly understood. Voice signals play an important role in vocal communication of many species of animals. Among mammals, the domestic dog is particularly interesting because its vocal repertoire has undergone significant changes during domestication. Barking is the "normal" behavior of dogs and an important means of communication. For example, dogs can bark to respond to other dogs or when communicating with their human owners. Humans, even without experience in having dogs, are able to identify the context of barking dogs based on the recording, which indicates the important role of vocal signals in communication between dogs and humans. Barking is a typical behavior of most dog breeds, but some do not display this type of vocal communication. In breeds from “ancient” group such as Basenji or New Guinea Singing Dog (NGSD), vocal capabilities are completely congruent with wolves' vocal behavior - they squeak and whine, howl, and have a welcome/joy signal, which is referred to as firing in Basenji and singing in NGSD. All of them can produce a single, sharp sound resembling a partial barking - this sound is referred to as the "vocal reaction of surprise". However, it is never a full, single bark. A similar sound is issued by wild wolves in the same situations, although their pups may also “bark”, especially when playing. In the “ancient” dog group there are also breeds that can bark, but they do it rarely and reluctantly, for example, Siberian Husky, Chow Chow or Shar Pei. The most well-known group of genes affecting vocal communication are the *FoxP* (*forkhead box P*) genes. Mutations in the *FoxP2* gene are responsible for some cases of verbal dyspraxia (difficulty to produce correct speech sounds) in humans. Patients with this disease are practically incapable of speaking, even though they do not suffer from hearing impairments, and their larynx and vocal cords are well-formed. Disorders associated with speaking and understanding words are not accompanied by a significant reduction in intelligence. *FoxP* genes are also found in other animals, and their coding sequences are very conservative. *FoxP* gene products are transcription factors that regulate the expression of many target genes and influence the embryonic development of speech and language areas of the brain. *FoxP* genes also influence the development and learning of song in birds. In model organisms (human, mouse) *FoxP* genes have several promoters and their mRNA have undergone alternative splicing, which causes each gene to have 20-25 transcripts. In dogs, only 1-7 transcripts have been described for each gene so far. Gene expression is regulated by promoters: sequences of 500-1000 nucleotides long localized before the gene transcription start site to which transcription factors can bind. Changes in the promoter sequence may lead to change in the transcription factors that bind to it, which in turn may lead to change in the rate, place and time of gene transcription. We hypothesize that changes in the rate, location and time of transcription determine the changes in vocal communication and were a subject to selection during dog domestication (main hypothesis). In the proposed project, which aims to assess the impact of *FoxP* genes and the genes they regulate on vocal communication and domestication, we plan to use three groups of dogs: non-barking, barely barking and well barking, as well as grey wolves. We predict that changing promoter sequences and/or coding sequences of *FoxP* genes will cause changes in the transcription of these genes, as well as changes in the gene regulation network leading to changes in canine voice communication, and that wolves and non-barking dog breeds show the same genetic pattern as opposed to well-barking breeds. This will be the first research that will give an insight into the *FoxP* gene regulation network and the impact of *FoxP* genes on canine vocal communication.