Social learning of risk recognition in wild birds

Predation risk is one of the strongest selective pressures in nature. To counter the risk of predation, animals have evolved a range of mechanisms allowing them to assess that risk and adjust the behavior. Risk recognition can occur via various sensory modes, including reliance on acoustic cues produced by predators. Eavesdropping on predator vocalizations for risk assessment is ubiquitous in animals, affecting e.g. breeding site selection decisions and many life-history traits of a prey. This is not surprising given that acoustic signals are often audible and publicly available, thus facilitate risk assessment by a prey through eavesdropping. However, there is a fundamental and still unresolved question regarding this phenomenon: how animals recognize that specific sounds convey information about a threat?

Here, we propose that animals can learn socially to recognize putative predator calls via acoustic-acoustic association, that is, by associating the novel, unfamiliar sounds with alarm calls of conspecifics, without even having to see the conspecific tutors or a predator. Our recent study shows that wood warblers (*Phylloscopus sibilatrix*) – small songbirds inhabiting temperate forests – can learn this way to recognize novel, complex sounds as a threat. Thus, social learning via acoustic-acoustic association may provide a potentially effective mechanism through which animals can learn auditory recognition of predators. In this project, we build on these results and propose a set of field experiments aiming to further explore learning of risk recognition via acoustic-acoustic association in wild birds, using wood warbler as a model species.

To be effective, any learned behavior needs to be memorized for later use, but there is a gap in the current understanding of maintenance of socially-acquired predator recognition in non-primate animals. The first objective of our project is to fill this gap and test whether the response to putative predator calls learned socially via acoustic-acoustic association is retained for a long, ecologically-relevant period. In the second objective, we will test whether birds can learn socially to recognize different levels of risk posed by putative predators based on differences in anti-predator responses of conspecific tutors. Risk-sensitive behavior is widespread in animals and constitute a fundamental basis of efficient predator avoidance in multi-predator environments. However, it remains to be shown whether wild birds can learn socially risk-sensitive predator recognition. Finally, we will explore constraints on learning via acoustic-acoustic association under natural conditions. Acoustic signals propagating through the environment undergo attenuation and degradation, both affecting signals' recognition and detection. Thus, spatial distribution of individuals within population will likely be a key factor affecting the possibilities for, and extent of, information transfer and learning based on acoustic cues in the wild. However, the challenges for social learning of risk recognition under natural conditions remain virtually unknown, because most studies have been conducted in captivity. Thus, the third objective of our project is to test how spatial distance between territories of conspecific neighbors during the breeding season affects eavesdropping on alarm calls and in turn the possibilities for social learning of risk via acoustic-acoustic association.

Results of our project will significantly expand the current understanding of, and open new pathways for studying, "information webs" within avian communities. The project will provide novel findings on social transmission of behaviors within animal populations, in an ecologically-relevant context that is tightly linked to fitness. Social learning is the cornerstone of animal traditions and culture – results of this project will add novel insights into these phenomena. The results will also be important in the applied context. Reintroductions and translocations are increasingly important conservation actions, but often fails because of high mortality of individuals due to predation. Learning through acoustic-acoustic association may be a simple and efficient tool for training captive-bred animals to avoid predators before release to the wild. However, for its successful application in conservation actions, comprehensive understanding of this mechanism is essential.