# Sensory drive in the era of artificial intelligence: new tools for new experiments

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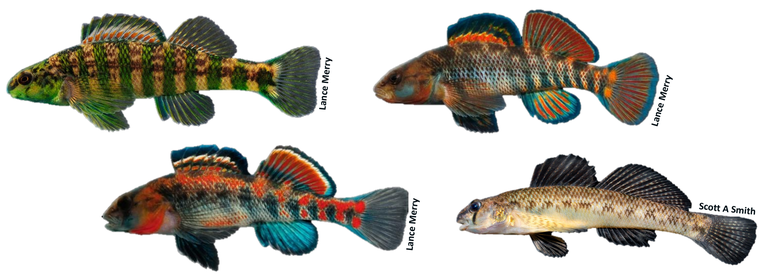
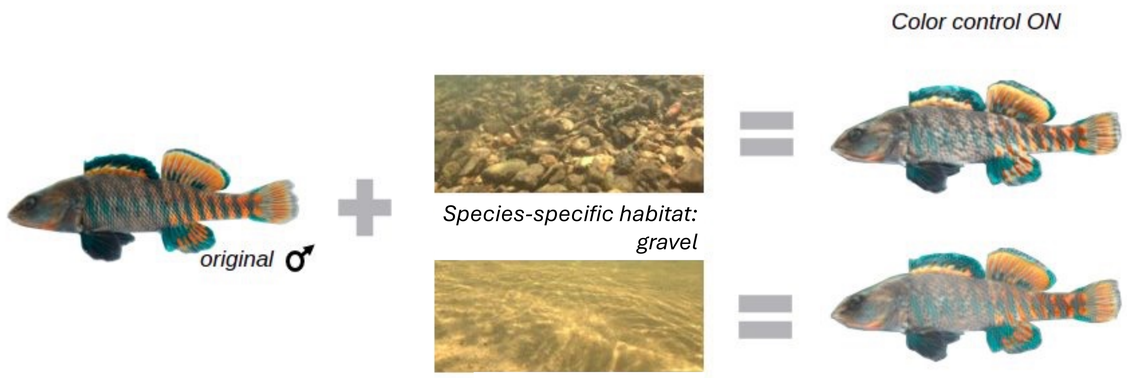


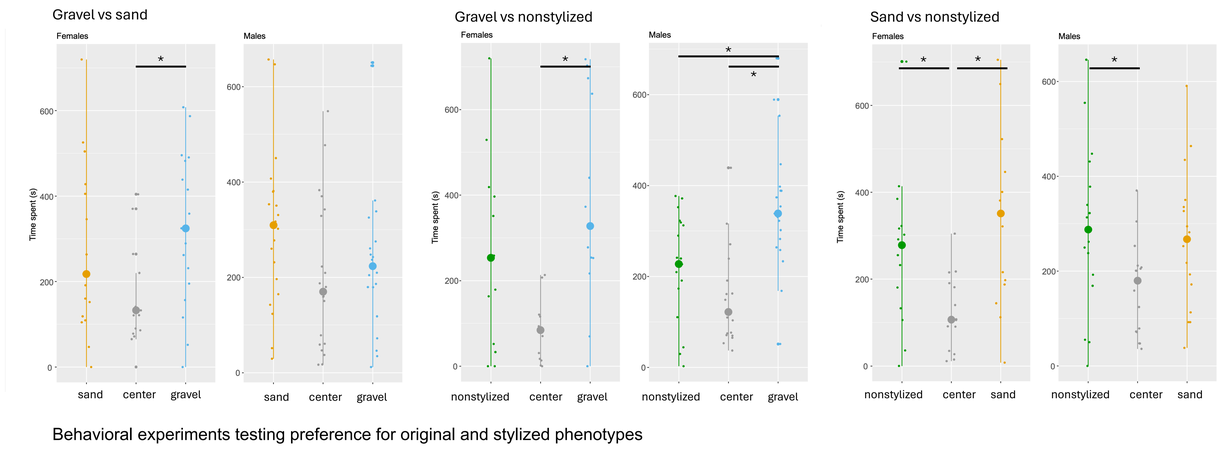

**Sensory drive** suggests that the need to be conspicuous leads to the evolution of different signals in different environments. Most supporting evidence comes from studies investigating the link between one feature of an animal signal design (e.g., coloration) and the corresponding physical characteristic in the environment (e.g., color of ambient light).

**Processing bias** suggests that, beyond detection, the ease with which a signal will be processed by efficient brains should also determine its evolutionary trajectory. Signals that mimic the characteristics of a species' habitat, to which sensory systems are adapted, could also elicit attractiveness, which could explain the evolution of complex signal designs in animal communication.

Here we present three different applications of **artificial intelligence** that test predictions of sensory drive and processing bias, asking whether sexual signals in *Etheostoma*, a diverse genus of colored freshwater fishes, mimic the underlying patterns of their habitat and whether the fish prefer these patterns. We illustrate how AI can be leveraged to test predictions of sensory drive while overcoming current limitations, here the one-trait approach, thereby demonstrating its generalizability.

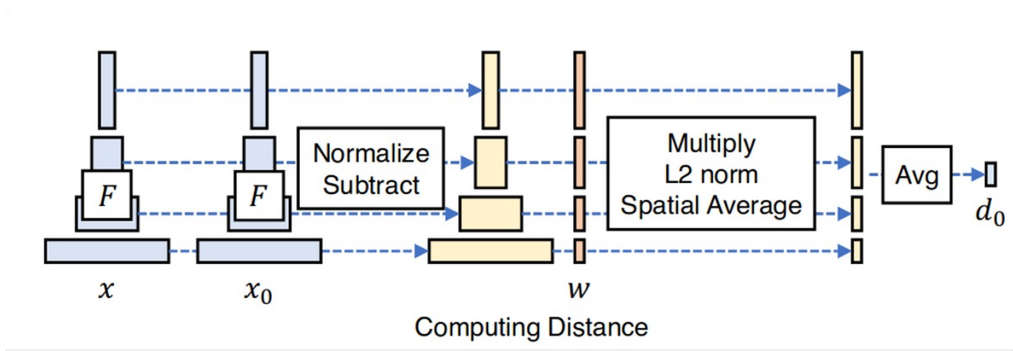
## I. Neural Style Transfer: Generating new global phenotypes without focusing on a single feature



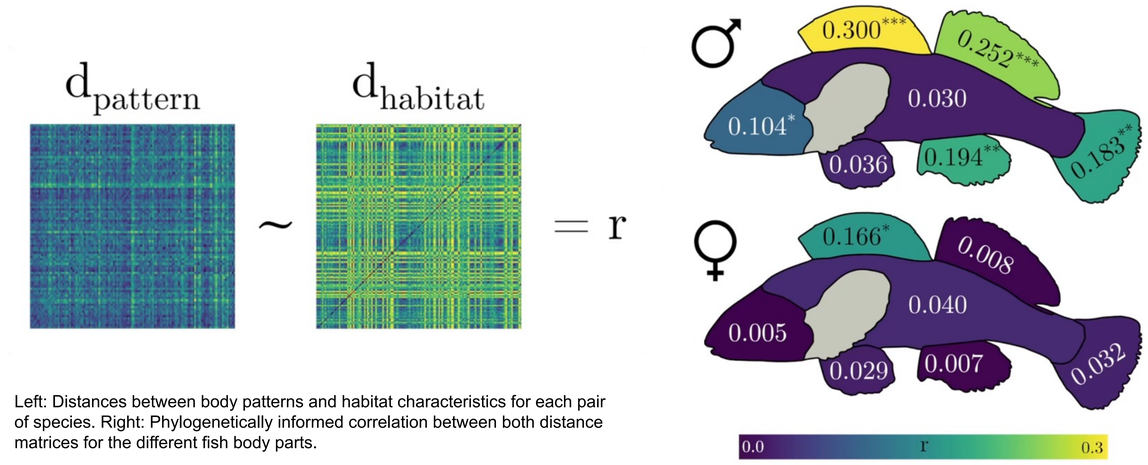




Behavioral experiments testing preference for original and stylized phenotypes

## II. Perceptual distance: Determining whether habitat similarity drives phenotypic similarity across species of *Etheostoma*

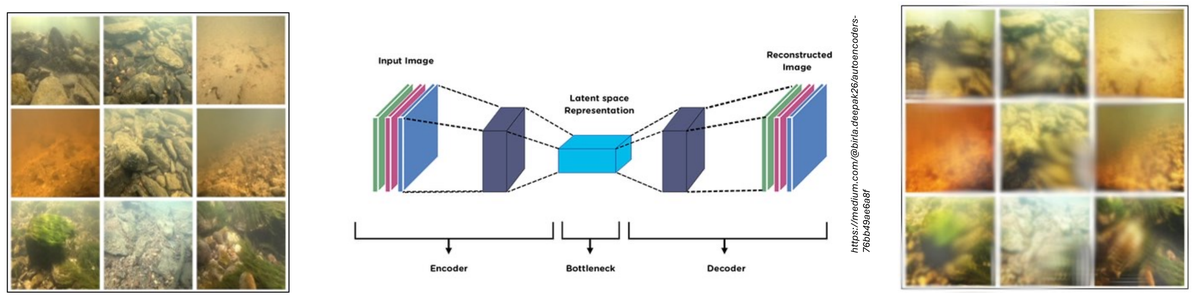



Zhang, R., Isola, P., Efros, A. A., Shechtman, E., & Wang, O. (2018). The Unreasonable Effectiveness of Deep Features as a Perceptual Metric. *2018 IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 586–595.




Left: Distances between body patterns and habitat characteristics for each pair of species. Right: Phylogenetically informed correlation between both distance matrices for the different fish body parts.

## III. Auto-Encoder: Representing the brain as an agent of selection




**Prediction**
Species + species-specific habitat AE: better reconstruction and/or sparser representation

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