Stimuli we encounter in daily life often come from a family of stimuli that vary continuously along one or more dimensions: a feature space. In vision, examples of feature spaces include orientation, color, motion direction and human faces, to name just a few. How does the brain encode such continuous feature spaces? How are they transformed through different stages of processing? How do they depend on behavioral goals and demands and context? And more importantly, can we measure the neural representation of these feature spaces in humans using functional magnetic resonance imaging (fMRI)?

I will describe two newly developed multivariate methods (forward modeling and dimensionality reduction) that allow us to derive, from fMRI measurements, lower-dimensional neural representations underlying features spaces.

I’ll show how we can use this novel methodology to investigate the neural representation of color. First, the forward modeling approach allows us to reconstruct even novel colors from fMRI responses taken from visual cortex, offering a major advance over current classification methods. Second, I’ll show how dimensionality reduction allows us to derive low-dimensional neural color spaces that can be compared directly with perceptual color spaces. Finally, I’ll show that in at least some of human visual cortex the neural representation of color is dynamic. More specifically, during a color naming task, the neural color spaces from V4v and VO1 begin to demonstrate a clustering of within-category colors, mimicking the perceptual boundaries between color categories.