Computational mechanisms underlying fMRI responses to affordance properties in visual scenes

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Presentation Abstract Summary A central component of spatial navigation is determining where one can move in the immediate environment. In a recent set of fMRI experiments, we found that a region of the human visual system known as the occipital place area (OPA) solves this problem by automatically identifying the navigational affordances of the local scene (Bonner & Epstein, 2017). Based on these results, we hypothesized that affordance identification could be achieved through a series of purely feedforward computations performed on retinal inputs. To test this idea, we examined responses within a biologically inspired convolutional neural network (CNN) with a feedforward architecture that was previously trained for scene categorization (Zhou et al., 2014). We found that the CNN contained information relating to both fMRI responses of the OPA and the navigational affordances of scenes. These representations relied heavily on features from the lower visual field, high-spatial frequencies, and cardinal orientations—consistent with visual biases in the OPA. In summary, we used functional mapping of visual cortex to identify a previously unknown mechanism for encoding the navigational affordances of scenes, and we identified a biologically plausible implementation of this process in a single forward pass through a hierarchical computational model.

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