NEUROSCIENCE

Learning and attention reveal a general relationship between population activity and behavior

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in correlated variability by investigating their relationship to behavior. There was a single, robust relationship between correlated variability and perceptual performance, whether changes in performance happened quickly (attention) (Fig. 3, A and B) or slowly (learning) (Fig. 3, C and D). This relationship was robust even when we removed the main effects of attention and learning (Fig. 3, E and F).

We analyzed the responses of V1 neurons (*7*, *8*) in animals performing the same attention task. Unlike in V4, correlated variability in V1 was not correlated with performance (fig. S5).

Both attention and perceptual learning improved the performance of a cross-validated, optimal linear stimulus decoder (fig. S6). However, the relationship between correlated variability in V4 and performance (Fig. 3) seems at odds with theoretical work that suggests most correlated variability should not affect the stimulus information that can be gleaned from an optimal decoder (*6*).

To examine the relationship between correlated variability and performance more directly, we developed a single-trial measure of correlated variability. We performed principal component analysis (PCA) relan371.u7070popul

study found that correlations depend on training experience but did not find a relationship between shared variability and information coding (*19*). Correlated variability should only affect the performance of an optimal decoder when it

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The neuronal population is the key unit

The responses of pairs of neurons to repeated presentations of the same stimulus are typically correlated, and an identical neuronal population can perform many functions. This suggests that the relevant units of computation are not single neurons but subspaces of the complete population activity. To test this idea, Ni *et al.* measured the relationship between neuronal population activity and performance in monkeys. They investigated attention, which improves perception of attended stimuli, and perceptual learning, which improves perception of well-practiced stimuli. These two processes operate on different time scales and are usually studied using different perceptual tasks. Manipulation of attention and learning in the same behavioral trials and the same neuronal populations revealed the dimensions of population activity that matter most for behavior.

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