Many neurons in the primary visual cortex (V1) project to the middle temporal area (MT). In V1, motion representations are tightly coupled to the physical properties of the stimulus. In MT, a more robust, stimulus invariant, representation of motion direction is computed. Here we examine how stimulus representations in networks of neurons in two cortical areas depend on stimulus structure.

METHODS

1. Manipulating stimulus structure
   - Sine wave gratings are narrowband and contain no cross-scale phase information.
   - Square wave gratings are broad band and phase aligned across scales.
   - Phase-randomised square wave gratings are broad band, but phases are scrambled cross-scale.

2. Population electrophysiology
   - Preparation
     - 5 anaesthetised marmoset monkeys
     - 96 channels in V1 (1 implant per case)
     - 32 channels in MT (1-4 implants per case, 10 total)

   - Stimuli drifted in one of 12 directions for 500 ms, and were followed by 500 ms of blank screen.

Correlations were calculated between neuron pairs that were visually responsive to any stimulus type.

Z-score distributions were matched across stimulus types for Integrative Brain Function.

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SUMMARY

Stimulus structure changes the amount of correlated noise between pairs of neurons.

More naturalistic stimuli produce lower rates of noise correlation, possibly because larger and more specialised normalisation pools are recruited.

Correlations in sub-networks of neurons based on functional properties vary in magnitude and the qualitative nature of their stimulus dependence.

Qualitatively, correlations between units in MT and V1 exhibit the same dependence on stimulus and functional sub-network.

Within V1 and MT, stimulus bandwidth and structure modulates the strength of correlated noise (rsc).

Direction selectivity propagates from V1 to MT, so we separated pairs based on selectivity.

Correlated noise is lower between areas than within areas, but is affected by structure in the same way.

Correlations are higher when both members of a pair are direction selective than when both are orientation selective.

Correlations were calculated between neuron pairs where both receptive fields overlap.

The effect of stimulus statistics restructures correlated variability within and between visual areas.