CORTICAL PROCESSING: TOP-DOWN MODULATION

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Top-down projections carry feedback information
Selective attention influences processing in extrastriate cortex (Desimone, 1985)

Attention directed toward the location of the preferred stimulus increases neuronal responses in area V4
Spatial attention influences response selectivity in extrastriate cortex (McAdams and Maunsell, 1999)
Spatial attention effect on V4 responses is carried by top-down inputs (McAdams and Maunsell, 1999)
Spatial attention does not influence response variability in extrastriate cortex (McAdams and Maunsell, 1999)

Figure 4. Population Response Variance Functions
These response variance functions were constructed by fitting power functions to the response variance data from all of the V4 neurons. The two functions are not significantly different (power: attended, 1.11; unattended, 1.12; coefficient: attended, 1.22; unattended, 1.26).
Spatial attention improves neuronal discriminability in area V4 (McAdams and Maunsell, 1999)

Figure 6. Orientation Discriminability Values
The best discriminability in the attended mode is plotted against the best discriminability in the unattended mode for all neurons. Points falling along the diagonal show no change in discriminability by attention. The dashed lines at 90° indicate the limit of meaningful discriminability values. Many points approach this limit in the unattended mode, but only a few in the attended mode.
Selective attention increases neuronal synchronization in the gamma band in area V4 (Fries et al, 2001)
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Figure 4. Attention effects in early response. Data are from 300 correct trials per attention condition. VEPs (A) and spike histograms (B) from two separate electrodes as a function of time after stimulus onset. Vertical lines indicate the time period for which STAs (D and F) were calculated. The modulation of firing rate by attention starts only at about 420 ms after stimulus onset. From 50 to 150 ms after stimulus onset, there are stimulus-locked gamma-frequency oscillations in firing rate synchronized with LFP fluctuations. Gamma-frequency oscillations are shown in detail (C) with the LFP filtered (40 to 90 Hz) and vertical lines indicating peaks of the rhythmic population activity. (D) STAs for 50 to 150 ms after stimulus onset and (E) the respective power spectra. (F) The STA from (D), filtered (40 to 90 Hz), and (G) the respective part of the power spectrum.
Engaging in an auditory task suppresses responses in auditory cortex (Otazu et al, 2009)

Cortical evoked responses are suppressed in the engaged condition, but spontaneous activity is unchanged. (a) Rats implanted with earphones performed a two alternative choice auditory task (Task 1) for 830 min (engaged period). The rat initiated a trial by poking its nose into the center port. Before and after the engaged period, the ports were blocked and the same stimuli were presented (passive period). (b–d) Examples of single unit, multi-unit and LFP responses elicited by the first stimulus (gray bar) showing suppression in the engaged condition relative to the passive condition.
Engaging in an auditory task suppresses responses in auditory cortex (Otazu et al, 2009)

Decision-relevant target is suppressed in engaged condition. (a) Responses evoked by clicks (task-irrelevant distractors) were attenuated at higher repetition rates in both the engaged (blue) and passive (red) conditions. The traces show the average normalized PSTH of cortical multi-unit responses to six different repetition rates. (b) Task-dependent suppression (modulation index) of the click-evoked responses decreased at higher stimulation rates. The square and triangle symbols indicate the modulation index for spontaneous firing and the first stimulus, respectively. (c) Example of a multi-unit cortical response to contralateral task-relevant stimulus. (d,e) The modulation of the target stimulus was correlated with the modulation of the preceding (task irrelevant) stimulus (d) and had a comparable magnitude (e). (f) Spatial selectivity and task-engaged suppression were statistically uncorrelated, indicating that selective responses were not preferentially enhanced during the task. Spatial selectivity was calculated between the left and right target stimulus during the passive condition.
Reward effects in visual cortex?

How do reward-related signals influence:

- perceptual performance
- feature encoding in visual cortex
Reward effects in posterior thalamus (Komura et al, 2001)

The cue was tone 1. 

- **a**, SDFs generated by different reward values. 
- **b**, Histograms of reaction time (the interval between protrusion of the spout and the onset of licking). 
- **c**, SDFs from the 2nd and 5th trials after changing the reward delay from 1 to 0 s. Trial 7–13 is the average SDF from trials 7–13 after changing the delay. 
- **d**, SDFs from the 2nd and 5th trials after changing the delay from 1 to 2 s. Trial 7–13 is the average SDF from trials 7–13 after changing the delay.
Feedback circuit that could mediate reward effects in posterior thalamus (Komura et al, 2001)


