Roles of superior colliculus and frontal eye field in reflexive and top-down attention shifts

Robert M. McPeek, The Smith-Kettlewell Eye Research Institute, San Francisco, CA USA

Are reflexive and top-down attention shifts processed by different neural pathways? Recent evidence suggests the involvement of the primate superior colliculus (SC) and frontal eye field (FEF) in shifts of attention in the absence of eye movements. To determine whether these areas play different roles in reflexive and top-down attention shifts, we recorded single-unit activity as monkeys remained fixated and discriminated the orientation of a briefly-presented peripheral target embedded in an array of distractors. In some blocks of trials, attention was reflexively cued to the target location by a color-oddity cue that preceded the target. In other blocks, top-down control of attention was tested by making the target more likely to appear in one location than in the others. Both manipulations had significant effects on the accuracy of discriminating the target’s orientation, indicating that they influenced attention. A subpopulation of SC and FEF cells was strongly modulated by the reflexive precues. In contrast, only FEF cells were significantly modulated by the top-down attention manipulation. These results suggest that reflexive and top-down shifts of attention are processed, at least in part, by different neural pathways: reflexive shifts involve both the SC and the FEF, while top-down shifts involve the FEF, but not the SC. Current experiments test this hypothesis by examining the effects on reflexive and top-down attention of selectively inactivating the SC or the FEF.