

Rate dependence of task-related cerebral activations: a PET-study

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Introduction

We previously delineated the visual short-term memory neural substrate involved in orientation discrimination, using a successive discrimination, i.e. the temporal same-different task (TSD) [1]. This network involves occipito-temporal and cerebellar regions. However, a previous study [2] using the same task paradigm suggests stimulus presentation rate strongly modulates the activity pattern within this network: whereas mainly occipito-temporal regions are differentially activated at a fast rate, a fronto-parietal network is activated at a slow rate. Using a parametric variation of rate, the current study further investigates the contribution of the cerebral and cerebellar regions to sensory discrimination.

Methods

The stimulus is a static grating (4 deg diameter), presented in central vision. TSD as well as its control task DIM (detection of the dimming of a central fixation point) are presented at 6 different rates: 10, 22, 34, 46, 58 and 70 stimuli/min. This 2x6 parametric-factorial design is completed with 2 passive viewing tasks. Twelve right-handed subjects participated in the PET-study (Siemens-CTI Ecat Exact HR+, 3D-mode). Successive orientation differences were individually adapted across tasks in order to titrate task difficulty.

Results

All tasks were performed at a level of 80-85 % correct. The most complete analysis is given by a conjunction between the main effect of task (all TSD - all DIM tasks) and all voxels demonstrating a positive linear rate effect. Significant differential activations are seen bilaterally in medial occipital gyrus, inferior and superior parietal lobes, premotor cortex and 6 cerebellar regions. Additionally, right fusiform gyrus [48 -72 -6] is activated. Only in this region a significant interaction between task and increasing rate is observed (Fig. A). Compared to a fixation baseline task (% change), a positive rate effect (linear) corresponds to increasing activations (Fig. A), a negative rate effect (linear) to increasing deactivations (e.g. left inferior temporal gyrus, [-54 -44 -12], Fig. B); no decreasing activations were observed.

Conclusions

(1) The neural substrate of successive orientation discrimination involves ventral as well as dorsal stream extra-striate regions, depending on the

stimulus presentation rate. Also, 6 non-motor cerebellar regions are involved during visual orientation discrimination.

(2) In contrast with the study of Rees et al., attentional modulated activity consisted of increased activations and deactivations compared to a fixation baseline task; no reduction of differential activations was seen with increasing rate.

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References

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