Whole-brain synchronization after in vivo *stimulation of D1 and D2 receptor-expressing neurons*

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Whole-brain dynamics in the resting brain is phenomenon that is currently under scrupulous research (Deco *et al.*, 2016; Hindriks *et al.*, 2016). However, the effect that local neural activity has on these large-scale dynamics is not well understood. Here, I?m presenting results showing that local *in vivo* stimulation of D1 and D2 receptor-expressing neurons in the basal ganglia in mice (Lee *et al.*, 2016) create a global synchronization characterized by a coherent global functional topology (as measured by fMRI), which is consistently present in all animals. Interestingly, this large-scale hypersynchronization is only present during stimulation periods while returning back to baseline within periods of no stimulation (Figure 1). As also seen in Figure 1, similarity of connectivity matrices over time (see methods summary) is greater during stimulation periods in both protocols and this result is consistently present across all animals.

Methods summary: fMRI while in vivo periodic optogenetical stimulation in the basal ganglia was performed in 10 lightly anesthetized mice (Lee et al., 2016). In total, 6 stimu- lation (on-off) periods were present in each animal. Whole-brain images were transformed into time series after motion correction, normalization and signal filtering. The brain was later parcellated into 96 regions. After applying the Hilbert transform to the time series across all regions, a whole-brain connectiv- ity matrix (CM) was constructed by computing the cosine difference between the instantaneous phase of each node pair at each time point t (Cabral *et al.*, 2017). This allowed to construct a CM at each time point in each animal, which let us explore dynamical properties at a whole-brain scale with a good temporal resolution. Later, the similarity between all CM pairs (across time) was com- puted by the correlating the lower triangular part. This information is resumed as a dynamic functional connectivity matrix or dFC (Deco *et al.*, 2016). This matrix was used to compute similarity and whole-brain synchronization scores during and after stimulation.

Conclusion: These results shed light into the intricate relationship between local neuronal activity and its effect with global dynamics. Even more interesting is the fact that these observations showed a clear periodic behavior, closely linking the effect of neuronal activity with fMRI.

References

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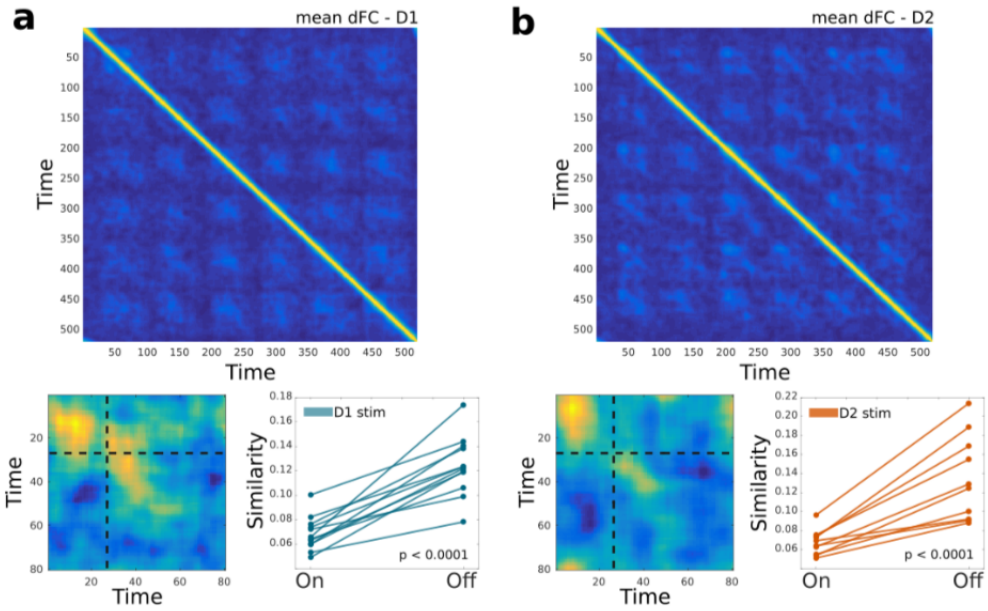

FIGURE 1. Global functional synchronization after optogenetic stimulation of the basal ganglia. a) Mean dynamic functional connectivity after D1 stimulation. Entries represent similarity between two given functional connectivity matrices over time. Lower matrix represents an extract of one stimulation period. Dotted lines depict the end of stimulation. Paired plot represents global similarity within off and on periods. b) Results for stimulation of D2-expressing neurons. p-values are generated after a paired t-test.

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