Dopamine deficiency in Parkinson's disease compromises adaptations in rewarded learning

D.A. Peterson, C. Elliott, D.D. Song, S. Makeig, T.J. Sejnowski, H. Poizner (La Jolla, California)

Objective: The objective of the present study was to investigate the relative contributions of age and dopamine in rewarded implicit learning.

Background: Theoretical and empirical evidence suggests that dopamine mediates rewarded learning. There is also growing evidence that PD patients on relatively high doses of dopaminergic medication are more likely to experience pathological gambling.
Methods: We adapted an implicit learning task originally used to study firing rates of dopamine cells in primate substantia nigra pars compacta (Morris et al. 2006 Nature Neurosci) for use as a ''gambling task'' with humans. Over the course of 256 trials subjects were exposed to pairs of images with different fixed probabilities of payoff. During a subsequent otherwise identical reversal phase, the reward probability contingencies for the stimuli were reversed. Seventeen PD patients with mean disease duration of 10 years and moderate disability (mean Hoehn and Yahr 2.4), 15 age-matched controls, and 8 young controls participated.

Results: All three groups of subjects demonstrated learning. The two older groups demonstrated slower learning rates than the young controls in both phases. The PD patients off medications uniquely exhibited a compromised ability to adapt to the reward contingency reversal.
Conclusions: The results suggest that the network dysfunction in PD induced by a compromised dopaminergic system leads to difficulties in adapting to changed learning demands, a phenomenon we refer to as ''learning to learn''. The results also suggest that this effect is not merely an age effect, but specific to the neuropathology of PD. High dosage dopaminergic therapies may overcompensate for the organic dopamine deficiency in PD and produce a hyper-adaptive system that is more susceptible to pathological gambling.