Different forms of skill learning in Parkinson's disease

Parkinson's disease, motor sequence learning, probabilistic categorization, artificial grammar leaning

Lukács, Ágnes[1], Demeter, Gyula[1,2], Racsmány, Mihály[1,2], Valálik, István [2,3], Kemény, Ferenc[4]
1 Department of Cognitive Science, Budapest University of Technology and Economics
2 Research Group on Frontostriatal Disorders, Hungarian Academy of Sciences
3 Department of Neurosurgery, St. John's Hospital, Budapest
4 Institute for Psychology, University of Graz

The striatal dopaminergic dysfunction in Parkinson's disease (PD) has been associated with deficits in skill learning, but results are inconclusive so far. Motor sequence learning (especially sequence-specific learning) is found to be deficient in the majority of studies using the SRT task (Jackson, Jackson, Harrison, Henderson, & Kennard, 1995; Siegert, Taylor, Weatherall, & Abernethy, 2006). While problems with motor sequences seem to be prevalent, PD patients show intact performance on AGL tasks, suggesting that the sequencing problem may be response- or task-dependent (Reber & Squire, 1999). Acquisition of nonsequential probabilistic associations also seems to be vulnerable as evidenced by impaired probabilistic category learning performance in PD (Knowlton, Mangels, & Squire, 1996; Shohamy, Myers, Onlaor, & Gluck, 2004).
Our aim was to explore the nature of the skill learning deficit by testing different types of skill learning (sequential versus nonsequential, motor versus verbal) in the same group of Parkinson's patients. 34 patients with PD (mean age: 62.59.77 years, SD: 7.67) were compared to age-matched typical adults using 1) a Serial Reaction Time Task (SRT) testing the learning of motor sequences, 2) an Artificial Grammar Learning (AGL) task testing the extraction of regularities from auditory sequences and 3) a Weather prediction task (PCL-WP), testing probabilistic category learning in a non-sequential task.
In motor sequence learning (SRT task), the two groups did not differ in accuracy; PD patients were generally slower, and analysis of z-transformed reaction times also revealed deficient motor sequence learning in PD compared to the control group. The PD group showed no evidence of sequence learning. The PD group showed the same amount of learning on the PCL task as controls, and we observed higher rates of learning on the AGL task in PD patients than in controls. These results support and also extend previous findings suggesting that motor skill learning is vulnerable in PD, while other forms of skill learning are less prone to impairment. Results are also in line with previous assumptions that mechanisms underlying artificial grammar learning and probabilistic categorization do not depend on the striatum (Reber & Squire, 1999).

References:

Jackson, G. M., Jackson, S. R., Harrison, J., Henderson, L., & Kennard, C. (1995). Serial Reaction-Time Learning and Parkinsons-Disease - Evidence for a Procedural Learning Deficit. *Neuropsychologia*, *33*, 577–593.
Knowlton, B. J., Mangels, J. A., & Squire, L. R. (1996). A neostriatal habit learning system in humans. *Science*, *273*, 1399–1402.

Reber, P. J., & Squire, L. R. (1999). Intact learning of artificial grammars and intact category learning by patients with Parkinson's disease. *Behavioral Neuroscience*, *113*, 235–242.

Shohamy, D., Myers, C. E., Onlaor, S., & Gluck, M. A. (2004). Role of the basal ganglia in category learning: How do patients with Parkinson's disease learn? *Behavioral Neuroscience*, *118*, 676–686.

Siegert, R. J., Taylor, K. D., Weatherall, M., & Abernethy, D. A. (2006). Is Implicit Sequence Learning Impaired in Parkinson's Disease? A Meta-Analysis. *Neuropsychology*, *20*, 490–495.

Financial disclosure:

This research was supported by the research grant of the Hungarian Brain Research Program (KTIA NAP Grant ID: 13-2-2014-0020) awarded to Mihály Racsmány as PI.

Gyula Demeter is a grantee of the János Bolyai Research Scholarship of the Hungarian Academy of Sciences.