Retrograde procedural memory in Parkinson's disease

Laure PAULY*[a,b], Claire PAULY[a,b], Maxime HANSEN[b,c], Valerie E. SCHRÖDER[a,b], Armin RAUSCHENBERGER[a], Anja K. LEIST[d], Rejko KRÜGER[a,b,c] on behalf of the NCER-PD Consortium

[a]Luxembourg Centre for Systems Biomedicine (LCSB), University of Luxembourg, 7 avenue des Hauts Fourneaux L-4362 Esch-sur-Alzette, Luxembourg;
[b]Department of Neurology, Centre Hospitalier de Luxembourg, 120 Route d'Arlon L-1150 Strassen, Luxembourg;
[c]Transversal Translational Medicine (TTM), Luxembourg Institute of Health, 1A-B, rue Thomas Edison L-1445 Strassen, Luxembourg;
[d]Department of Social Sciences, Institute for Research on Socio-Economic Inequality, University of Luxembourg, 2 avenue de l'Université L-4365 Esch-sur-Alzette, Luxembourg

INTRODUCTION

Aim: Developing a neuropsychological tool for the evaluation of retrograde procedural memory in Parkinson's disease (PD).

PROCEDURAL MEMORY

Procedural memory is our "how to" knowledge. It stores information on how to perform procedures unconsciously, like driving a car or playing an instrument.

Procedural memory appears to be mostly dependent on the basal ganglia, a brain area particularly affected by PD.

The learning of a new procedural skill, the anterograde procedural memory, has been shown impaired in PD. However, the retention and execution of a procedural memory that has been learned in earlier life stages, the retrograde procedural memory, has not yet been systematically studied (Fig.1).

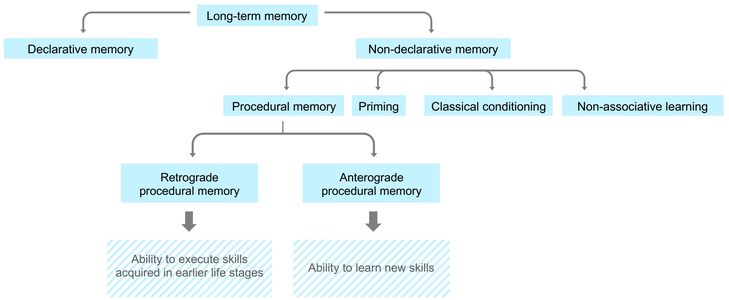


Figure 1. Representation of the components of procedural memory

OBJECTIVE

To investigate if people with PD show more difficulties recalling the copying procedure of the cube than control subjects, we evaluate two components of the Cube Copying Test, the procedure of copying the cube and the correctness of the outcome.
We hypothesized that the cube copying performance, suggestive for the retrograde procedural memory, is impaired in PD compared to their age- and gender-matched control group.

METHODS

We established an extended evaluation system, called CUPRO* evaluation system, based on the Cube Copying Test:

	YES	NO	
INTERMEDIATE SCORE 1 - IS_1			
The subject starts with one of the squares / surfaces / with the 3 axes	1	0	Retrograde Procedural Memory
a → The subject drew the inside sides b → The subject drew a second square (superposition) c → The subject drew a second face d → The subject drew the 3 axes and continued by drawing any other surface	1	0	
The subject fills in the connection lines correctly	1	0	
INTERMEDIATE SCORE 1 IS_1	/3		
INTERMEDIATE SCORE 2 – IS_2			
The drawing is 3D, the proportions are correct	1	0	Visuo-constructive functions
The orientation of the drawing is correct (mirror image)	1	0	
The final result is correct	1	0	
INTERMEDIATE SCORE 2 IS_2	/3		
TOTAL SCORE	/6		

Figure 2. The scoring sheet for the CUPRO evaluation system

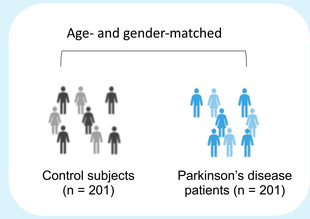
The CUPRO evaluation system differentiates between the cube copying procedure, representing functioning of the retrograde procedural memory, and the final result, representing the visuo-constructive functions.

Copying a cube requires the application of an unconscious procedure that has been learned in earlier life stages and meets therefore the conditions of assessing retrograde procedural memory.

*CUPRO stands for CUbe copying PROcedure

RESULTS

Comparing people with typical PD (n=201) with age- and gender-matched control subjects (n=201),



this study demonstrated significantly lower cube copying performance in people with PD (p=0.008). No significant differences were observed for years of education.

DISCUSSION

This study established a new evaluation system for the cube task to assess functioning of retrograde procedural memory and demonstrated deficits in retrograde procedural memory in people with PD compared with control subjects.

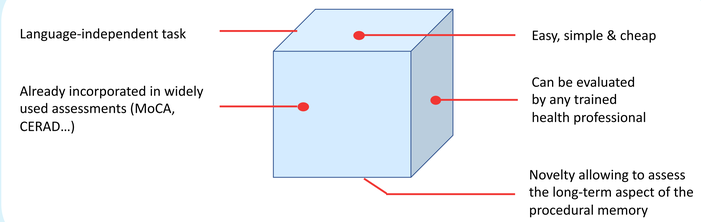


Figure 3. Advantages of the CUPRO evaluation system