

Paradoxical brain-behavior relationship: a case of semantic category-specific impairment in knowledge of great expertise

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BACKGROUND

- Conceptual knowledge is dissociated in different categories in the human brain and this is supported by cases of patients with neurological damage who show category-specific semantic anomia.
- Category-specific dissociations can be influenced by differences in premorbid experience. General assumption sustains that mastered areas of knowledge are more resistant to brain damage than less well-mastered ones¹
- We here report the paradoxical case of patient MDR who after suffering a traumatic lesion in the left temporal pole and mesial frontal cortex lost his premorbid ability to manipulate excelled knowledge of three semantic categories (plants, carpentry tools and familiar faces), while knowledge on less well-trained categories remained intact.

METHODS

BEHAVIORAL EVALUATION

- Neuropsychological evaluation and general language evaluation (Table 1).
- Tests to evaluate specific-category dissociations in naming between premorbid expertise domains and other non-expert domains. Results were compared with control subjects (Table 2)

NEUROIMAGING

- Structural magnetic resonance imaging (MRI) and diffusion tensor imaging (DTI) were acquired.
- Deterministic tractography was performed in order to reconstruct the tracts of interest (the uncinate fasciculus and the inferior longitudinal fasciculus) in both hemispheres.
- A meta-analysis of functional MRI studies on the term "Semantic" was performed using Neurosynth. In order to evaluate the disconnection of areas not directly affected by the lesion, the Disconnectome map software was used. An overlap between the fMRI meta-analysis and the disconnectome map of the patient is also shown.

RESULTS

Table 1. Language Assessment

Tests	MDR Score (proportion)	Performance descriptor
WAB	89.2/100	
Naming Actions (n=100)	93 (.93)	Normal
Phonemic Word Fluency (Total)	35	Normal
Semantic Word Fluency		Normal
Tools	15	
Vegetables	15	
Means of Transport	9	
Domestic Animals	8	
Clothing	13	
Fruits	11	
Musical Instruments	14	
Animals	16	
Plants	12	
Boston Naming Test (Abbreviated) (n=15)	12 (.8)	Normal
Snodgrass and Vanderwart Pictures (n=260)	256 (.98)	Normal
PEABODY	172	Normal

Table 2. Performance of MDR and the Control Participant on Naming Tools, plants and Faces tests

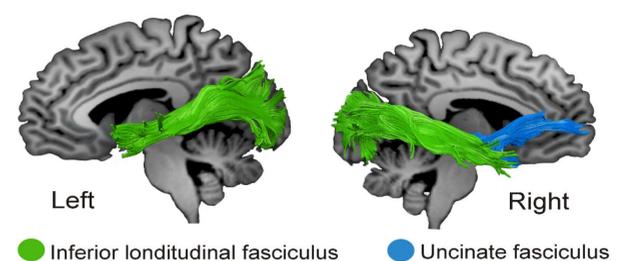
	MDR		Controls	
		M	SD	
Naming test	.98	.98	.026	
Tools	.76	.99	.008	
Plants	.46	.79	.096	
Familiar Faces	.5	NT	NT	

T1-weighted image in native space.

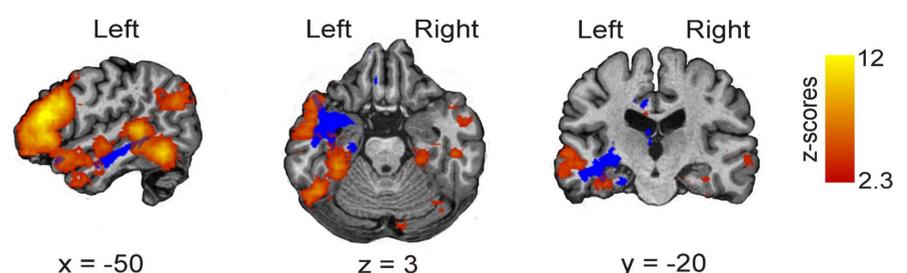


Deterministic tractography *

*The uncinate fasciculus could not be reconstructed in the left hemisphere.



Meta-analysis of functional MRI studies reporting activations related to the term "Semantic" (red-yellow) and the probability of disconnection of areas not directly affected by the lesion (blue).



CONCLUSIONS

- The results derived from the study of this case suggest that extensive knowledge in a semantic category is not necessarily a protective factor of anomia within this category after brain damage.
- Our single case study suggests that once expert knowledge have been achieved, visual features have a more important role than functional features for distinguishing visually-similar items within the same domain². Left temporal lobe lesions are related to difficulties in naming concepts differentiated mostly by visual attributes
- The uncinate fasciculus is an important circuitry involved in retrieval of proper names