Visualization problems in neuroscience

cortico-subcortical loops mechanism

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Visualizations in neuroscience face various technical challenges. One of them is, for instance, a problem of how to provide for the methodological necessity for an accurate reflection of all important elements and aspects of a specific mechanism, while at the same time to keep its legibility and instructive purpose. The poster focuses on two specific aspects of this issue. The first aspect concerns the need to properly depict the space and size relationships as well as the general arrangement between mechanism structures. The second aspect is the need to show the dynamic relationship between the components of the neural mechanism, because diagrams showing only the order of the components performing a given function lose an important perspective about the whole mechanism. Hence an appropriate and successful visualization should carry all of the vital information about the multidimensional nature of a given mechanism, and not only show the sequence of stimulations [1]. This poster uses an example of how one could accurately visualize the cortico-subcortical loops mechanism [2], in order to present possible solutions to the above-mentioned problems of static visualization in neuroscience.
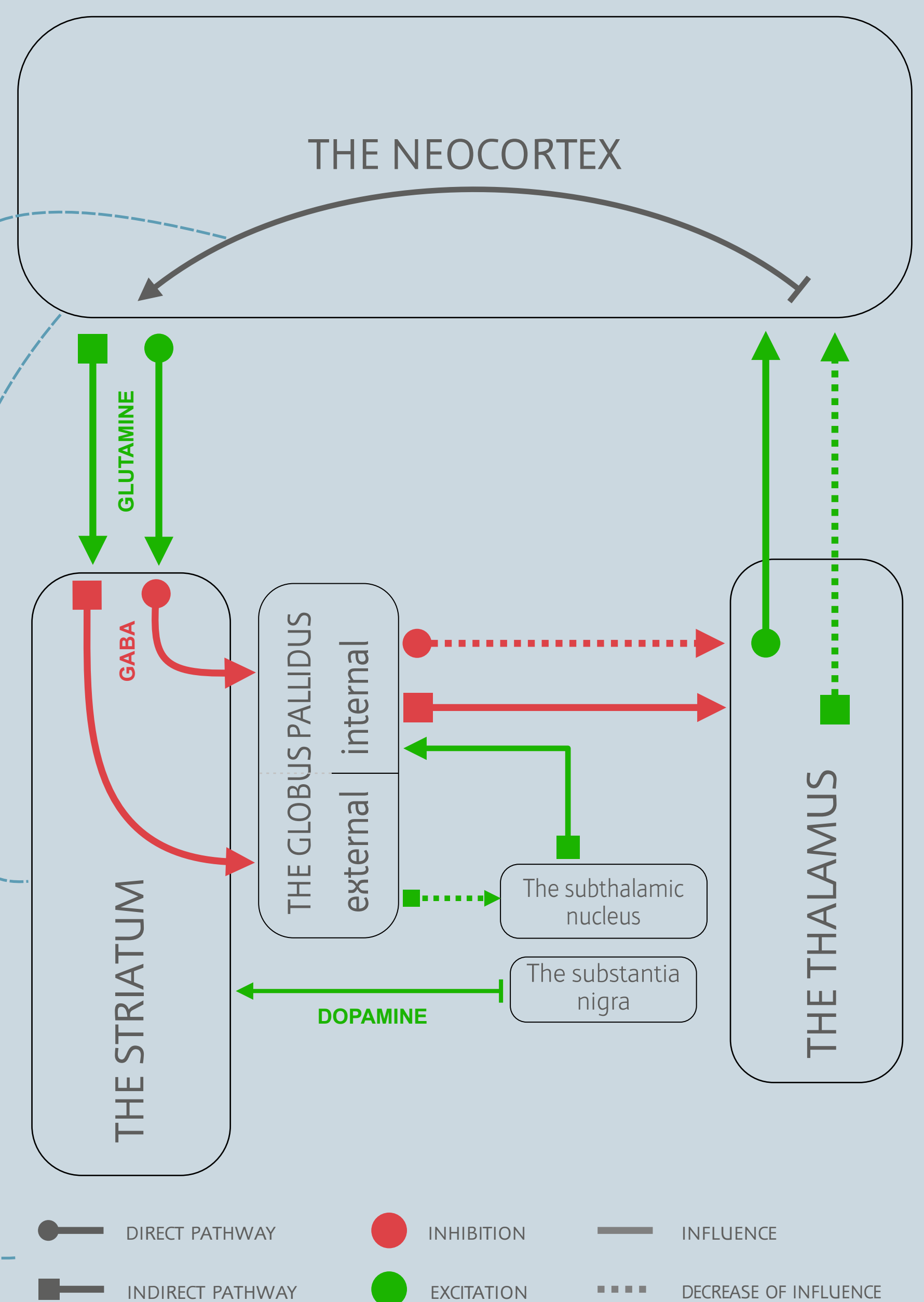
The visualization takes into account the spatial aspect of the CS-L mechanism. It reflects approximate hierarchical, geometric and size relationships between individual structures.

To mark the connections that are not a part of any direct or indirect pathways, but play a crucial role in the mechanism, different colors and starting shape types were used on arrows.

The arrangement of the boxes also corresponds to the approximate arrangement of the symbolized structures in reality.

Mutual stimulation and inhibition of individual parts plays a key role in the functioning of the CS-L mechanism. The design of an arrow indicates the key aspects of the particular pathway:
- character (activation/inhibition) – marked in green or red color
- type (direct/indirect) – indicated by shape type (square or circle) at the start of an arrow
- intensity (influence/reduction of influence) – marked as solid or dash line style.

THE NEOCORTEX

GLUTAMINE

GABA

THE STRIATUM

THE GLOBUS PALLIDUS
external | internal

The subthalamic nucleus

The substantia nigra

DOPAMINE

THE THALAMUS

DIRECT PATHWAY INHIBITION INFLUENCE
INDIRECT PATHWAY EXCITATION DECREASE OF INFLUENCE

Bibliography:
[1] Machamer, P., Darden, L., Craver, C. (2000). Thinking about mechanisms. *Philosophy of Science, 67* (1), 1-25.
[2] Gorzelańczyk, E. J. (2011). Functional Anatomy, Physiology and Clinical Aspects of Basal Ganglia. In: J. Peres (ed.), *Neuroimaging for Clinicians – Combining Research and Practice* (p. 3–32). InTech.
[3] Gerfen, C. R., Bolam, J. P. (2017). The Neuroanatomical Organization of the Basal Ganglia. *Handbook of Behavioral Neuroscience, 24.*
[4] Wimsatt M., Simpson, J. (2022). Interactive brain model. https://www.brainfacts.org/ (30.08.2022).

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