KONRAD HINSEN

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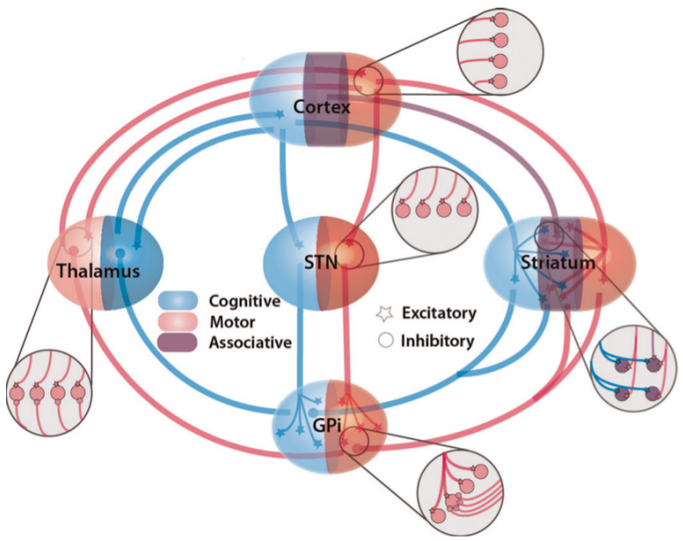
ReScience

Reproducible science is good. Replicated science is better.

Once upon a time there was a model…

(Guthrie et al., 2013)



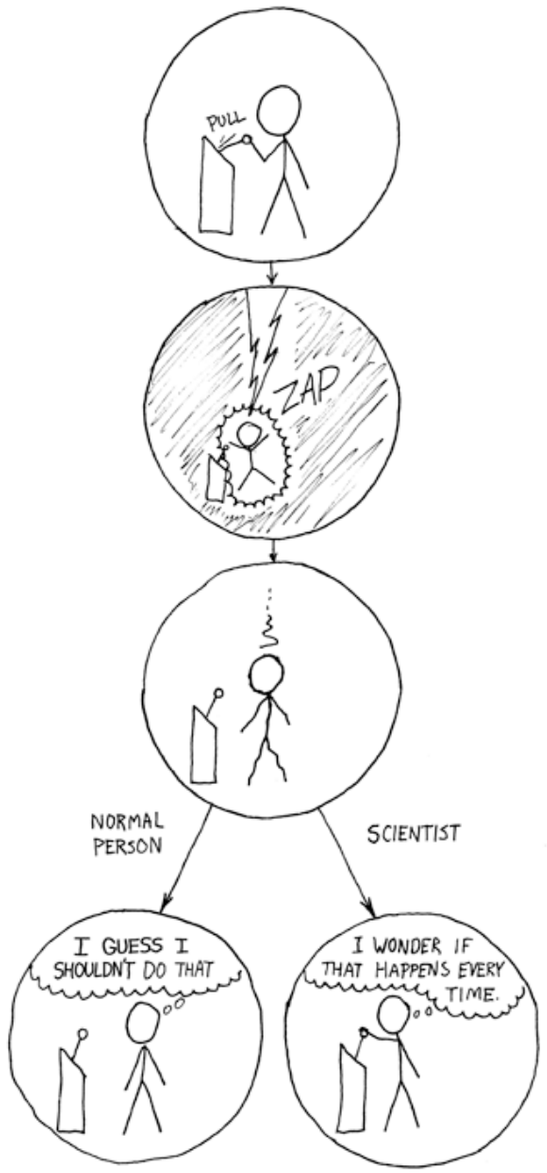
Nice paper, good results, but…

- No public repository
- No easy access
- No version control
- Model description included ambiguous information
- Sources were mixing actual computation and GUI code
- Model was split into a hundred files
- Main file was 6,000 lines long

Model was hardly reproducible.

Did you say reproducible science ?

(Crook et al., 2011)



"*Reproducible experiments are the cornerstone of science: only observations that are independently confirmed enter the body of scientific knowledge.*

Computational science should excel in reproducibility, as simulations on digital computers avoid many of the small variations that are beyond the control of the experimental biologist or physicist."

Reality is different, though.

Three months of hard work for a 200 lines script...

(Topalidou et al., 2015)

Three months of hard work:

- Use of the Python language and numerical libraries
- Use of the DANA library for intuitive description
- Use of the IPython notebook for interactive sessions

Source is now a single file of ~200 readable lines.

Without this replication effort, model would have been **dead** and **forgotten** by the community.

What is replication ?

octodex.github.com

Bob reads Alice's paper, takes note of all model properties and then implements the model himself using a method of his choice.

Bob confirms Alice's result by obtaining qualitatively the same results.

Alice's model is declared reproducible.

Did you say replication ?

octodex.github.com

During the course of a PhD, it is often the case that a student will try to replicate results from the literature, possibly interacting with the original authors.

Such replication generally lives inside the hard-drive of the computer's student while it would be actually useful for the whole scientific community.

What do we do then ? **Let's review it & publish it !**

Can we make such effort sustainable ?

Yes we can !™

ReScience is a peer-reviewed journal that target **any** computational research and encourage the explicit reproduction of already published research promoting new and open-source implementations.

ReScience lives on github where each new implementation is made available together with explanations (article)

And of course, we privilege **Python** replications…

Why git & github ? free & popular

GitHub offers a web-based git repository hosting service with great specific features (issue, pull request, etc).

→ Version control
→ Public repositories
→ Transparency and verifiability
→ Easy exploration of new ideas

A kind of modern lab notebook for the computer scientist.

How to submit ?

octodex.github.com

1. Fork the ReScience-Submission repository

2. Write your code, data and article

3. Submit a pull request

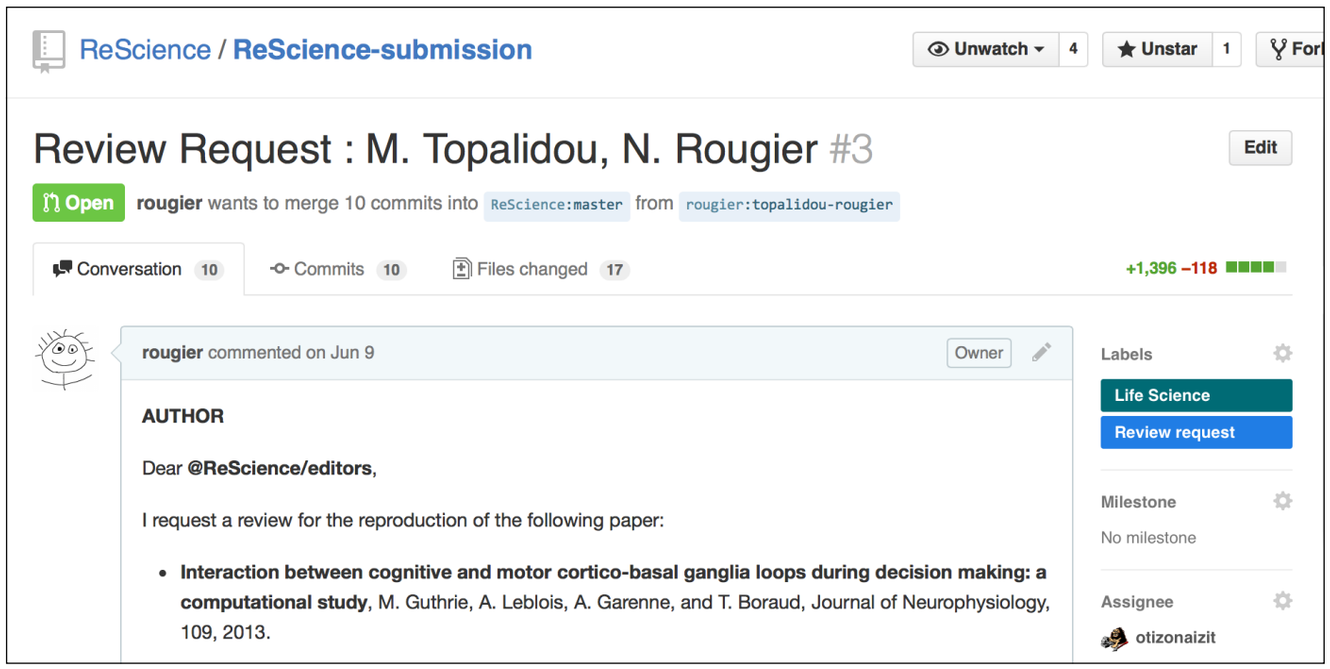
4. Address reviewer's comments and questions

5. Get published and get a DOI

Actual submission

(Topalidou and Rougier, 2015)

Authors: Meropi Topalidou & Nicolas Rougier
Editor: Tiziano Zito
Reviewers: Mehdi Khamassi & Benoît Girard



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[Re] Interaction between cognitive and motor cortico-basal ganglia loops during decision making: a computational study

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The authors have declared that no competing interests exist.

Code repository

A reference implementation of

→ *Interaction between cognitive and motor cortico-basal ganglia loops during decision making: a computational study*, M. Guthrie, A. Leblois, A. Garenne, and T. Boraud, Journal of Neurophysiology, 109, 2013.

Introduction

We propose a reference implementation of [1] that introduces an action selection mechanism in cortico-basal ganglia loops based on a competition between the positive feedback, direct pathway through the striatum and the negative feedback, hyperdirect pathway through the subthalamic nucleus. The original implementation was made in Delphi (Object Pascal) whose sources are available on request to any of the author of the original article. We have used these sources to disambiguate ambiguous and missing information in the original article. The reference implementation we propose has been coded in Python for ease of reading and Cython for performances because the main result includes a batch of 250 experiments over 120 trials that would be too slow for regular Python scripts.

Methods

We used the description of the model in the original article as well as the sources of the model (requested from author) that are made of a hundred files and 6,000 lines of Delphi for the main source. We have been unable to compile this original implementation but we were able to run the provided Windows executable. We found some factual errors in the original article that have been corrected in this implementation. The initialization of weights are defined in two different parts of the paper. First on page 3030 (second column) *"Weights were initialized to a Gaussian distribution with a mean of 0.5 and a SD of 0.005 at the start of each simulation…"*, then on page 3031 in the caption of figure 4, *"All synaptic weights were initialized to 0.5"*. It happened that both definitions are right but do not address the same projections. Cortico-striatal synaptic weights use Gaussian distribution while all other weights are set to 0.5. Furthermore, the Boltzmann equation given in the original paper uses a . instead of + between first term and second term.

ReScience

One notable modification in our implementation is the reinforcement learning rule that has been greatly simplified. Original authors have been using quite a complex algorithm for ensuring that *"corticostriatal weights are bounded by a sigmoidal transfer function to represent physical constraints on synaptic growth with an absolute maximum of 0.75 and an absolute minimum of 0.25."*. This algorithm is not described in the article, but from sources, it appears that it is based on the estimation of the weight gradient along the sigmoid. We use instead an Oja-like rule given in the *Synapse* table.

We provide below the formal description of the model according to the proposition of Nordlie et al. [2] for reproducible descriptions of neuronal network models.

Table 1: Model description following [2] prescription.

Table	Description
Populations	Cortex (motor, associative & cognitive), Striatum (motor, associative & cognitive), GPi (motor & cognitive), STN (motor & cognitive), Thalamus (motor & cognitive)
Topology	–
Connectivity	One to one, one to many (divergent), many to one (convergent)
Neuron model	Dynamic rate model
Channel model	–
Synapse model	Linear synapse
Plasticity	Reinforcement learning rule
Input	External current in cortical areas (motor, associative & cognitive)
Recordings	Firing rate & performances

Table 2: Populations

Name	Elements	Size	Threshold	Noise	Initial state	τ
Cortex motor	Linear neuron	1×4	-3	1.0%	0.0	10
Cortex cognitive	Linear neuron	4×1	-3	1.0%	0.0	10
Cortex associative	Linear neuron	4×4	-3	1.0%	0.0	10
Striatum motor	Sigmoidal neuron	1×4	0	0.1%	0.0	10
Striatum cognitive	Sigmoidal neuron	4×1	0	0.1%	0.0	10
Striatum associative	Sigmoidal neuron	4×4	0	0.1%	0.0	10
GPi motor	Linear neuron	1×4	+10	3.0%	0.0	10
GPi cognitive	Linear neuron	4×1	+10	3.0%	0.0	10
STN motor	Linear neuron	1×4	-10	0.1%	0.0	10
STN cognitive	Linear neuron	4×1	-10	0.1%	0.0	10
Thalamus motor	Linear neuron	1×4	-40	0.1%	0.0	10
Thalamus cognitive	Linear neuron	4×1	-40	0.1%	0.0	10
Values (V_i)	Scalar	4	–	–	0.5	-

Table 3: Connectivity

Source	Target	Pattern	Weight	Gain	Plastic
Cortex motor	Thalamus motor	$(1, i) \rightarrow (1, i)$	1.0	0.4	No
Cortex cognitive	Thalamus cognitive	$(i, 1) \rightarrow (i, 1)$	1.0	0.4	No

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Grand opening on September 1st 2015

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Help the project !

→ submit articles
→ become a reviewer (contact me **nicolas.rougier@inria.fr**)