

Representational complexity and dynamics of recurrent processing during visual object recognition

Project Name Representational complexity and dynamics of recurrent processing during visual object recognition - Representational complexity and dynamics of recurrent processing during visual object recognition

Grant Title 11C9122N

Principal Investigator / Researcher Timothee Maniquet

Project Data Contact Timothee Maniquet

Description Recognising objects is a crucial feature of human perception, achieved by the brain rapidly and accurately despite the complexity of visual environments. This ability, termed core object recognition, relies on a set of hierarchical operations by the ventral stream, whereby stimuli are progressively integrated in a feedforward fashion. Evidence shows, however, that modelling object recognition with feedforward activity provides a limited account. Research provides a solution with recurrent processing. Recent evidence from functional imaging indeed supports its role in object recognition. Despite the consensus in the field that core object recognition relies on both feedforward and recurrent processing, there is divergence in how to measure their relative input. Dissective studies estimate the recurrence associated with separate visual phenomena, whereas integrative studies compare non-recurrent with recurrent models. Here, we take a significant step towards reconciling these two approaches, as we design a new paradigm that simultaneously compares non-recurrent and recurrent processes of visual recognition, and separates their respective computational role. We combine functional imaging methods (fMRI & EEG) for an acute spatial and temporal measure of the impact of recurrence upon representational transformations in the ventral stream. This series of studies will significantly enhance our understanding of the role of recurrent processing in object recognition.

Institution KU Leuven

1. General Information

Name applicant

Timothee Maniquet

FWO Project Number & Title

11C9122N

Representational complexity and dynamics of recurrent processing during visual object recognition

Affiliation

- KU Leuven

2. Data description

Will you generate/collect new data and/or make use of existing data?

- Generate new data

Describe in detail the origin, type and format of the data (per dataset) and its (estimated) volume. This may be easiest in a table (see example) or as a data flow and per WP or objective of the project. If you reuse existing data, specify the source of these data. Distinguish data types (the kind of content) from data formats (the technical format).

Type 1:

Type: Behavioural responses of participants to visual tasks on computer or using online platform.

Format: Mostly .mat (Matlab files) or .csv

Size: 1-10 GB

How created: Output of experimental scripts written in e.g. Matlab (PsychToolbox) or Python (PsychoPy)

Type 2:

Type: Magnetic Resonance Images (MRI) of the brain, Structural & Functional

Format: Mostly NIfTI or DICOM

Size: 300 GB - 1 TB (the latter including intermediate processing steps)

How created: MRI research scanner

Type 3:

Type: Electroencephalography (EEG)

Format: Depending on software, often .py and .mat

Size: 40 GB - 100 GB (the latter including intermediate processing steps)

How created: EEG equipment (electrodes attached to the skin)

Type 4:

Type: Computer simulation data

Format: Depending on software, often .py and .mat

Size: 500 GB

How created: By implementing artificial neural networks & training them to classify visual images (e.g. using Python & Tensorflow/PyTorch)

3. Legal and ethical issues

Will you use personal data? If so, shortly describe the kind of personal data you will use. Add the reference to your file in KU Leuven's Register of Data Processing for Research and Public Service Purposes (PRET application). Be aware that registering the fact that you process personal data is a legal obligation.

- Yes

Yes, we use personal data. This is registered through our ethical approvals with EC and SMEC.

For all studies, we obtain the name, email address, personal address, and bank account information. This information is needed to pay participants.

This identifiable information is kept separate from the actual research data (see types 1-4 under *Section 2.2*). The research data are coded.

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? If so, add the reference to the formal approval by the relevant ethical review committee(s)

- Yes

Yes, there are ethical considerations, and they are covered by several ethical approvals.

SMEC: G-2020-2910; G-2020-2379

EC: S62131

Does your work possibly result in research data with potential for tech transfer and valorisation? Will IP restrictions be claimed for the data you created? If so, for what data and which restrictions will be asserted?

No.

Do existing 3rd party agreements restrict dissemination or exploitation of the data you (re)use? If so, to what data do they relate and what restrictions are in place?

No.

4. Documentation and metadata

What documentation will be provided to enable reuse of the data collected/generated in this project?

The raw data files for all four types are automatically stored with relevant meta-data.

For each experiment a detailed Methods section is written that allows to replicate the experiment, and re-analyse the obtained data.

Will a metadata standard be used? If so, describe in detail which standard will be used. If no, state in detail which metadata will be created to make the data easy/easier to find and reuse.

- Yes

We use data acquisition and analysis software that is internationally used (e.g., fMRIPREP, SPM, cosmoMVPa toolbox), and where relevant the applicable standard data formats such as BIDS

(which also standardizes directory structure & experimental information).

5. Data storage and backup during the FWO project

Where will the data be stored?

The coded research data are stored on the professional KU Leuven Onedrive for Enterprises servers, using the drive of the main experimenter per experiment (up to 3 experimenters can be involved in this project). Copies can be made and kept on personal professional devices that fall under the university secure environment. All people with access to these data use multi-factor authentication.

How is backup of the data provided?

The Onedrive assures a storage using online cloud services. In addition, the coded research data might be backed-up on local external hard drives that are encrypted and password-protected.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely. If no or insufficient storage or backup capacities are available then explain how this will be taken care of.

- Yes

Yes, the expected size of the research data is smaller than the 2 TB per person provided through Onedrive.

What are the expected costs for data storage and back up during the project? How will these costs be covered?

No substantial costs expected, except the purchase of a few external hard drives.

Data security: how will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?

The research data are always on password-protected devices. These research data are coded.

The identifiable information (name, email, address) is not saved with the research data.

The link between the identifiable information and the code of the research data is stored together with the informed consent form on paper (= not electronically). This paperwork is stored in KU Leuven offices within a locked closet.

6. Data preservation after the FWO project

Which data will be retained for the expected 5 year period after the end of the project? In case only a selection of the data can/will be preserved, clearly state the reasons for this (legal or contractual restrictions, physical preservation issues, ...).

The coded research data will be preserved for 10 years.

The informed consents on paper will also be preserved for 10 years.

Where will the data be archived (= stored for the longer term)?

Currently we archive data on a central storage RAID system of our research group when a lab member's contract ends, with additional backup on encrypted & password-protected external hard drives stored in a different building.

Towards the end of this project, we hope to move towards using the university's central servers (with automatic back-up procedures) for at least 10 years, conform to the KU Leuven RDM policy.

What are the expected costs for data preservation during the retention period of 5 years? How will the costs be covered?

With current policies, we expect a total cost of around 5 000 euro, which can be covered by the C1 budget (grant already existing in the lab).

7. Data sharing and reuse

Are there any factors restricting or preventing the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)?

- Yes. Specify:

The research data can be shared (anonymously) with other researchers, also on online databases. This is explicitly mentioned in the informed consent forms signed by the participants.

Which data will be made available after the end of the project?

We share the final analyses files and further experimental material (stimuli etc.) using the OSF

platform.

Where/how will the data be made available for reuse?

- In an Open Access repository

We use the Open Science Framework (OSF).

Partially also by mail, because not all the raw data files might be on OSF.

When will the data be made available?

- Upon publication of the research results

Who will be able to access the data and under what conditions?

Summary data & analysis files and experimental material will be fully open access for all that are registered on OSF

What are the expected costs for data sharing? How will the costs be covered?

OSF has no costs (at the moment).

8. Responsibilities

Who will be responsible for data documentation & metadata?

The PhD candidate (Timothée Maniquet) and the supervisor/promotor (Prof. Hans Op de Beeck, the latter is the first contact point).

Who will be responsible for data storage & back up during the project?

The PhD candidate (Timothée Maniquet) and the supervisor/promotor (Prof. Hans Op de Beeck, the latter is the first contact point).

Who will be responsible for ensuring data preservation and reuse ?

The supervisor/promotor (Prof. Hans Op de Beeck).

Who bears the end responsibility for updating & implementing this DMP?

The end responsibility for updating and implementing the DMP is with the supervisor/promotor (Prof. Hans Op de Beeck).