Neuroscience Experiments System – NES

Technology Transfer Team

Second NeuroMat Workshop: New frontiers in neuromathematics

November 23th, 2016

NeuroMat Technology Transfer

- Innovations being developed by NeuroMat are strongly based on theoretical and conceptual developments obtained by our research team
- NeuroMat's technology transfer activities can be divided into two fronts:
  - Neuro-rehabilitation and diagnosis
  - Computational tools

Neuro-rehabilitation and diagnosis

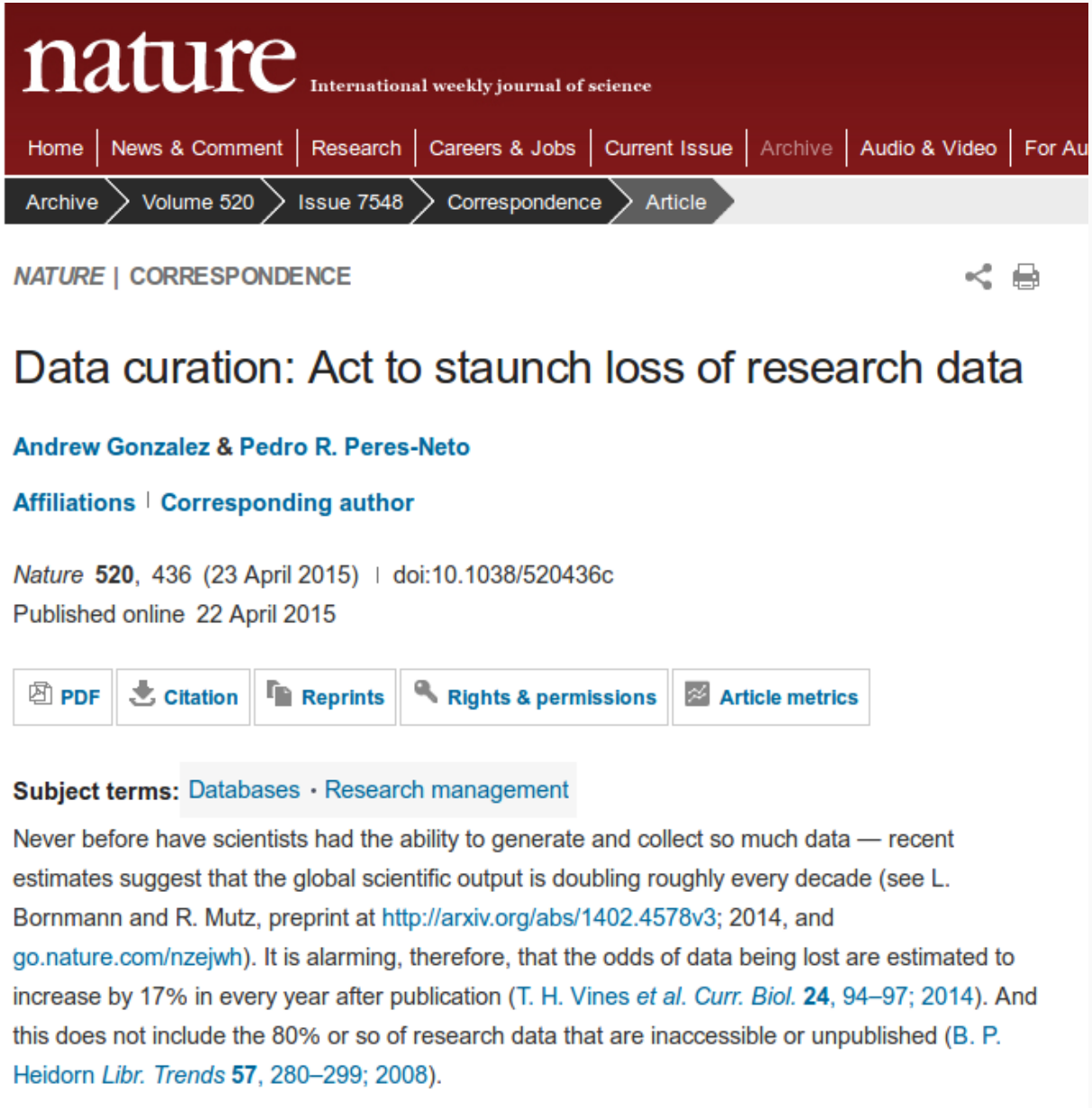
NeuroMat current initiatives on neuro-rehabilitation and diagnosis:

- Plasticity in brachial plexus avulsion
- Plasticity in Parkinsons disease
- Psychosis and psychiatric illnesses

Computational tools

NeuroMat focus is on the development of **free and open source** software tools:

- **Neuroscience Experiments System (NES)**
- Goalkeeper game
- NeuroMat database of neuroscientific data



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Archive > Volume 520 > Issue 7548 > Correspondence > Article

NATURE | CORRESPONDENCE

Data curation: Act to staunch loss of research data

Andrew Gonzalez & Pedro R. Peres-Neto

Affiliations | **Corresponding author**

Nature **520**, 436 (23 April 2015) | doi:10.1038/520436c
Published online 22 April 2015

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Subject terms: Databases · Research management

Never before have scientists had the ability to generate and collect so much data — recent estimates suggest that the global scientific output is doubling roughly every decade (see L. Bornmann and R. Mutz, preprint at http://arxiv.org/abs/1402.4578v3; 2014, and go.nature.com/nzejwh). It is alarming, therefore, that the odds of data being lost are estimated to increase by 17% in every year after publication (T. H. Vines *et al. Curr. Biol.* **24**, 94–97; 2014). And this does not include the 80% or so of research data that are inaccessible or unpublished (B. P. Heidorn *Libr. Trends* **57**, 280–299; 2008).

http://www.nature.com/nature/journal/v520/n7548/full/520436c.html

Some Public Electrophysiological / Neuroimaging Repositories

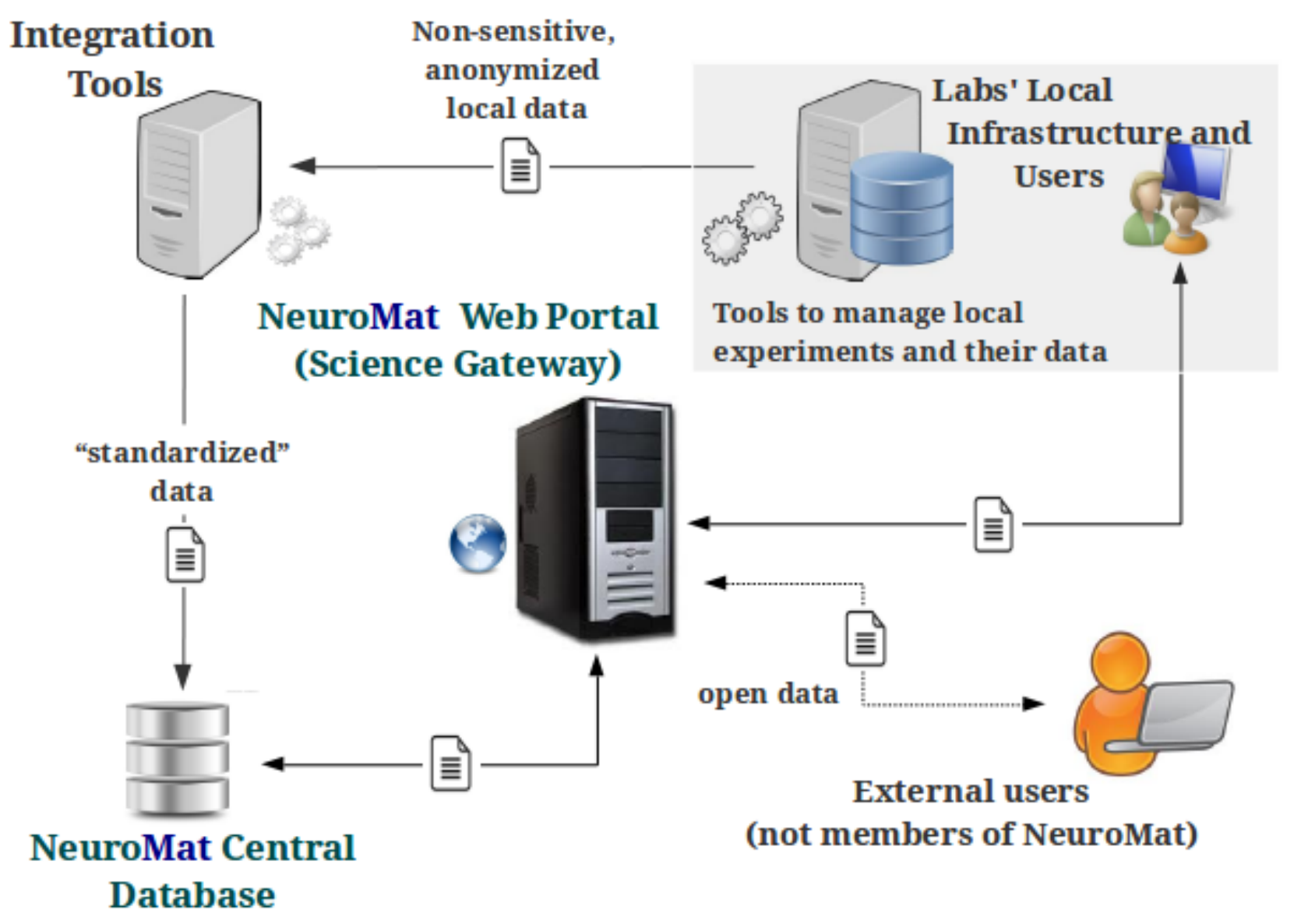
System	Purpose	Data Access
[1]EEGBase	EEG/ERP, experiments, scenarios	Open
[2]CARMEN	neurophysiology	Open
[3]CRCNS	Visual/auditory cortex, hippocampus, eye movements	Open
[4]NACC	Alzheimer's (NP, MRI)	Open/Restricted
[5]ABIDE	Autism (NP, MRI, fMRI)	Open
[6]OpenfMRI	Primary data (MRI, fMRI)	Open

[1]https://eegdatabase.kiv.zcu.cz
[2]http://www.carmen.org.uk
[3]https://crcns.org
[4]https://www.alz.washington.edu
[5]http://fcon1000.projects.nitrc.org/indi/abide
[6]https://openfmri.org

Challenges in Public Scientific Databases

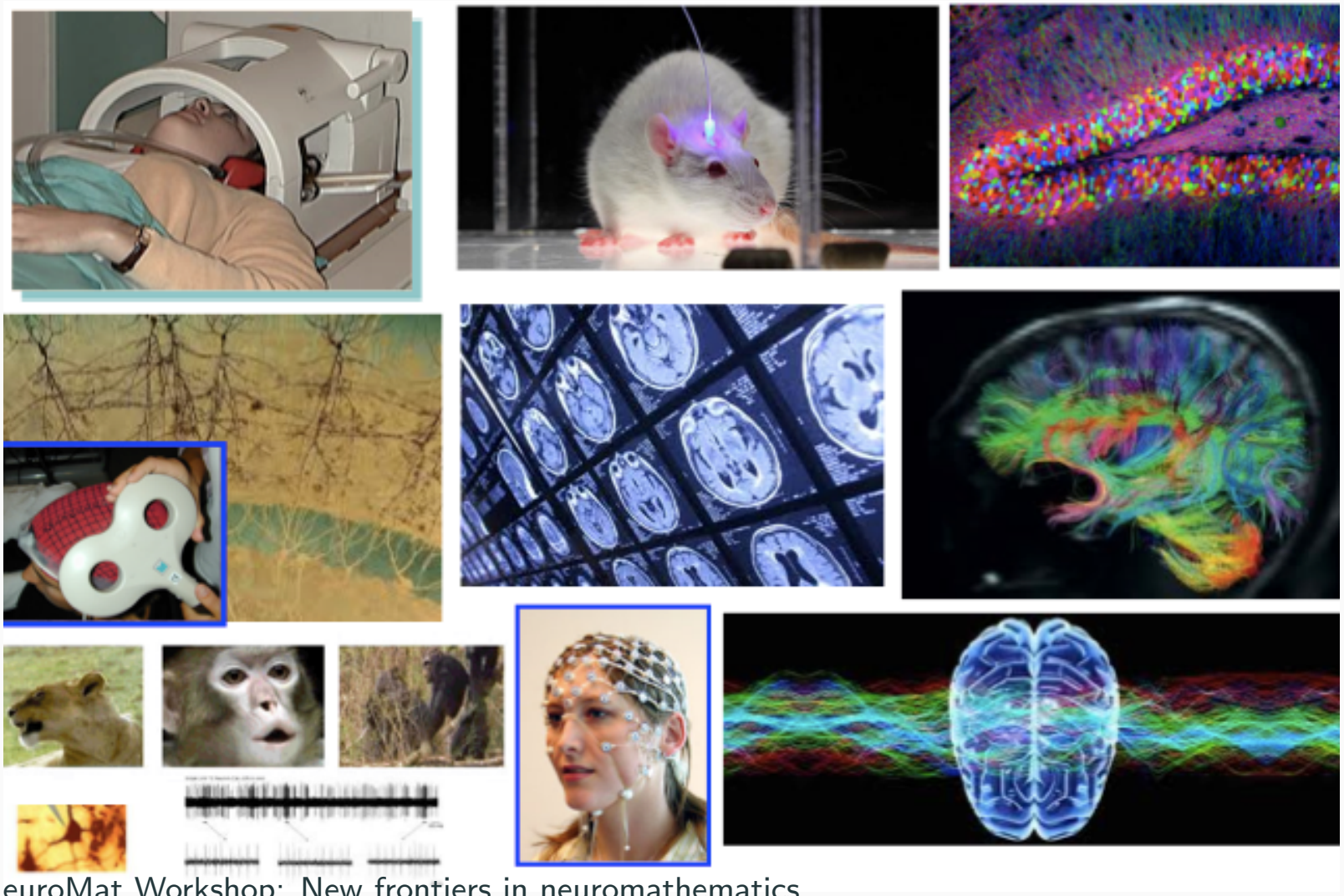
- **Poor quality**: inconsistency, incompleteness, "outdated" data, etc.
- **Insufficient documentation**; lack of metadata
- **Lack of standardization** in data representation
- **Overcomplicated access control** to data
- Requirement of **specific computer knowledge** and **additional software installation**
- Database as **mere data repository** (= "federation of datasets")
  - Datasets with different levels of quality and structures
  - Lack of an infrastructure where heterogeneous datasets can be viewed as a unique integrated repository

NeuroMat Databases & Data Management Software Tools



Neuroscience Experiments System – NES

Free, open-source software for the management of clinical and experimental neurophysiological data



Neuroscience Experiments System – NES

Free, open-source software for the management of clinical and experimental data

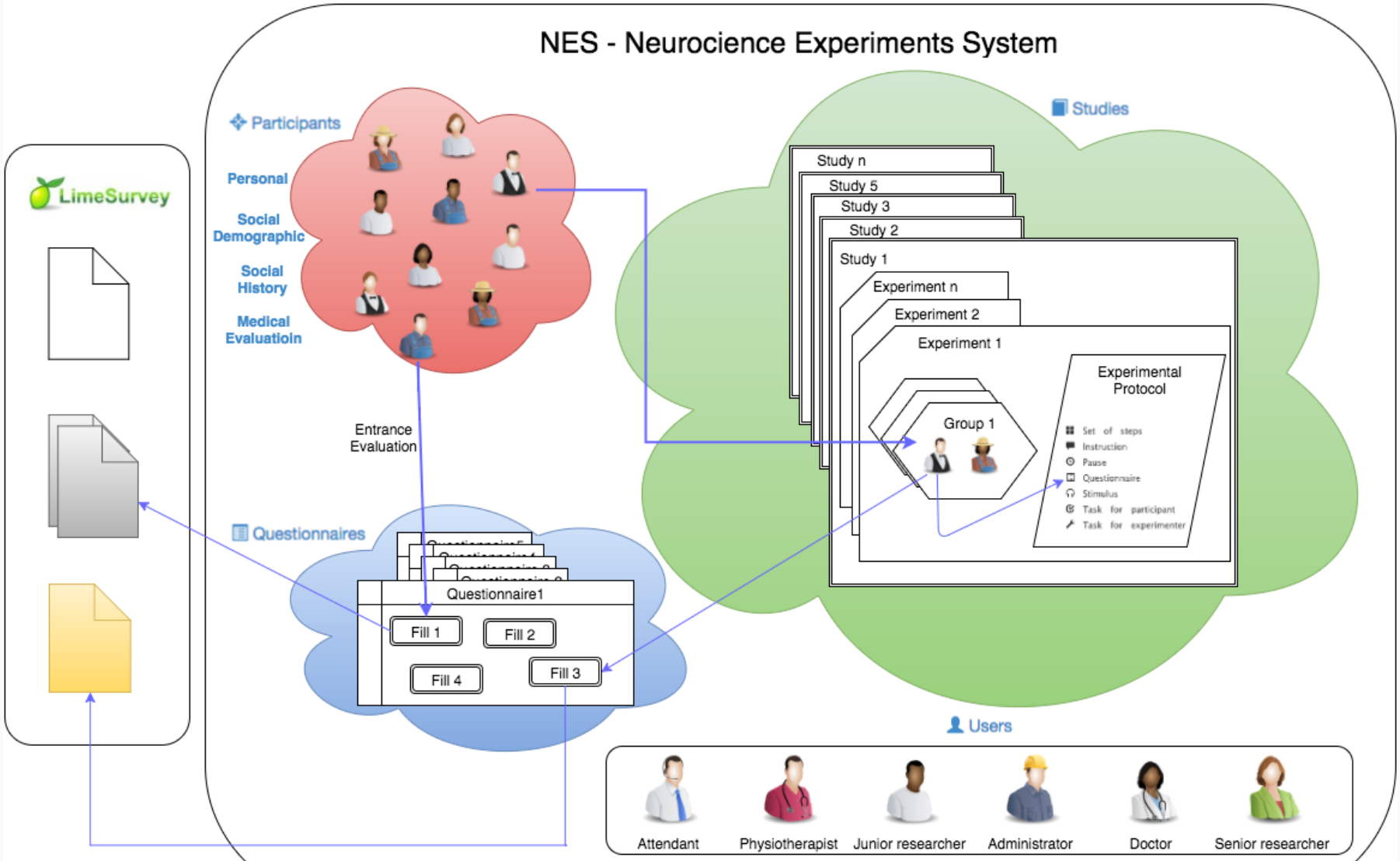
- Stores **raw data and metadata** of the experiment, including the description of the experimental protocol
- Integrates in a **centralized repository** all the experimental data from a research laboratory, group, or project
- Manages data from **different modalities**:
  - clinical, electrophysiological, surveys, etc.
- Web-based system; user-friendly interface

Neuroscience Experiments System – NES

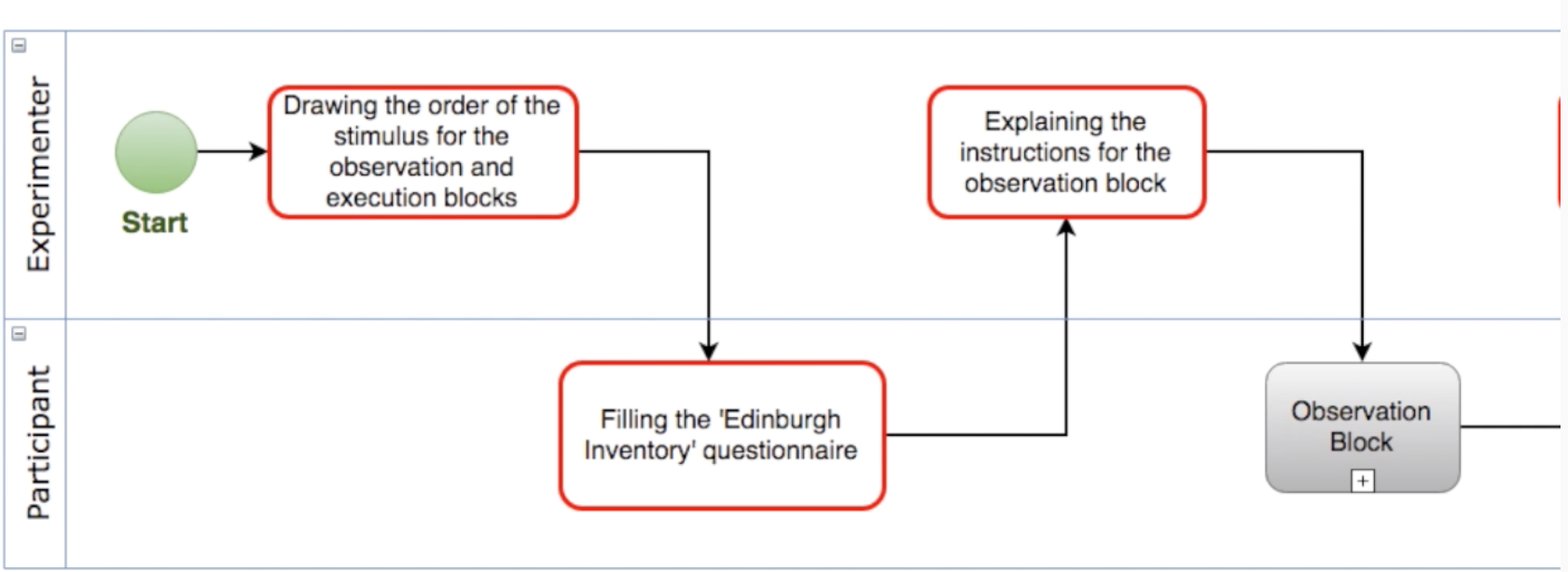
Free, open-source software for the management of clinical and experimental neurophysiological data

- Based on several proposals from the neuroscience community for data and metadata representation
- Under development since January 2014
- Current version: 1.3
- **In use at the Institute of Neurology Deolindo Couto – Rio de Janeiro State University since November 2014**
- Available at `https://github.com/neuromat/nes`

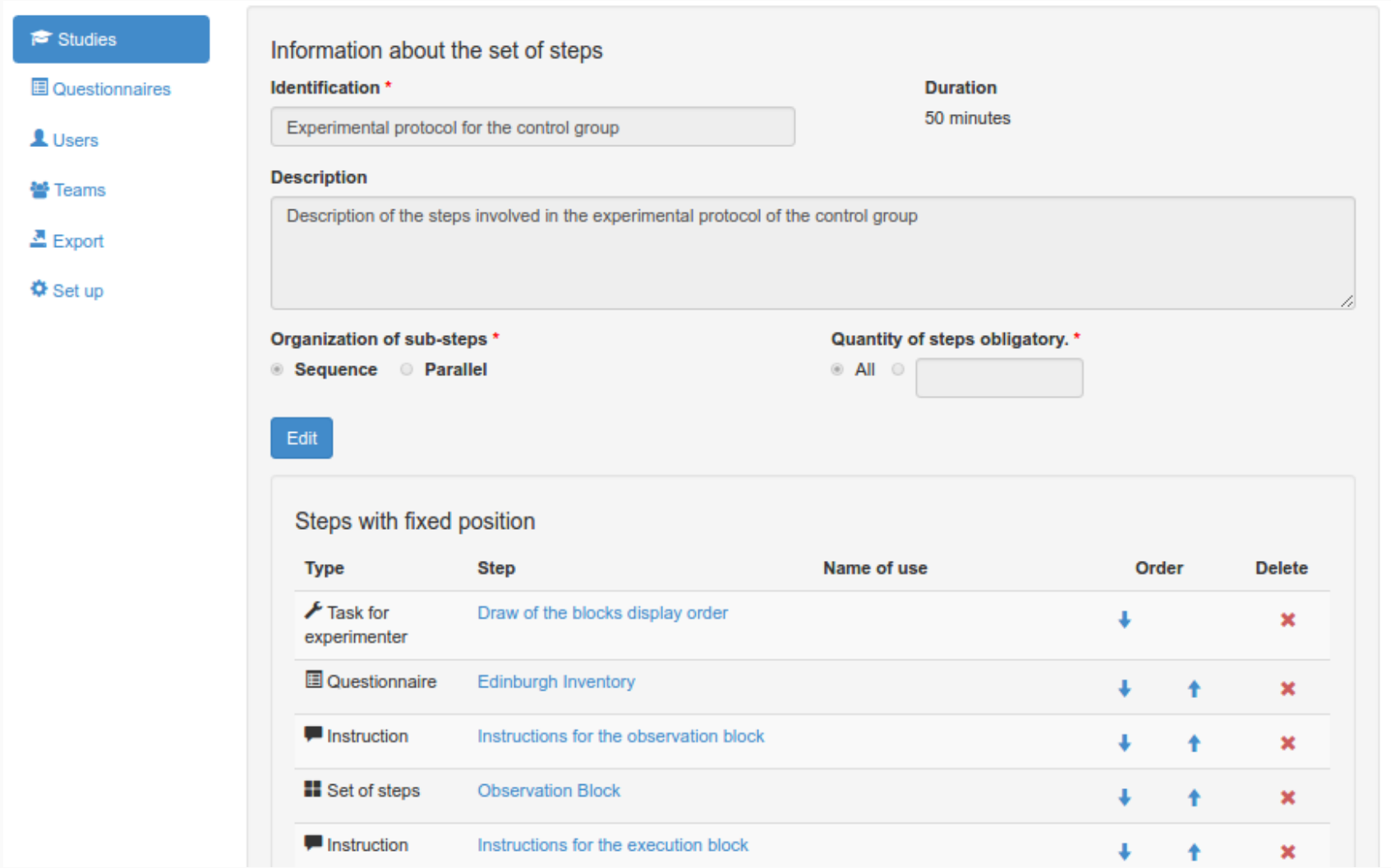
Neuroscience Experiments System – NES



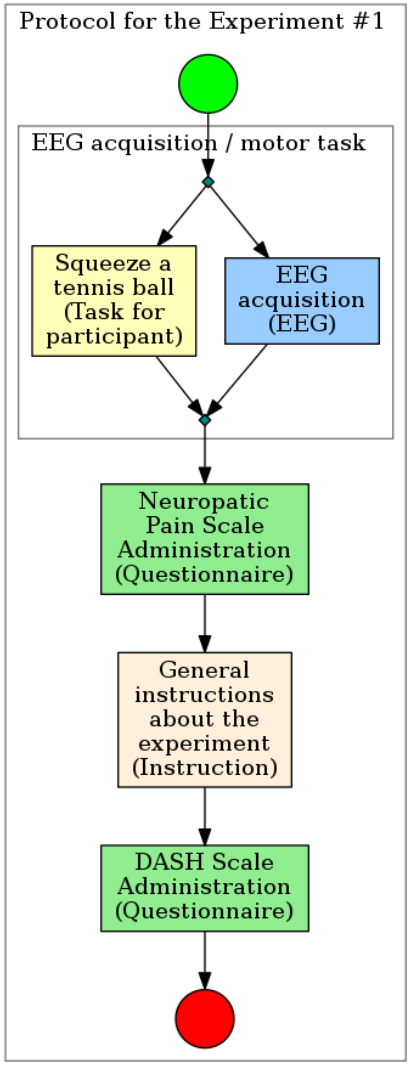
Neuroscience Experiments System – NES



Experimental Protocol – Definition



Experimental Protocol – Graphical Visualization



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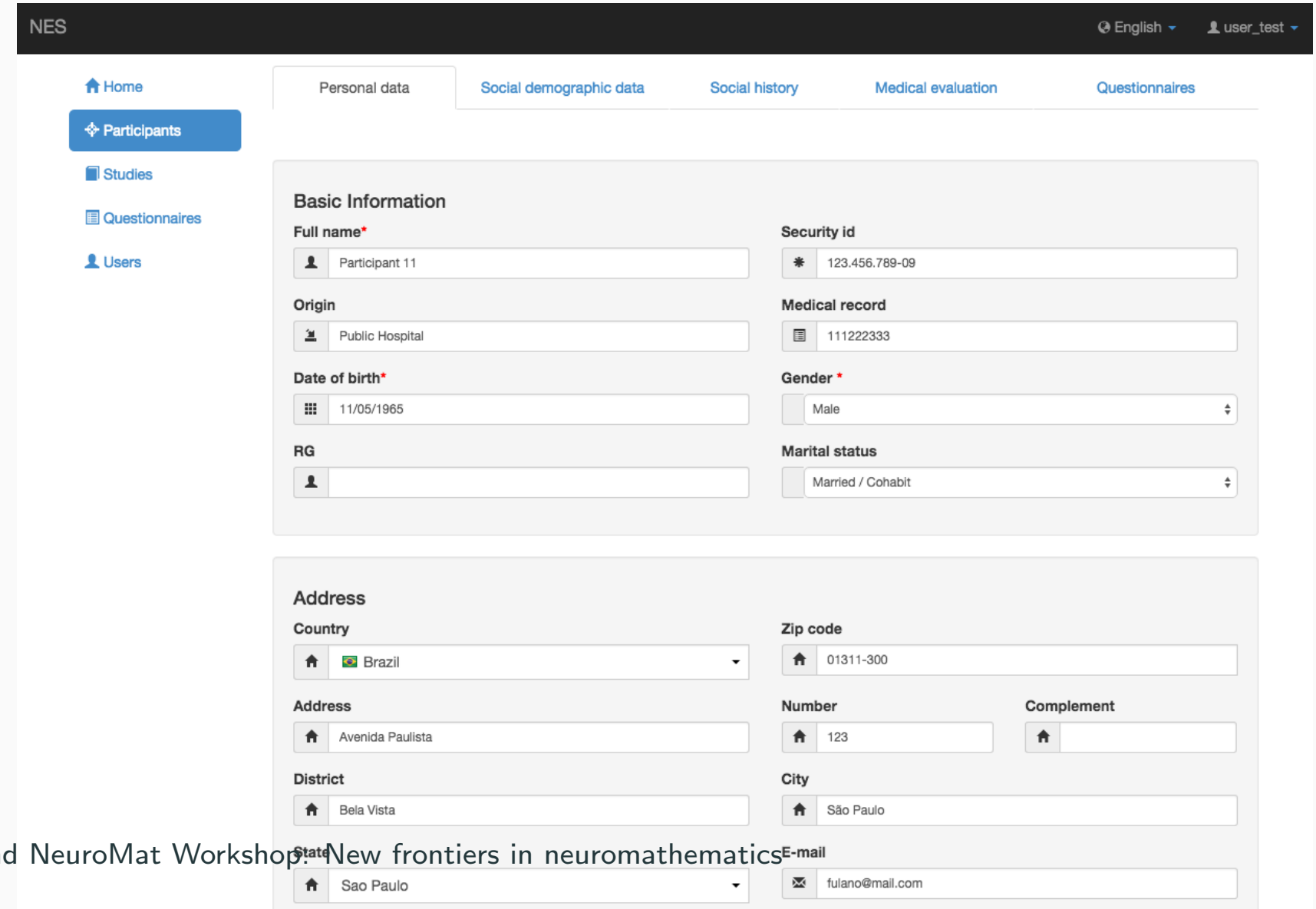
Experiment Participants



Neuroscience Experiments System – NES

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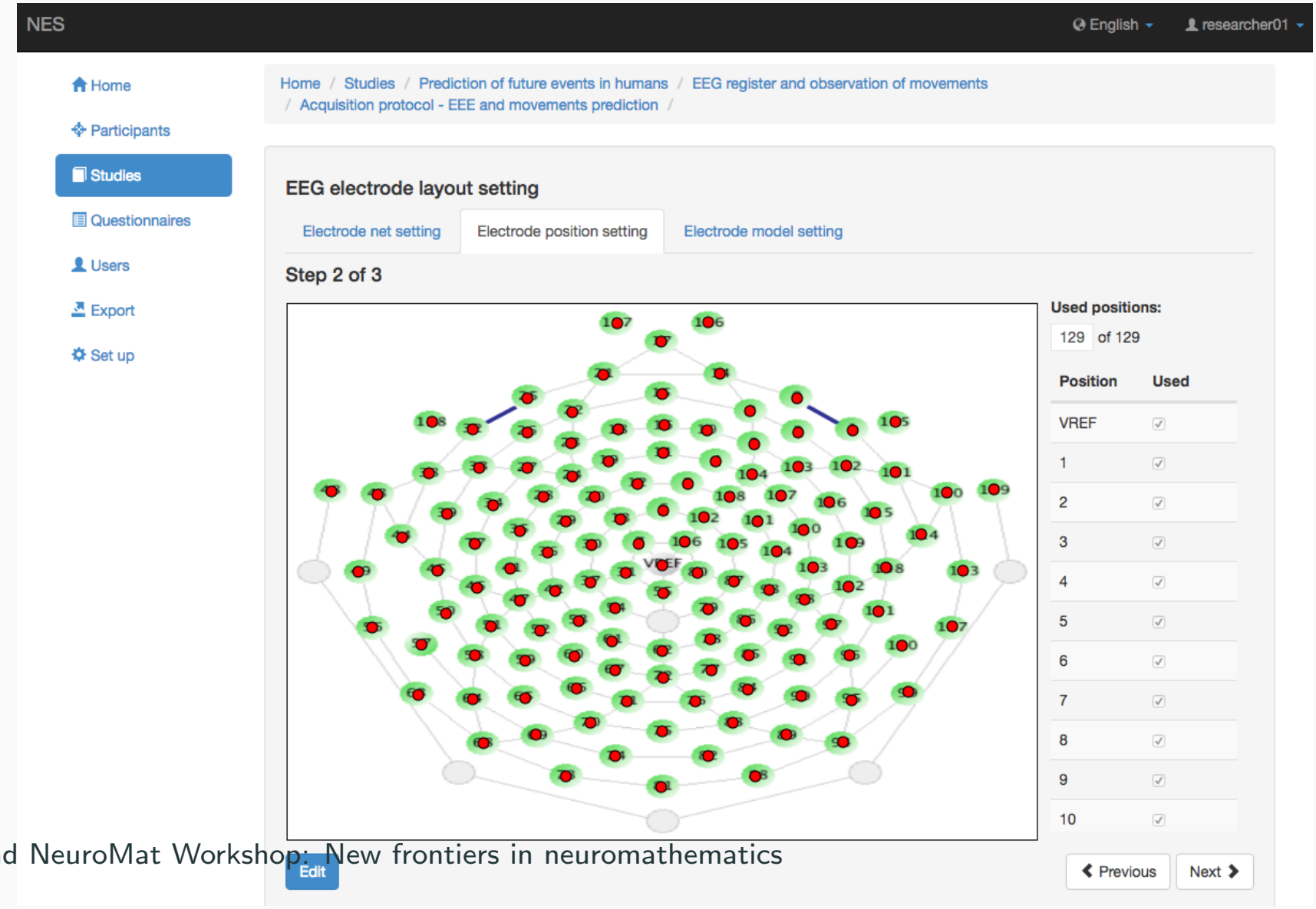
Electroencephalography (EEG) Data



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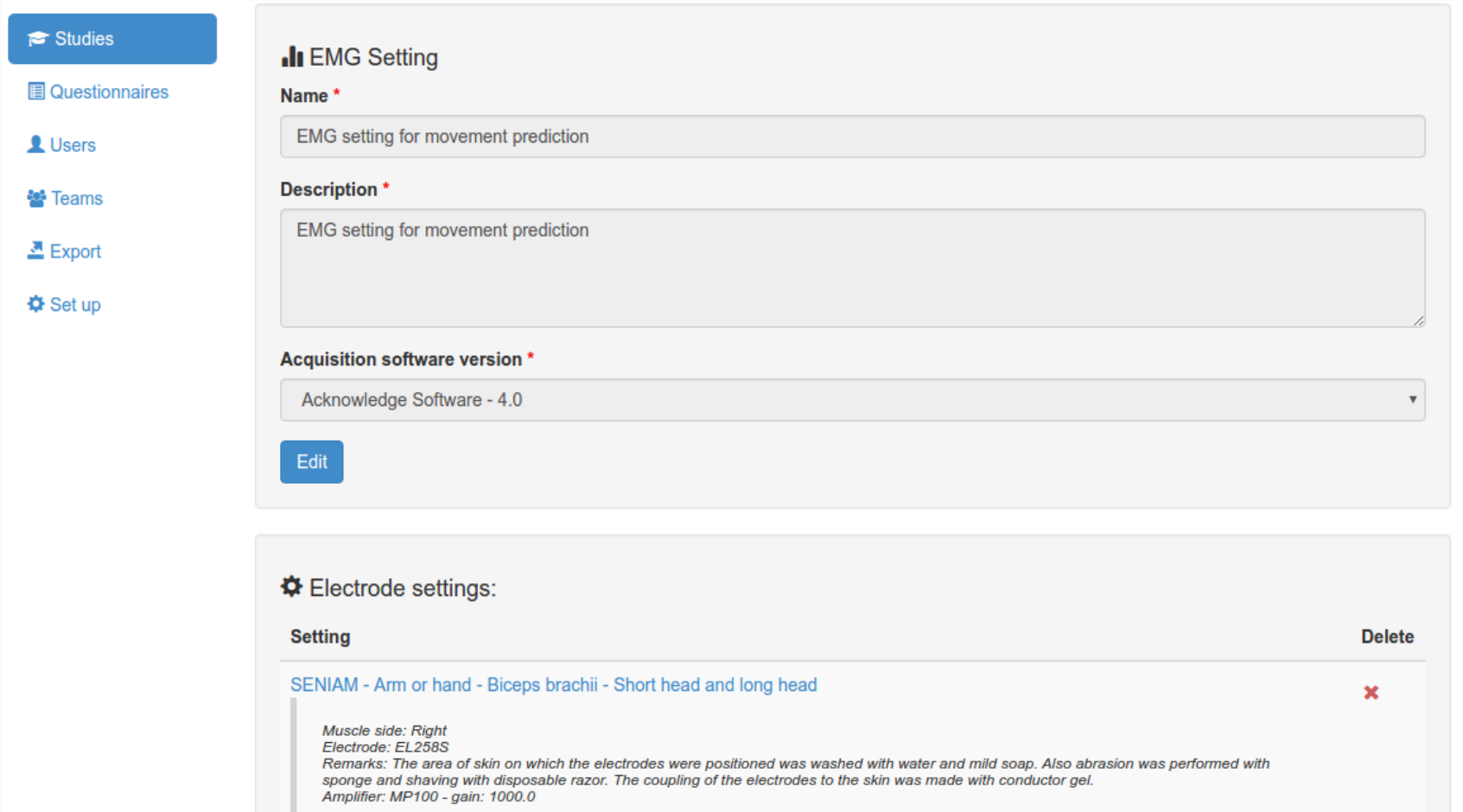
Electromiography (EMG) Data



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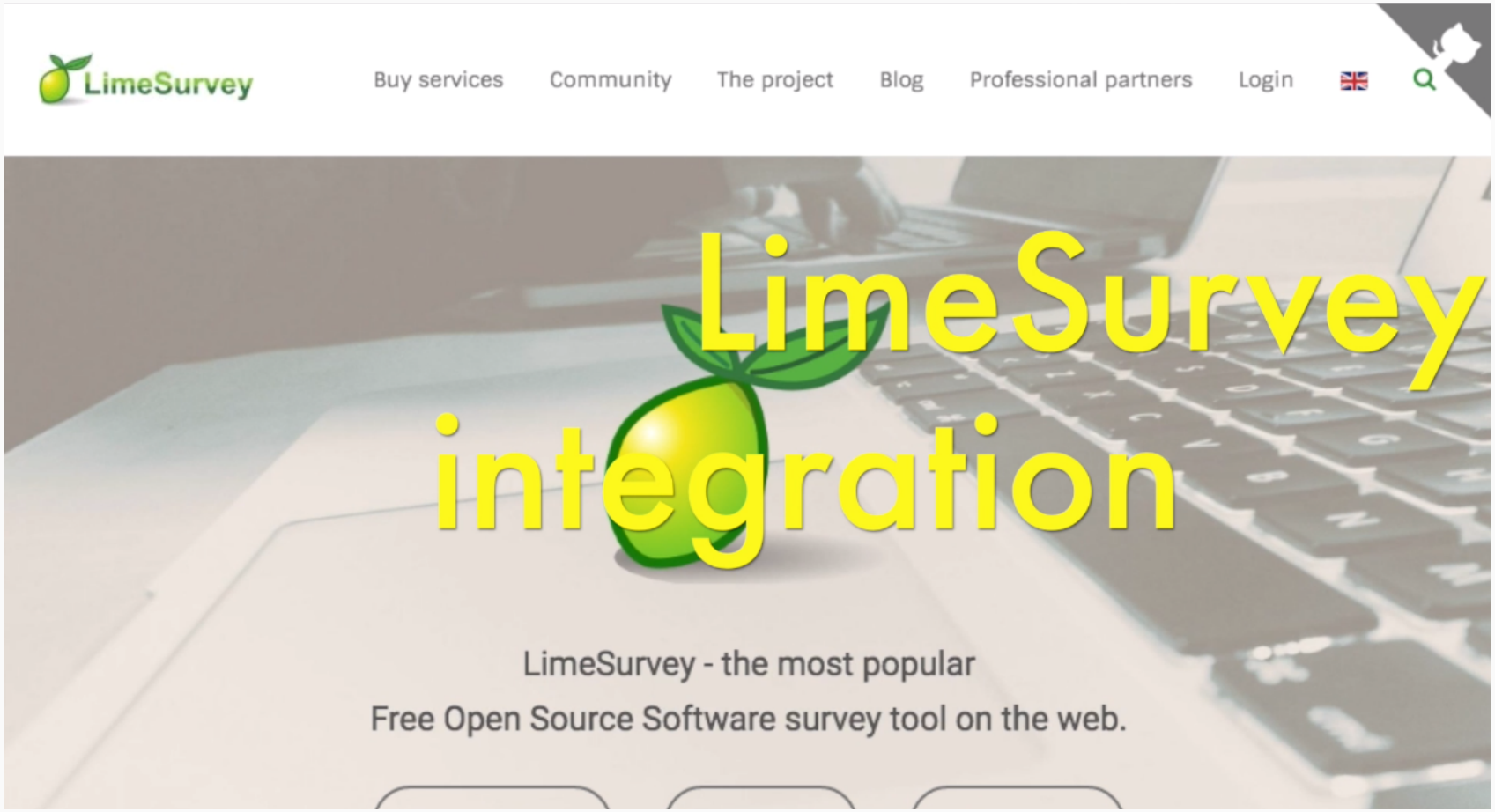
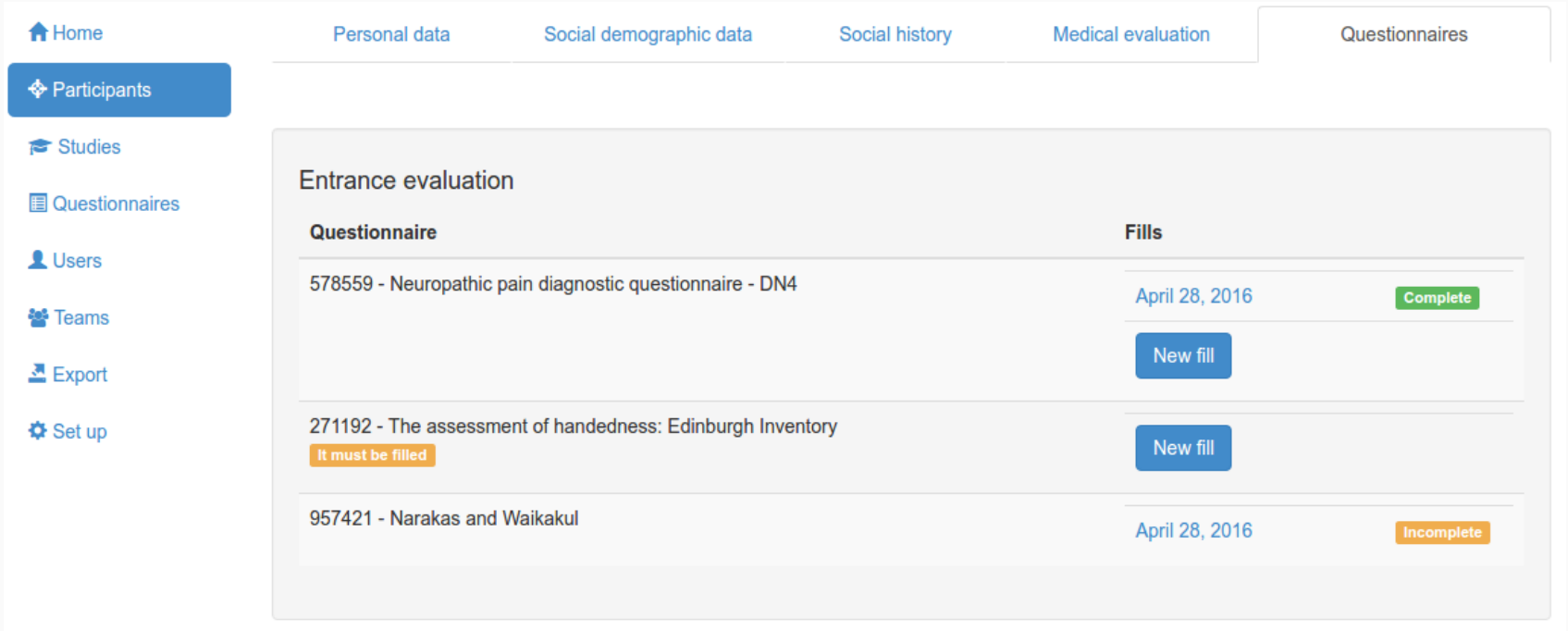


Neuroscience Experiments System – NES

Electronic Questionnaires



Electronic Questionnaires

The assessment of handedness: Edinburgh Inventory

OLDFIELD, 1971.

English

The assessment of handedness: Edinburgh Inventory
Oldfield (1971)

* **Have you ever had any tendency to left-handedness?**

○ Yes ◉ No

* **Is there someone left-handed in your family?**

○ Yes ◉ No

* **Please indicate your preferences in the use of hands in the following activities by putting +in the appropriate column. Where the preference is so strong that you would never try to use the other hand unless absolutely forced to, put ++. If in any case you are really indifferent put + in both columns. Some of the activities require both hands. In these cases the part of tthe task, or object, for wich hand-preference is wanted is indicated in brackets. Please try to answer all the questions, and only leave a blank if you have no experience at all of the object or task.**

	Right limb			Left limb		
	0	+	++	0	+	++
Writing	○	○	◉	◉	○	○
Drawing	○	◉	○	◉	○	○
Throwing	○	○	◉	○	◉	○

Neuroscience Experiments System – NES

Currently available modules enable users to manage data from:

- **Participants (subjects) of experiments**
  - Identification, social demographic and history data, medical records
- **Experiments**
  - Subject groups and their experimental protocols
  - Electrophysiological data and metadata (EEG, EMG, TMS)
- **Electronic questionnaire management**
  (integrated to *LimeSurvey* – `https://www.limesurvey.org/`)
- **Project organization**
- **Users and access control**

New Modules of NES

Currently under development:

- Neuroimaging data acquisition
- Data searching, importing and exporting

Next Steps:

- Behavioral data acquisition
- Derived Data
    - Analysis processes (= scientific workflows)
- Data from experiments with non-humans

Database Design & Software Development Team

Development Team

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- Evandro S. Rocha (NeuroMat – USP)
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- Kelly R. Braghetto (DCC – IME – USP)

INDC – UFRJ Research Group

Team involved with the design and use of NES:

- Claudia D. Vargas
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- Fernanda Torres
- Juliana S. Maia
- Lidiane Souza
- Maria Luiza S. Rangel
- (...)