Good Research Practices and Research Ethics (GRP)

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Course given in: **English**
ECTS Credits: **3 credits**, 24h
Max number of students: 20
Schedule: **Spring 2022**, 3.0h. course (weekly average)
Link to the schedule
Link to course website
Related programme: Doctoral school in Information Systems
Lemanic Neuroscience Doctoral School (LNDS)
Related courses: Philosophy of Social Science (G. Palazzo)
Experiments: Lab, Natural, Field and Quasi (C. Peukert and E. de Bellis)

Introduction

The goal of the course is to provide PhD students with an understanding of the **main perils that researchers can face during their careers**. Specifically, the course will support students in developing a critical mind necessary to spot issues affecting reproducibility and research integrity in the context of (preclinical and fundamental) research with both humans and animals.

The course will tackle **three main areas** of the contemporary debate on research excellence: **research ethics, scientific integrity, and reproducibility**. One of the aims of the instructors is to show how these topics are tightly interlinked. Another objective of this course is to provide students with **practical tools and strategies** to prevent experimental design mistakes, improve their scientific rigor, and conduct reproducible research.

The course will be taught using **contrasting case studies**: each core topic of the course will be presented through two case studies that reveal different facets of the same topic. Students will be asked to study the case studies, and prepare summaries highlighting the major ethical issues identified that will be presented and discussed in class.

Learning outcomes

At the end of the course students should be able to:

A. Recognize design flaws of scientific studies that might lead to irreproducible research
B. Refer to and integrate experimental designs that will lead to valid research results
C. Provide necessary elements in their scientific reporting that will allow their research to be reproducible and replicable.

D. Use commonly accepted Open Research repositories and software.

Course structure

This course is a studio/seminar. The course is organized in a **reversed classroom** format: each week students will have to watch a few videos detailing the theoretical content. Class time will be devoted to discussing theory, answering students' questions, practical activities, etc. The last class of the course is a **workshop**: students will be invited to bring their own experimental designs and discuss how their experiments could be improved by including and considering reproducibility and ethical elements in their setups.

Students will be asked **to review readings before each class** and present a critique of the articles in class. The students will have to demonstrate knowledge of topics, and design and research methodologies presented during the course.

Grading of the knowledge acquisition of the course will be based on two elements:

1. The project presented during the workshop;
2. A **final written exam** consisting of open-ended questions.

COVID-19: Due to the coronavirus situation, this year the course will be taught in modality hi-flex: students will be able to choose between attending in person, attending remotely via Zoom, and following the course asynchronously. The theoretical content comes via short video recordings. Class time will be devoted to presentations, Q&A, exercises, and group activities. Classes can be attended physically or via Zoom. Because of the health evolution related to COVID-19, the study plans may be adapted during the semester.

Resources

All the content is available on the web site of the class (Moodle) and on the Ubicast channel of the course (rec.unil.ch).

The class will loosely follow the following books:

- Lazic, S. E. (2016). Experimental design for laboratory biologists: Maximising information and improving reproducibility. Cambridge University Press.
- American Psychological Association. (2020). Publication manual of the American Psychological Association (7th ed.). https://doi.org/10.1037/0000165-000

During the course, we will use different software for training and animate the classwork. Students will need to **bring their laptop** to class.

Pre-requisites

- Students need to have basic knowledge of Statistics (cf. Bachelor course "Statistics").
- We will try to adapt the technical prerequisite of the course to the audience. We will measure fluency with the following languages at signup: `R`, `SPSS`, coding/programming.

Maximum and minimum attendance

The course will be given with a minimum attendance of 6 students. Given the design of the course and the close-level coaching of the pedagogical activities, we have set a maximum attendance of 20 students.

Interested students will be required to sign up for the course using this form. Confirmation of official enrolment in the course will be sent to the students 2 weeks before the first class.

Evaluation

First attempt
Exam: Written 1h00 hours
Documentation: Not allowed
Calculator: Not allowed

Evaluation:
The evaluation has two elements:
- Assessment of the **workshop individual project** (20%)
- **Written exam**: open-ended questions (80%)

Active participation in classroom/Zoom activities will entitle the student to a 0.5 point bonus on the final grade. Active participation means making concrete contributions to classroom work (e.g, present result of group activity, provide detailed answers to a question).

Specific regulations:
- **A minimum grade of 3.0 in the written exam is required for other activities to count towards the final grade.** If the grade achieved in the written exam is less than this, other elements (i.e., active participation bonus, or workshop individual project) will not be part of final grade consideration.
- The written exam is a "open book" examination. Only dictionaries are allowed.

Retake
Students will be given the option to go for an oral exam instead of a written exam. If one of the students in the retake session prefers the written exam, then all students in the retake session will have to take the written exam, like for the first exam session.

Exam: Oral 0h20 minutes exam plus 0h20 minutes preparation

Documentation: Not allowed
Calculator: Not allowed

Evaluation:

- The grade of the oral examination will replace the grade obtained during the final written exam. The other gradings (workshop individual project, active participation bonus) will remain unchanged and are part of the computing for the final grade.

Detailed schedule

Classes are held in the room indicated in the schedule spreadsheet from **2pm to 5pm**.

Class	Content
C01 [3h]	**Scientific Integrity** ● What is scientific integrity? ● Why do we do what we do? a personal take on scientific integrity ● Why does scientific integrity get degraded? **Training activity** ● case studies: students will be challenged with scenarios that touch upon choices considered daily routine in a laboratory setting **Reading material** ● *Nature* Journals' competing interests declaration: https://www.nature.com/nature/editorial-policies/competing-interests ● Daniele Fanelli. How Many Scientists Fabricate and Falsify Research? A Systematic Review and Meta-Analysis of Survey Data. *PLOS*, (2009). https://doi.org/10.1371/journal.pone.0005738 ● Nicholas H. Steneck. Fostering integrity in research: Definitions, current knowledge, and future directions. *Science and Engineering Ethics*, (2006). https://doi.org/10.1007/PL00022268 ● David B. Resnik & Adil E. Shamoo**.** The Singapore Statement on Research Integrity. *Accountability in Research*, (2010). https://www.tandfonline.com/doi/full/10.1080/08989621.2011.557296
C02 [3h]	**Reproducibility and Replicability** ● What is reproducible research? ● What are the main causes of irreproducible research? Biases (e.g., selection, confounding, confirmation, anchoring, social desirability). Low statistical power. P-hacking. Herding effect, Academic 'abandonware'. ● Endogeneity ● HARKing **Training activity**

	• Case studies: several readings will be proposed and reviewed in class. The goal will be to identify reproducibility flaws. **Reading material** • Intro reproducibility: Open Science Collaboration. "Estimating the reproducibility of psychological science." *Science* 349, no. 6251 (2015). https://doi.org/10.1126/science.aac4716 • Gilbert, Daniel T., Gary King, Stephen Pettigrew, and Timothy D. Wilson. "Comment on “Estimating the reproducibility of psychological science”." *Science* 351, no. 6277 (2016): 1037-1037. https://doi.org/10.1126/science.aad7243 • Overview paper: Munafò, Marcus R., Brian A. Nosek, Dorothy VM Bishop, Katherine S. Button, Christopher D. Chambers, Nathalie Percie Du Sert, Uri Simonsohn, Eric-Jan Wagenmakers, Jennifer J. Ware, and John PA Ioannidis. "A manifesto for reproducible science." *Nature Human Behaviour* 1, no. 1 (2017): 1-9. http://dx.doi.org/10.1038/s41562-016-0021 • For discussion: Halsey, Lewis G., Douglas Curran-Everett, Sarah L. Vowler, and Gordon B. Drummond. "The fickle P value generates irreproducible results." *Nature Methods* 12, no. 3 (2015): 179-185. https://doi.org/10.1038/nmeth.3288 • Goodman Steven N., Fanelli Daniele, & Ioannidis John P. A. (2016). What does research reproducibility mean? *Science Translational Medicine*, 8(341), 341ps12-341ps12. https://doi.org/10.1126/scitranslmed.aaf5027 • Ioannidis, J. P. A. (2005). Why Most Published Research Findings Are False. *PLOS Medicine*, 2(8), e124. https://doi.org/10.1371/journal.pmed.0020124 • Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-Positive Psychology: Undisclosed Flexibility in Data Collection and Analysis Allows Presenting Anything as Significant. *Psychological Science*, 22(11), 1359–1366. https://doi.org/10.1177/0956797611417632 • Kerr, N. L. (1998). HARKing: Hypothesizing after the results are known. *Personality and Social Psychology Review*. 2 (3): 196–217. doi:10.1207/s15327957pspr0203_4 • Head ML, Holman L, Lanfear R, Kahn AT, Jennions MD (2015) The Extent and Consequences of P-Hacking in Science. *PLOS Biology* 13(3): e1002106. https://doi.org/10.1371/journal.pbio.1002106 • Sullivan, L. M., Weinberg, J., & Keaney, J. F. (n.d.). Common Statistical Pitfalls in Basic Science Research. *Journal of the American Heart Association*, 5(10), e004142. https://doi.org/10.1161/JAHA.116.004142
C03 [3h]	**Strategies to Design Reproducible Research** • Detection of reporting inconsistencies and errors • Experimental design (e.g., triangulation, blinding; systematic random sampling; inclusion of controls; pseudo-random number generator) • Power analysis (inc. simulations) • P-curves • Exploratory vs confirmatory hypothesis testing • Methods of quality control for reliability and reproducibility • Restructuring incentives

	Training activity ● Power analyses: several experimental designs will be provided to the class. Students will be asked to compute a power analysis and identify the number of study participants required or verify whether the collected data had enough statistical power to detect effects. **Reading material** ● Simmons, J. P., Nelson, L. D., Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological Science*, 22, 1359-1366 https://doi.org/10.1177/0956797611417632 ● Simonsohn, U., Nelson, L. D., & Simmons, J. P. (2014). P-curve: A key to the file-drawer. *Journal of Experimental Psychology*: General, 143, 534-547 https://doi.org/10.1037/a0033242 ● Bishop, Dorothy VM. "Fallibility in science: Responding to errors in the work of oneself and others." *Advances in Methods and Practices in Psychological Science* 1, no. 3 (2018): 432-438. https://doi.org/10.1177/2515245918776632 ● Exploratory vs confirmatory: Wagenmakers, Eric-Jan, Ruud Wetzels, Denny Borsboom, Han LJ van der Maas, and Rogier A. Kievit. "An agenda for purely confirmatory research." *Perspectives on Psychological Science* 7, no. 6 (2012): 632-638. https://doi.org/10.1177/1745691612463078 ● Power: Lakens, Daniel. 2021. “Sample Size Justification.” PsyArXiv. January 4. https://doi.org/10.31234/osf.io/9d3yf ● Halsey, Lewis G., Douglas Curran-Everett, Sarah L. Vowler, and Gordon B. Drummond. "The fickle P value generates irreproducible results." *Nature methods* 12, no. 3 (2015): 179-185. https://doi.org/10.1038/nmeth.3288 ● Cumming, Geoff, and Sue Finch. "Inference by eye: confidence intervals and how to read pictures of data." *American psychologist* 60, no. 2 (2005): 170. https://doi.org/10.1037/0003-066X.60.2.170 ● Bik, Elisabeth M., Arturo Casadevall, and Ferric C. Fang. "The prevalence of inappropriate image duplication in biomedical research publications." *MBio* 7, no. 3 (2016): https://doi.org/10.1128/mBio.00809-16
C04 [3h]	**How to Tell the Truth with Numbers** ● Reporting guidelines ● Statistical analysis plans ● JASP: open-source statistical software ● Avoiding statistical pitfalls ● Computational notebooks in R (guest speaker) ● Practise on simulations **Training activity** ● Computational notebooks: students will be asked to prepare a computational notebook to share the statistical analysis of their study with reviewers or with the readers. We will discuss style and conventions to produce these artifacts.

	Reading material ● Wilson, Greg, Dhavide A. Aruliah, C. Titus Brown, Neil P. Chue Hong, Matt Davis, Richard T. Guy, Steven HD Haddock et al. "Best practices for scientific computing." *PLoS biology* 12, no. 1 (2014): e1001745. https://doi.org/10.1371/journal.pbio.1001745 ● Pollard, D. A., Pollard, T. D., & Pollard, K. S. (2019). Empowering statistical methods for cellular and molecular biologists. *Molecular Biology of the Cell*, 30(12), 1359–1368. https://doi.org/10.1091/mbc.E15-02-0076 ● Wilkinson, M. D. et al (2016). The FAIR Guiding Principles for scientific data management and stewardship. Scientific Data, 3(1), 160018. https://doi.org/10.1038/sdata.2016.18
C05 [3h]	**Open Research** ● Data acquisition and ownership ● Why are data not shared? ● Manage and share your research ● Study protocols, questionnaire definitions, consent forms ● Registered reports and study preregistration ● Open datasets, anonymization, and licensing ● Threats of Open Data (e.g., training-set leakage) ● Examples and discussion **Training activities** ● Anonymise example dataset: a demo of a software for anonymising a dataset will be provided. ● Create repository with OSF: students will be asked to create a test repository with OSF. In addition we will look for published projects (e.g. github/OSF) as an example of how this could help students with their own projects. **Reading material** ● Chambers, C. D. and L. Tzavella (2021). "The past, present and future of Registered Reports." Nature Human Behaviour. http://dx.doi.org/10.1038/s41562-021-01193-7 ● Preregistration: First analysis of 'pre-registered' studies shows sharp rise in null findings.*doi:* https://doi.org/10.1038/d41586-018-07118-1
C06 [3h]	**Human Participation in Research** ● Compliance and ethics terms ● Interpersonal responsibility ● Vulnerable populations ● Conflict of interest ● Examples and discussion **Training activity** ● Prepare informed consent: students will be asked to prepare an informed consent for a study with particular focus on compliance with the ethics terms of UNIL. In addition students will be asked to detail their data

	management plan. **Reading material** ● Quinn, C. R. (2015). General considerations for research with vulnerable populations: Ten lessons for success. *Health & Justice*, 3(1), 1. https://doi.org/10.1186/s40352-014-0013-z ● Tai, M. C.-T. (2012). Deception and informed consent in social, behavioral, and educational research (SBER). *Tzu Chi Medical Journa*l, 24(4), 218–222. https://doi.org/10.1016/j.tcmj.2012.05.003 ● John Rooksby, Parvin Asadzadeh, Alistair Morrison, Claire McCallum, Cindy Gray, and Matthew Chalmers. 2016. Implementing ethics for a mobile app deployment. In *Proceedings of the 28th Australian Conference on Computer-Human Interaction* (OzCHI '16). Association for Computing Machinery, New York, NY, USA, 406–415. https://doi.org/10.1145/3010915.3010919
C07 [3h]	**Animal Participation in Research** ● 3Rs (Replacement, Reduction and Refinement) ● The EQIPD quality system for preclinical data ● Experimental Design Assistant (EDA, NC3Rs UK) ● Studying cognition in animals: pitfalls & opportunities **Training activity** ● Interactive exercise: develop a therapy (from bench to bedside) for Alzheimer's disease **Reading material** ● Bespalov et al, **Introduction to the EQIPD Quality System**. eLife 2021. 10:e63294 https://doi.org/10.7554/eLife.63294 ● Nathalie Percie du Sert et al, **The ARRIVE guidelines 2.0: Updated guidelines for reporting animal research**. PLOS Biology, 2020. https://doi.org/10.1371/journal.pbio.3000410 ● Adrian J Smith, R Eddie Clutton, Elliot Lilley, Kristine E Aa Hansen, Trond Brattelid. **PREPARE: guidelines for planning animal research and testing**. Laboratory Animals, 2017. https://doi.org/10.1177/0023677217724823
C08 [3h]	**Workshop** Students will present research data (either their own data, experimental design, or peer-reviewed articles) using the point of view of a 'reproducibility scientist'. The goal is to probe the student's ability to apply the concepts and tools acquired during the course. This will be an open-discussion session where student-to-student discussions are encouraged) using the point of view of a 'reproducibility scientist'.