Good scientific practice

Why and how to do honest research...

... and how to avoid doing the opposite!!

Henrik Hartmann, BGP
Outline

• Content
  – Part I: What is misconduct and what are the rules of good scientific practices?
  – Part II: Guidelines for early-career scientists on selected issues...
    ... Ethics, psychological aspects, authorship, manuscripts, (statistics)

• Structure
  – The official parts (MPG rules) → not very interesting
  – Deeper insights → interesting
  – Homework → very interesting !!

• Formula
  – Interactive (please ask questions and give comments)

• Evaluation and credits
  – 0.2 points + homework (see later)
GSP - why do we have to care?
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- Science is based on TRUST
  - The public must trust our results (to give us money)
  - Other scientist must trust our scientific method and ethics to collaborate
GSP - why do we have to care?

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  – The public must trust our results (to give us money)
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• HONESTY is the basis for trust and violation of honesty destroys trust in science
GSP - why do we have to care?

- Science is based on TRUST
  - The public must trust our results (to support funding)
  - Other scientist must trust our scientific method and ethics to collaborate

- Honesty is the basis for trust and violation of honesty destroys trust in science

- Science is a methodical and systematic process
  - Gaining knowledge with trustable (i.e. verifiable and reproducible) results
Sources of misconduct
Sources of misconduct

• Lack of care
  − Application of scientific methods
  − Data handling
Sources of misconduct

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- Deliberate misconduct
  - Falsification of data or results
  - Deceit
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5 Data points changed
Examples of misconduct
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- False statements
  - Fabrication of data
  - Falsification of data → selective reporting, rejection of unwanted results
  - Incorrect statements
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  - Incorrect statements

- **Infringement of intellectual property**
  - Plagiarism
  - Theft of ideas, findings, hypotheses, theory or methods
  - Usurpation of authorship or unjustified acceptance of it
  - Unauthorized publishing of others’ work
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• Impairment of research work of others
  - Sabotage of research work

• Taking part in misconduct of others
Examples of misconduct

- See APPENDIX 1 of “Rules”
Scientists behaving badly...
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- Jan Hendrik Schön
  - German 'Wunderkind'
  - Bell Laboratories
  - Secret candidate for Nobel price
  - 1 paper every 8 days in 2001-2002
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- Jan Hendrik Schön
  - German 'Wunderkind'
  - Bell Laboratories
  - Secret candidate for Nobel price
  - 1 paper every 8 days in 2001-2002
  - Many of his papers were retracted
  - Lost his job
  - Cannot work as scientist anymore
Responsibility for bad behavior

Am I safe of such behavior?
What are the most popular misconducts?
Scientists behaving badly...

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Percentage of scientists who say that they engaged in the behaviour listed within the previous three years (n = 3,247)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Top ten behaviours</strong></td>
<td></td>
</tr>
<tr>
<td>1. Falsifying or ‘cooking’ research data</td>
<td>0.3</td>
</tr>
<tr>
<td>2. Ignoring major aspects of human-subject requirements</td>
<td>0.3</td>
</tr>
<tr>
<td>3. Not properly disclosing involvement in firms whose products are based on one’s own research</td>
<td>0.3</td>
</tr>
<tr>
<td>4. Relationships with students, research subjects or clients that may be interpreted as questionable</td>
<td>1.4</td>
</tr>
<tr>
<td>5. Using another’s ideas without obtaining permission or giving due credit</td>
<td>1.4</td>
</tr>
<tr>
<td>6. Unauthorized use of confidential information in connection with one’s own research</td>
<td>1.7</td>
</tr>
<tr>
<td>7. Failing to present data that contradict one’s own previous research</td>
<td>6.0</td>
</tr>
<tr>
<td>8. Circumventing certain minor aspects of human-subject requirements</td>
<td>7.6</td>
</tr>
<tr>
<td>9. Overlooking others’ use of flawed data or questionable interpretation of data</td>
<td>12.5</td>
</tr>
<tr>
<td>10. Changing the design, methodology or results of a study in response to pressure from a funding source</td>
<td>15.5</td>
</tr>
<tr>
<td><strong>Other behaviours</strong></td>
<td></td>
</tr>
<tr>
<td>11. Publishing the same data or results in two or more publications</td>
<td>4.7</td>
</tr>
<tr>
<td>12. Inappropriately assigning authorship credit</td>
<td>10.0</td>
</tr>
<tr>
<td>13. Withholding details of methodology or results in papers or proposals</td>
<td>10.8</td>
</tr>
<tr>
<td>14. Using inadequate or inappropriate research designs</td>
<td>13.5</td>
</tr>
<tr>
<td>15. Dropping observations or data points from analyses based on a gut feeling that they were inaccurate</td>
<td>15.3</td>
</tr>
<tr>
<td>16. Inadequate record keeping related to research projects</td>
<td>27.5</td>
</tr>
</tbody>
</table>

Note: significance of χ² tests of differences between mid- and early-career scientists are noted by ** (P<0.01) and *** (P<0.001).

Rules of good scientific practice

How to avoid misconduct
Regulations to avoid misconducts

- General principles governing scientific practice
- Cooperation and leadership responsibility within working groups
- Guidance for junior scientists
- Securing and storing primary data
- Data protection
- Scientific publications
- Conflict of interest
- Appointing ombudsman
- Whistleblower protection
Scientific care and ethics

• Data:
  – Follow rules for acquiring, selecting and processing data
  – Reliable securing and storage of primary data
  – Clear and comprehensible documentation of methods and results
Scientific care and ethics

- **Data:**
  - Follow rules for acquiring, selecting and processing data
  - Reliable securing and storage of primary data
  - Clear and comprehensible documentation of methods and results

- **Scientific ethics:**
  - Apply systematic skepticism, openness to doubt
  - Avoid wishful thinking, misinterpretations and over-generalizations

• General regulations governing scientific practice
Death from drought in tropical forests is triggered by hydraulics not carbon starvation

L. Rowland¹, A. C. L. da Costa², D. R. Galbraith³, R. S. Oliveira⁴, O. J. Binks⁵, A. A. R. Oliveira², A. M. Pullen⁵, C. E. Doughty⁶, D. B. Metcalfe⁷, S. S. Vasconcelos⁸, L. V. Ferreira⁹, Y. Malti⁵, J. Grace¹, M. Mencuccini¹⁰,¹¹ & P. Meir¹,¹¹
Wishful thinking and over-generalization

- General regulations governing scientific practice
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Colleagues and cooperation

- No hindrance of other people’s work
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- No hindrance of other people’s work
- (Active promotion of junior scientists’ qualification)
Colleagues and cooperation

- No hindrance of other people’s work

- (Active promotion of junior scientists’ qualification)

- Openness to criticism by other scientists and colleagues
Publication of results

- Principle of public availability of research results

- General regulations governing scientific practice
Publication of results

- Principle of public availability of research results
- Correction of published mistakes

ERRATA

In the paper by Waldrop et al. (2004), entitled “Nitrogen deposition modifies soil carbon storage through changes in microbial enzymatic activity” (Ecological Applications 14(4):1172-1177), the units for soil organic carbon along the y-axis in Fig. 1 should be “g C/kg soil” (i.e., grams of carbon, not milligrams).
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**Ecological boundary detection using Bayesian areal wombling**

Matthew C. Fitzpatrick,1,2,3,7 Evan L. Preisser,7 Adam Porter,4 Joseph Elkinton,4 Lance A. Waller,8 Bradley P. Carlin,6 and Aaron M. Ellison3
Publication of results

- Principle of public availability of research results
- Correction of published mistakes
- Fair evaluation and **CITATION** of literature
- Recognition of contribution of colleagues
- Free availability of results achieved with public funds
Review process

- Careful, altruistic (= unselfish) and impartial appraisal of colleagues
- No delaying of reviews
- No biased appraisals
- No appraisal if suspicion of or actual conflict of interest
Internal (MPG) regulations

- Security and defense research, spinoffs, conflict of interest
- Be aware of the society’s types and consequences of scientific misconduct
Securing and storing primary data
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• Data (and samples!!) must be stored $\geq$ 10 years on durable, secure locations
  – Institutional backed-up server, journal websites (supplemental material)
  – Meta data (variable description, units, devices used etc.)
  – Samples http://intra.bgc-jena.mpg.de/wiki/images/0/00/BreakoutArchivingSamples.pdf
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• Examinations, experiments and numerical calculations must be documented comprehensively ≥10 years
  – Lab books
  – Script documentation
  – Supplementary documents (manuals, description of procedures and analytical methods, reactant concentrations etc.)
Documentation of data and processing
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Documentation of data and processing

```r
# AICc table
AICc_table <- function(cand.set, modnames, sort=TRUE) {
  check_HL <- unlist(lapply(cand.set, FUN=function(x) 1&method))
  if (any(check_HL=="HL")) warning("Model selection for fixed effects is only appropriate with method="ML;"
  # default) shoule only be used to select random effects!!!")
  Results <- data.frame(Modnames=modnames)
  Results$K <- unlist(lapply(cand.set, AICc))
  Results$AICc <- unlist(lapply(cand.set, AICc, return.K=FALSE))
  Results$Delta_AICc <- Results$AICc - min(Results$AICc)
  Results$ModelLik <- exp(-0.5*Results$Delta_AICc)
  Results$AICcWe <- Results$ModelLik/sum(Results$ModelLik)
  if (sort) Results <- rev(order(Results$AICcWe),)
  Results$Cum.Wt <- cumsum(Results$AICcWe)
  return(Results)
}
```

Data protection

- Regulations governed by the Federal Data Protection Act (Bundesdatenschutzgesetz)
- Personal data must be sanitized, i.e. replaced with case ID
- Files containing personal data linked with case ID must be kept in a separate file
- If a test person demands deletion, data should be blocked and not used for further research
Scientific publications

- Full and comprehensible description of results and methods
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- Full and correct credit for third-party preparatory work
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- Supporting but also contradicting findings should be mentioned
Scientific publications

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- Supporting but also contradicting findings should be mentioned
- No “honorary authorship”: only persons making considerable contributions may be co-authors
Conflict of interest

- Collaborations between science and industry (but not only)

- Conflict potential
  - Patent registrations
  - Confidentiality of unpublished data
  - Expected results vs. available data

- Economic aspects not allowed to take precedence over scientific freedom

- Disclosure of financial and other interests to supervisors and other responsible instances
Ombudspersons

- **Institutional and sectional ombudspersons**
  - Voted by scientific and technical-scientific staff
  - **BGC**: wbrand@bqc-jena.mpg.de

- **Confidential advisor in suspected cases of scientific misconduct**
  - Information treated with confidence
  - May initiate meetings with suspected person or institute management
Whistleblower protection

- The name of whistleblower remains confidential during initial ombudsperson’s investigation

- During formal investigation, identity only revealed if necessary for defense of suspect or to examine credibility or motives of whistleblower

- Especially junior scientists should be protected because they fear for future progress

- Whistleblowing does not mean denunciation and damage but rather its prevention
Rules of procedures in cases of suspected scientific misconduct

What to do when research wasn’t honest
Preliminary enquiry

• If significant indication of misconduct ombudsman contacts Managing Director who then contacts Vice President of MPG section

• They decide if case is to be pursued and if so, they confront the suspect with incriminating facts

• Suspect has two weeks to respond and then further decision is taken (to go on or stop)

• If proof of misconduct → sanctions or consequences

• If grounds for suspicion → formal investigation
Formal investigation

- **Investigation committee:**
  - Chairperson, Section Vice President, 3 conciliators from different sections, Head of Department of Personnel and Legal Affairs at HQ

- **Oral proceedings**
  - Affected institute must be given opportunity to comment
  - Suspect must be granted oral hearing and can be assisted by a person of trust

- **Disclosure of name of informant if necessary**

- **If misconduct established:** results of investigation and recommendations submitted to President for decision

- **No internal procedure for complaint**
Possible sanctions in case of misconduct

• Reprimand (precursor of dismissal) in less serious cases

• Extraordinary dismissal (2 week notice instead of labour law defined notice)

• Mutual rescission (both agree on termination of contract)

• Academic consequences:
  – Withdrawal of doctoral degree
  – Withdrawal of license to teach

• Civil law consequences (e.g., court orders, restitutory or damage claims)

• Penal consequences (e.g., infringement of private sphere or copyright, falsification of documents, damage to property)
Freedom of research and research risks

Doing research responsively by avoiding misuse
Research freedom ??
Research freedom

- Research for increasing human welfare, prosperity, and security
  - Freedom of research is required to achieve these benefits
  - Science must be transparent, allow free exchange of information and publication of results
  - But, “dual use” (misuse) can lead to risks of scientifically neutral research
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  ... regulate methods (e.g., experiments on humans or animals)
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- But, legal provisions cannot account for (rapidly changing) area-specific risks
  - Hence, scientist must recognize and assess potential risks to humans and their environment and set their own limitations
  - Ethical guidelines are needed to define these limitations
Risks management

- Scientists must prevent or minimize harm to humans and the environment
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- Risk assessment with respect to:
  - Human dignity, human life and human welfare
  - Environment or other values protected by constitution
  - Misuse: context of research, nature of customer or partners
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Risk minimization through
- Security measures (e.g., to prevent theft of dangerous substances, knowledge or data)
- Selection of employees and partners based on reliability and responsibility
- Avoiding cooperation with susceptible partners (e.g., certain states)
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- Publications
  - Could easily implementable results produce danger or damage?
  - Should publication be postponed or results be partially excluded in cases of potential risk?
  - Complete avoidance of publication as *ultima ratio* only in exceptional cases
Risks management

• **Ultima ratio**
  - Only when potential risk disproportionate to benefit
  - Dual research project with disproportionate risk could be carried out to counter research by others
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- **Documentation and communication of risks**
  - Document risks assessment, counter measures, and changes in status during work progress
  - Inform the Ethics Commission of Vice President BEFORE starting the research
  - Also inform SAB of the institute
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• **Training and information**
  - Communicate principles of responsible approach to research risks to junior scientists *(THAT’S WHAT WE’RE DOING HERE)*
  - Raise awareness of these issues when lecturing outside the MPG
Responsibilities and help
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- **Responsibility**
  - In first instance – the scientist responsible for the research (YOU !!) and – ultimately – their superiors
  - Inform your superiors anyways, they should then take part in risk assessment
  - Legal limitations → Compliance unit or Legal Affairs Department (Administrative Headquarters)
  - Ethical limitations → Ethics commission
  - Or → Ombudsperson
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- **Ethics commission**
  - You can request the EC to examine your project
  - Three year term of office
  - Three permanent members of the Max Planck Society of different sections
  - During procedures, chairperson of concerned section also joins
  - They vote up to two other members with expertise in specific scientific field
  - In cases of uncertainty (about the ethical compliance of any project) any employee or PhD can inform the EC
  - Researchers are to be informed if their project is part of an evaluation and they have the right to be heard