Tips and Tricks for Ph.D. students

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Reproducible Science

You should strive to make your experiments and analyses reproducible... by others, but also by yourself!

- you should keep track of exactly how you selected your materials
- you should keep track of what you did exactly for the analyses
- someone else should be able to check what you did, and reproduce it
- This is often very difficult to achieve!

Possible strategies:

1. keep a detailed lab notebook (I only know one person who can do it)
2. write computer programs all the processing pipelines
3. give up, hope you have not made mistakes, and will not need to check or rerun the experiment

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Tools for reproducible science

- It is worth learning how to program cleanly! . The aim is notsimply to write a program that works but a program that can be reread and modified. In the end, you will spend less time in front of the computer
- Programming tools
  - Good ones: Python, R, Matlab ...
  - Bad ones: Excel, E-prime...
    - impossible to check thouroughly.
    - compatibility not assured between successive versions.
    - it is not impossible to make good use of Excel and Eprime
- Version control tools (svn, git, mercurial,...)
  - keep track of the history of a files (all previous versions)
  - allow to collaborate between several people
- Suggested site “Software Carpentry”

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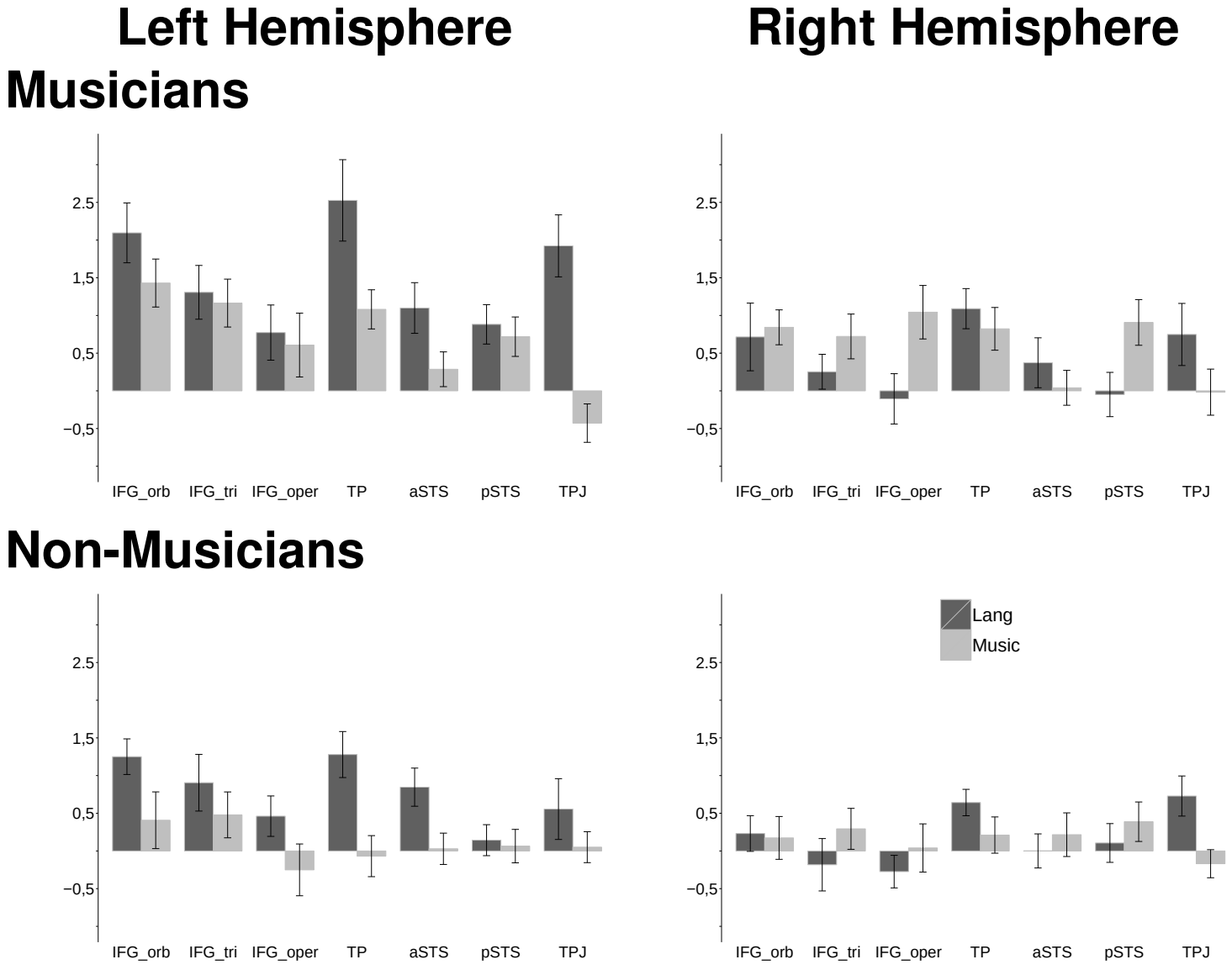
Selecting materials from Lexique for an experiment

You should not use Lexique's web interface but download the current database and write a script to select your materials.
See demo in lexique_search

Data analysis with R



Amplitudes of the constituent size effect

Beyond p-values!!!

"Certain journals present tables of p-values (or even worse, F-statistics, degrees of freedom and associated p-values)"
Gerald van Belle *Statistical rules of thumb* Wiley.
Rule of thumb: Show your data! Report your results with estimates of effects and the associated confidence intervals.

See also G. Loftus (1996) Psychology will be a Much Better Science When We Change the Way We Analyze Data. *Current directions in Psychological Science*.

One of the problem with significance tests

(from Gelmann & Stern (2005). The difference between “significant” and “not significant” is not itself statistically significant.)

Consider two independent studies estimating the same effect:

$\delta_1 = 25 \pm 10$ ($p < .01$)

$\delta_2 = 10 \pm 10$ ($p > .10$)

It would be tempting to conclude that there is a large difference between the two studies. However, the difference (15 ± 14) is not even close to being statistically significant.

Now imagine a third replication:

$\delta_3 = 2.5 \pm 1.0$ ($p < .01$)

This third study attains the same significance level as the first study, yet the difference between the two is itself also significant!

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Writing

- Writing is a matter of successive refinement:
  To write something, you must first write something dirty and the clean it. You should write a first draft, a second draft,... to obtain the final version.
- For most people, writing is very difficult. For me, I find it easier if I can work *continuously*. I have a huge cost of starting again.
- For the PhD, I recommend to start writing 1 year before the deadline.
- I find PhD manuscripts based on papers frustrating (even if I recognize it is efficient)
- peril of perfectionism
- learn touch-typing (two persons I know who did it: Stan Dehaene & Anne Christophe)

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Tools for writing

> *"Linguistics is cheap: you just need a pen and an eraser. Philosophy is even cheaper: you do not need the eraser"*

We, psychologists, need more technology...
Word or LaTeX? That is the question...
My reasons to use LaTeX:

- very bad experiences with Word/OpenOffice (crashes, bugs). Never lost work with LaTeX
- produces tidy complex documents with typically less work than Word (if one refrains from customizing)
- allows one to automatically generate documents (particularily useful for graphics)
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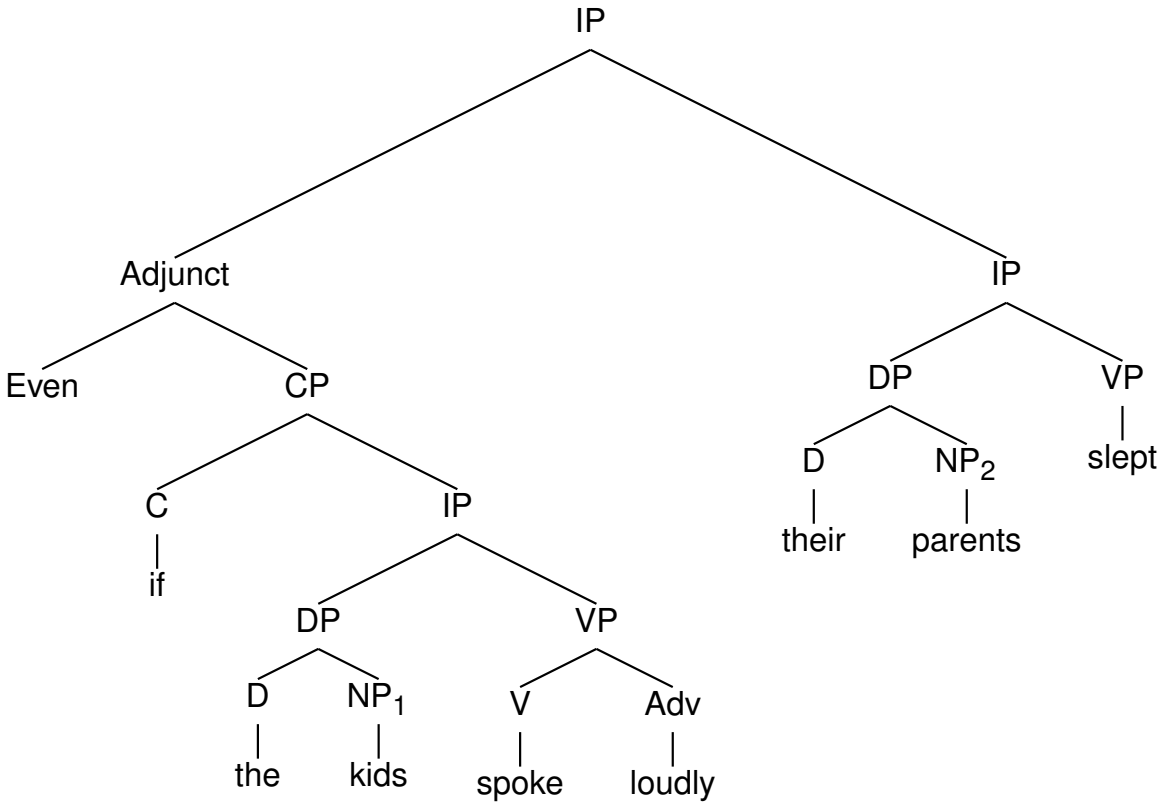
LaTeX example 1: syntactic trees



```
\Tree [.IP [.Adjunct  Even [.CP
               [.C if ]
               [.IP [.DP [.D the ] [.NP_1 kids ]]
                    [.VP [.V spoke ] [.Adv loudly ]]]]]
           [.IP
               [.DP [.D their ] [.NP_2 parents ]]
               [.VP slept ]]]
```

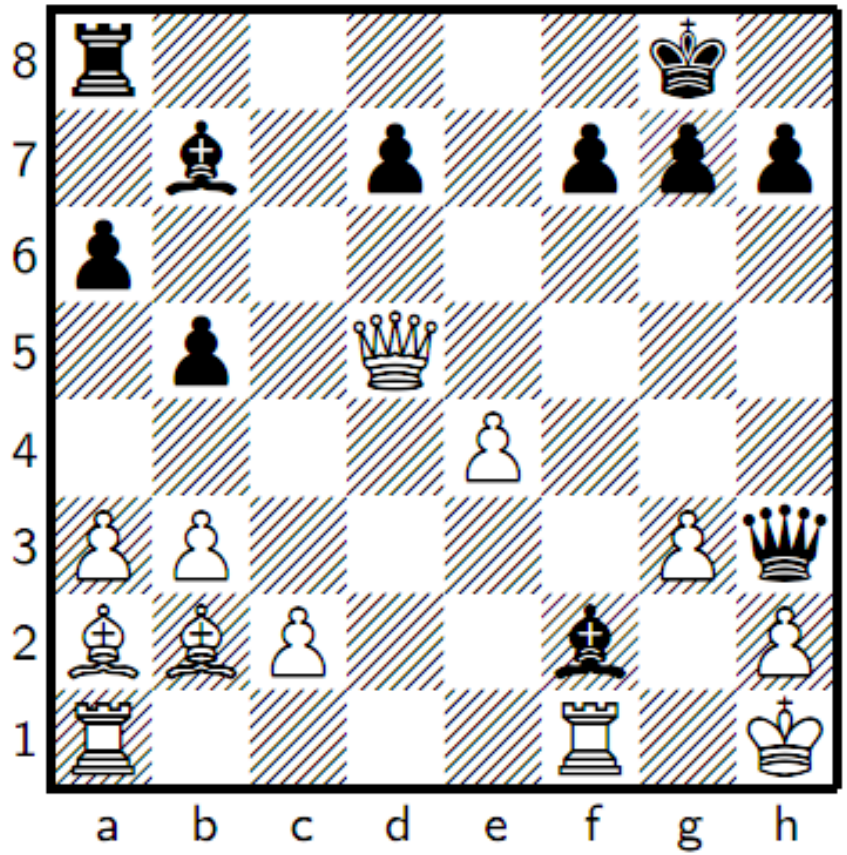
LaTeX example 2

$$\text{Even if the } \begin{Bmatrix} \text{kids} \\ \text{naughty kids} \\ \text{very naughty kids} \end{Bmatrix} \text{ spoke loudly, ...}$$

```
Even if the $\begin{bcases}
   \mbox{kids}              \\
   \mbox{naughty kids}      \\
   \mbox{very naughty kids} \\
\end{bcases}$ spoke loudly, ...

\newenvironment{bcases}
  {\left\lbrace\begin{aligned}}
  {\end{aligned}\right\rbrace}
```

LaTeX example 3



The code uses the well-established Forsyth-Edwards Notation:

```
\fenboard{r5k1/1b1p1ppp/p7/1p1Q4/2p1r3/PP4Pq/BBP2b1P/R4R1K w - - 0 20}
```

My point of view about the ideal PhD

1. A PhD Candidate is not a Research Assistant.
   It should not even be called a “student”.
   It is a young researcher who still has to acquire some technical and scientific knowledge, but who should already have the mindset of a researcher (curiosity and rational thinking)
2. “Directeur de thèse” vs. “PhD advisor”.
   I see my role as:
   - provides the PhD with the means to perform the research
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   - [illegible]

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My point of view about the ideal PhD

3. What I expect from the PhD “student”:
   - the student should progressively become the “master” of the project.
   - s/he should think by herself/himself. We should have two-way exchanges and become colleagues.
   - read the litterature. know what s/he knows and what s/he does not know.
   - report when one is blocked.
4. A PhD can mean:
   - 3 years of quasi total freedom to investigate a question that interest you (this was the case in Jacques Mehler’s lab)
   - 3 years of painful work if you do not understand/like the topic, are obsessed with getting results, etc...

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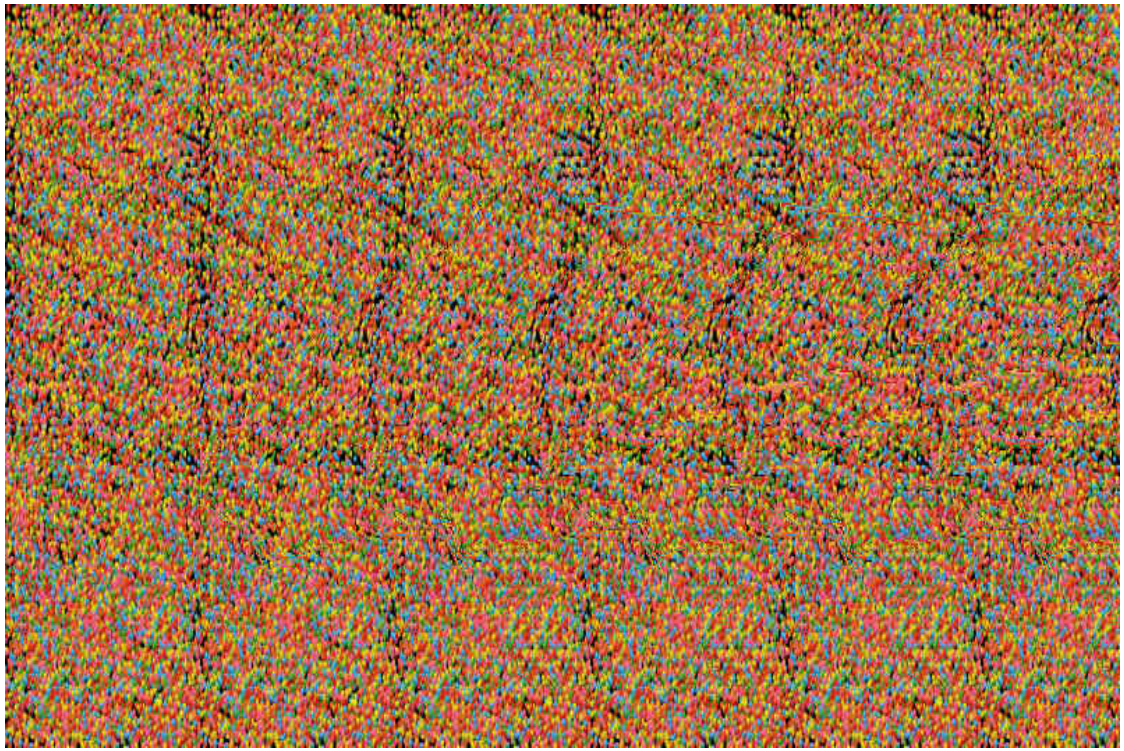
If you need to improve your work organization

If you feel overwhelmed and inefficient; if the stress in front of the many takss is paralyzing you, offer yourself some useful procrastination:

- Getting Things Done (GTD): Getting Things Done: The Art of Stress-Free Productivity
- Zen to done (ZTD): The Ultimate Simple Productivity System
- Learn about **Mind Mapping** (Note-taking that maps out your ideas)

On the importance of being a bilingual in Science



Bela Julesz (a hungarian psychologist-engineer) claimed that “scientific bilingualism” is the key to creative contributions to science.

A bit of Epistemology can do no harm

- Sometimes, When I read (neuro)cognitive papers, I miss behaviorism.
- Suggested Reading:
  Zoltán Dienes *Understanding Psychology as a Science*
- This diagram may be banal, but worth showing anyway: