Breaking Bad Habits in Experimental and Quantitative Research in Linguistics

Dr Massimiliano Canzi

mcanzi/2022_daw | May 5th 2022

Section 1

Introduction

About me

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Massimiliano **“Max”** Canzi

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- Lab Manager / Data Scientist @ Uni Konstanz

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Interested in: **R**, experimental designs, **reproducibility**, open science, improving existing methodologies, data visualisation, honest scientific communication…

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https://www.ling.uni-konstanz.de/forschung/workshops/

Motion Pictures / Scientific Experiments

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Planning a (linguistics) experiment and a movie production are not as far apart as you would think…

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- Press, festivals

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Figure 1: Severance (2022)

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- Data wrangling, analaysis and visualisation
- Papers, conferences

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Just like when shooting a film, **plan ahead**.

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Just like when shooting a film, **plan ahead**.

The more things you can accurately predict and plan, the more solid your design and experiment will be. **That's pretty much all there is to it**.

Thank you!

Questions?

Thank you!

Thank you!

Just kidding... let's get started.

Section 2

Pre-Production

The Script

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Develop clear, **testable** hypotheses.

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- What experimental **design**?

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- What **method** is best to answer the question?
- How many experiments?
- What experimental **design**?
- How (and what) are variables going to be coded?

The Genre (aka The Method)

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Don't be afraid to innovate.

Film or Mini Series?

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Multiple experiments might allow for a less complex experimental design, follow-up studies, …

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Multiple experiments might allow for a less complex experimental design, follow-up studies, …

However, more experiments also mean more time spent on participant recruitment, data collection, …

Camera and Lens

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If you were to take one thing home from today, make it this one:

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For the now visibly upset Bayesians…

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- Choose a balanced design

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- Know your **limits**
- Know your **goals**
- Choose a balanced design
- **Register your report?**

Registered Reports

- Mertzen, D., Lago, S., & Vasishth, S. (2021). The benefits of preregistration for hypothesis-driven bilingualism research. Bilingualism: Language and Cognition, 24(5), 807-812.
- Roettger, T. B. (2021). Preregistration in experimental linguistics: Applications, challenges, and limitations. Linguistics, 59(5), 1227-1249.

Resoution

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Section 3

Production

Find a Balance

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Things to consider:

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- Location of the experiment (e.g. lab, online)

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- Location of the experiment (e.g. lab, online)
- Number of items

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- Location of the experiment (e.g. lab, online)
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- Number of participants
- What sample?

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Filming Locations

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Online platforms are getting better and better, allowing for more complex designs and data collection types (e.g. reaction times, Stoet 2017).

Scenes

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Ideally, you would have an infinite number of both.

Always ask your participants a little more, especially if it's a lab-based experiment.

Casting

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Are university students in your university represnatitve enough of the sample you're looking for?

Bits and Pieces

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- Write everything down (hardware, software, locations, etc.)

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- Get all the forms you need (participant consent, data protection)

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- Get all the forms you need (participant consent, data protection)
- Plan a storage solution for data and anonymise whenever possible
- Hire a research assistant

Section 4

Post-Production

Editing

Know your data!

Editing

Let's have a look at some R code

```
model_one <- rt_log %>% lmer(formula = rt ~ condition * fricative + partic
```

Editing

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Welcome back!

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Some references:

- Baayen, R. H., & Milin, P. (2010). Analyzing reaction times. International Journal of Psychological Research, 3(2), 12-28.
- Leys, C., Ley, C., Klein, O., Bernard, P., & Licata, L. (2013). Detecting outliers: Do not use standard deviation around the mean, use absolute deviation around the median. Journal of experimental social psychology, 49(4), 764-766.

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When modelling:

- Your most complex model should be clear to you before you even start collecting data.

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When modelling:

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- What is a fixed effect and what is a random effect in your experiment?

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When modelling:

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- What is a fixed effect and what is a random effect in your experiment?
- Slopes galore

Editing

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Sometimes, it's not as straightforward

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Sometimes, it's not as straightforward i.e. the story of event-related potentials (ERP)

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Reporting your results:

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- Standardise (e.g. APA)

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- Provide supporting material

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Reporting your results:

- Standardise (e.g. APA)
- Provide supporting material
- package `report`

Editing

We fitted a linear mixed model (estimated using REML and nloptwrap optimizer) to predict rt with condition, fricative and participant_device_type (formula: rt ~ condition * fricative + participant_device_type). The model included condition, participant_private_id and item as random effects (formula: list(~condition | participant_private_id, ~1 | item)). The model's total explanatory power is substantial (conditional R2 = 0.41) and the part related to the fixed effects alone (marginal R2) is of 0.08. The model's intercept, corresponding to condition = NM, fricative = FF and participant_device_type = computer, is at 6.89 (95% CI [6.81, 6.97], t(11044) = 171.01, p < .001). Within this model:

- The effect of condition [WM] is statistically non-significant and positive (beta = 4.10e-03, 95% CI [-0.04, 0.05], t(11044) = 0.17, p = 0.867; Std. beta = 7.57e-03, 95% CI [-0.08, 0.10])
- The effect of fricative [SH] is statistically significant and negative (beta = -0.22, 95% CI [-0.30, -0.15], t(11044) = -5.52, p < .001; Std. beta = -0.41, 95% CI [-0.56, -0.27]) …

Editing

Analyses were conducted using the R Statistical language (version 4.0.3; R Core Team, 2020) on macOS Big Sur 10.16, using the packages ggpubr (version 0.4.0; Alboukadel Kassambara, 2020), Matrix (version 1.3.2; Douglas Bates and Martin Maechler, 2021), lme4 (version 1.1.26; Douglas Bates et al., 2015), ggplot2 (version 3.3.5; Wickham. ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York, 2016.), stringr (version 1.4.0; Hadley Wickham, 2019), tidyr (version 1.1.2; Hadley Wickham, 2020), forcats (version 0.5.1; Hadley Wickham, 2021), readr (version 1.4.0; Hadley Wickham and Jim Hester, 2020), dplyr (version 1.0.4; Hadley Wickham et al., 2021), tibble (version 3.1.5; Kirill Müller and Hadley Wickham, 2021), lmerTest (version 3.1.3; Kuznetsova A et al., 2017), purrr (version 0.3.4; Lionel Henry and Hadley Wickham, 2020), sjPlot (version 2.8.9; Lüdecke D, 2021), viridis (version 0.5.1; Simon Garnier, 2018), viridisLite (version 0.4.0; Simon Garnier et al., 2021) and tidyverse (version 1.3.0; Wickham et al., 2019).

Color Grading

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Figure 2: Severance (2022)

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When modelling, I like to provide plots showing model estimates, rather than plotting raw data.

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For example, you can use package `sjPlot`, or do it yourself with packages `ggeffects` and `ggplot2`.

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- Check with journals

Festivals

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Share your data and your code with your paper.

Ending Credits

- Baayen, R. H., & Milin, P. (2010). Analyzing reaction times. International Journal of Psychological Research, 3(2), 12-28.
- Green, P., & MacLeod, C. J. (2016). SIMR: an R package for power analysis of generalized linear mixed models by simulation. Methods in Ecology and Evolution, 7(4), 493-498.
- Leys, C., Ley, C., Klein, O., Bernard, P., & Licata, L. (2013). Detecting outliers: Do not use standard deviation around the mean, use absolute deviation around the median. Journal of experimental social psychology, 49(4), 764-766.
- Stoet, G. (2017). PsyToolkit: A novel web-based method for running online questionnaires and reaction-time experiments. Teaching of Psychology, 44(1), 24-31.