Psychology 205: Research Methods
Details on Experiment 2

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Outline

Background information Designing the study Analyzing the data The General Linear Model Writing the paper References Refer
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Motivation and Cognition

Cognitive Performance

Four broad classes of cognitive performance tasks

1. Tasks requiring sustained attention
   - vigilance
   - proof reading
2. Tasks requiring working memory
   - memory scanning
   - n-back
   - list learning
3. Tasks requiring retrieval from long term memory
   - tests of knowledge and skill (semantic memory)
4. "Complex tasks" require integration of attention, working memory, long term memory
   - Graduate Record Exam

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Motivation and Cognition,

Varieties of motivation

1. Resource availability
   - Energetic Arousal (Thayer, Takahashi & Pauli, 1988; Thayer, 1989)
     - varies diurnally (Revelle, Humphreys, Simon & Gilliland, 1980).
     - increased by stimulant drugs
   - Tense Arousal (Gray, 1991; Wilt, Oehlberg & Revelle, 2011)
2. Resource Allocation
   - Focus on task
   - breadth of allocation

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Personality and Motivation

Personality and the availability and allocation of cognitive resources

1. Impulsivity/Extraversion
   - General Approach Behavior (Gray, 1991; Revelle, 1997; Wilt & Revelle, 2009)
   - Extraversion and sensitivity to cues for reward Smillie, Cooper, Wilt & Revelle (2012); Smillie, Geaney, Wilt, Cooper & Revelle (2013)
2. Impulsivity as related to diurnal (energetic) arousal rhythm
3. Anxiety and the allocation of resources
   - Anxiety leads to narrowing of attention
   - Anxiety and focus of attention on threat salient cues

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Personality and Motivation

Prior work

1. The Personality-Motivation-Cognition lab at NU
   - Person characteristics
   - Situational Characteristics
   - Intervening motivational states
   - cognitive performance
   - (Anderson & Revelle, 1982, 1994; Revelle & Loftus, 1992; Revelle & Oehlberg, 2008; Revelle & Anderson, 1992; Revelle, Amaral & Turriff, 1976; Revelle et al., 1980; Wilt et al., 2011)

2. The simulation is a theory of the relationship between these four sets of variables
   - person characteristics
   - situational characteristics
   - intervening motivational states
   - cognitive performance

Possible Independent and Dependent Variables

1. Experimental Variables
   - Time of Day
   - Caffeine

2. Subject Variables
   - Sex
   - Anxiety
   - Impulsivity

3. Dependent Variables
   - Energetic Arousal
   - Tense Arousal
   - Cognitive Performance (on a simple cognitive task)

See https://personality-project.org/revelle/syllabi/
205/simulation/simulating-experiments.pdf

Conducting the study

1. Choose some variables of interest
   - Ignore other variables by randomization (increases generalizability)
   - or control other variables at fixed levels (increases power)
2. Assign subjects to conditions
   - Randomly
   - Counter balanced
   - Block randomization (use block.random in psych)

Block randomization using block.random

```
library(psych)
cond <- block.random(96,c(drug=2,time=3))
cond
```

```
    blocks drug time
S1      1    1    3
S2      1    2    2
S3      1    1    2
S4      1    2    3
S5      1    2    1
S6      1    1    1
S7      2    1    3
S8      2    2    3
S9      2    1    1
S10     2    2    1
S11     2    1    2
S12     2    2    2
...
S89    15    2    3
S90    15    1    2
S91    16    1    3
S92    16    1    2
S93    16    2    2
S94    16    2    1
S95    16    2    3
S96    16    1    1
```

1. Make the psych package active

2. specify the conditions

3. show the output

4. save the output to a text editor

Run the study and move to R

1. https://personality-project.org/revelle/syllabi/
   205/simulation/simulation.experiment.php
   - Specify the number of subjects
   - The next window opens and allows you to specify the
     conditions for each subject
   - When finished, a new page opens with the results (enter that
     you are finished and want the data)
   - Copy the entire page to the clipboard

2. Go to R

```
library(psych)  #if you have not already done so
sim.data <- read.clipboard()    #notice the parentheses
describe(sim.data)   #to make sure that you have it
```

Additional help at https://personality-project.org/
revelle/syllabi/205/analysing-data.pdf or
https://personality-project.org/r/r.guide.html or
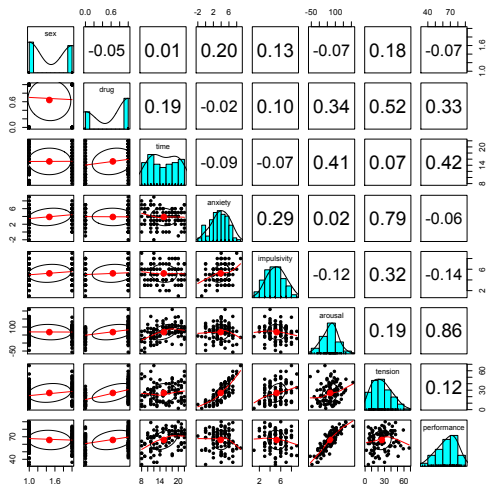https://personality-project.org/r/r.205.tutorial.html

Get the data and describe them

```
sim.data <- read.clipboard()
describe(sim.data)
            var   n  mean    sd median trimmed   mad min max range  skew kurtosis   se
snum          1 100 50.50 29.01   50.5   50.50 37.06   1 100    99  0.00    -1.24 2.90
sex           2 100  1.47  0.50    1.0    1.46  0.00   1   2     1  0.12    -2.01 0.05
drug          3 100  0.64  0.48    1.0    0.68  0.00   0   1     1 -0.57    -1.69 0.05
time          4 100 15.26  4.35   15.0   15.31  5.93   8  22    14 -0.01    -1.29 0.43
anxiety       5 100  3.87  2.25    4.0    3.95  2.97  -2   9    11 -0.25    -0.45 0.23
impulsivity   6 100  5.23  1.69    5.0    5.20  1.48   1   9     8  0.03    -0.53 0.17
arousal       7 100 68.03 48.23   71.0   68.46 43.74 -57 210   267 -0.08     0.17 4.82
tension       8 100 25.79 14.54   25.0   24.80 17.79   2  68    66  0.54    -0.39 1.45
performance   9 100 65.72 12.94   69.0   66.41 13.34  33  90    57 -0.45    -0.53 1.29
cost         10 100  1.00  0.00    1.0    1.00  0.00   1   1     0   NaN      NaN 0.00
```
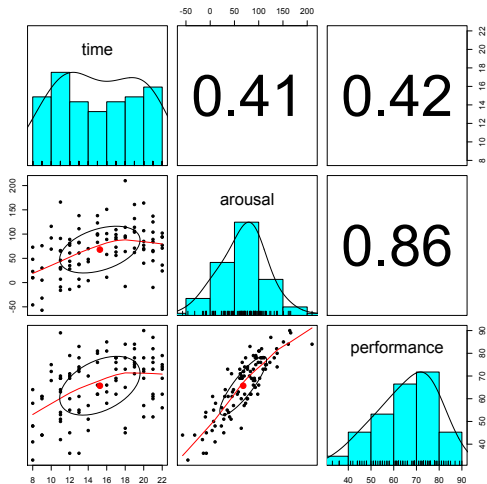
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Descriptive Statistics

Show the pairs.panels

```
pairs.panels(sim.data[2:9])
```

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Descriptive Statistics

Just show a selected set of variables

```
pairs.panels(sim.data[c(4,7,9)])
```

Types of models

1. $Y = bX$ (X is continuous) Regression

2. $Y = bX$ (X has two levels) t-test

3. $Y = bX$ (X has > 2 levels) F-test

4. $Y = b_1X_1 + b_2X_2 + b_3X_3$ (X_i is continuous) Multiple regression

5. $Y = b_1X_1 + b_2X_2 + b_3X_{12}$ (X_i is continuous) Multiple regression with an interaction term

   - In this case, we need to zero center the X_i so that the product is independent of the Xs.

6. $Y = b_1X_1 + b_2X_2 + b_3X_{12}$ (X_i is is categorical) Analysis of Variance

7. $Y = b_1X_1 + b_2X_2 + b_3X_{12} + Z$ (X_i and Z are continuous) Analysis of Covariance

The General Linear Model

```
model = lm(y ~ x1 + x2 + x1*x2,data=my.data)
```

But the product term is correlated with X_1 and X_2 and so we need to zero center (subtract out the mean) from the predictors.

```
cen.data.df <- data.frame(scale(sim.data,scale=FALSE))
model = lm(arousal ~ drug * time,data=cen.data.df)
summary(model)  #to show the results
```

The basic moderated multiple regression

```
cen.data.df <- data.frame(scale(sim.data,scale=FALSE))
model = lm(arousal ~ drug * time,data=cen.data.df)
summary(model)

Call:
lm(formula = arousal ~ drug * time, data = cen.data.df)

Residuals:
    Min      1Q  Median      3Q     Max
-111.886 -25.533   1.889  24.796 120.735

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  -0.3015     4.3534  -0.069 0.944933
drug         27.8027     9.1221   3.048 0.002978 **
time          3.9382     1.0078   3.908 0.000173 ***
drug:time     0.7470     2.0731   0.360 0.719393
---
Signif. codes:  0 0***0 0.001 0**0 0.01 0*0 0.05 0.0 0.1 0 0 1

Residual standard error: 42.72 on 96 degrees of freedom
Multiple R-squared:  0.2392,	Adjusted R-squared:  0.2155
F-statistic: 10.06 on 3 and 96 DF,  p-value: 7.932e-06
```

1. Center the data to allow for interactions
2. Specify the linear model in terms of the Dependent Variable as a function of a number of Independent Variables
3. Summarize it
   - Each row of the regression is a 1 by 96 degrees of freedom test and is reported (e.g.,) as a $t_{96} = 3.05, p < .01$

Multiple regression is hard to understand from just the table

A picture is worth a 1000 words.

```
with(sim.data,plot(arousal ~ time,pch=21-drug,
     main= 'Arousal varies by Caffeine and drug'))
by(sim.data,sim.data$drug,function(x)
        abline(lm(arousal ~time,data=x)))
text(10,25,"Placebo")
text(10,60,"Caffeine")
```

1. Draw the basic graph with different plot characters (pch) for different drug conditions
2. Add the lines for the two drug conditions
3. Add labels for each line

Show the graph

Arousal varies by Caffeine and drug
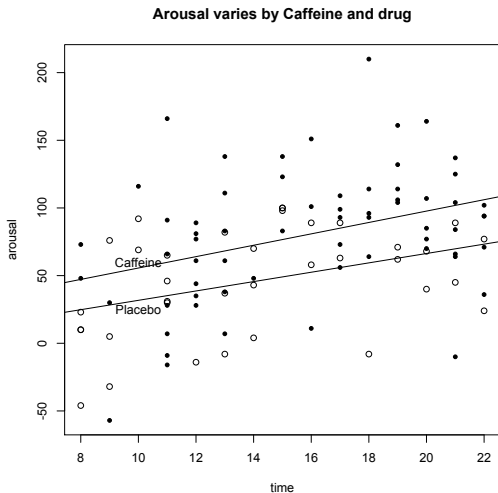
The figure in more detail

```
with(sim.data,plot(arousal ~ time,pch=21-drug,
      main= 'Arousal varies by Caffeine and drug'))

by(sim.data,sim.data$drug,function(x)
        abline(lm(arousal ~time,data=x)))

text(10,25,"Placebo")
text(10,60,"Caffeine")
```


Arousal varies by Caffeine and drug
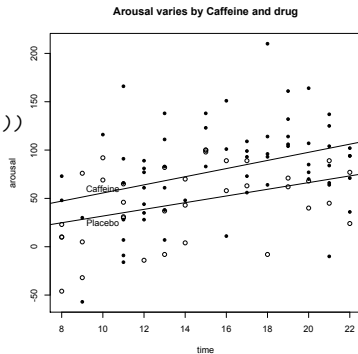
Sections of an APA style paper

1. Title page
2. Abstract (separate page - write last)
3. Introduction (starts a new page, but uses the title of the paper
4. Method (does not start a new page)
   - Materials
   - Procedure
5. Results
6. Discussion and Conclusion
7. References
8. Tables
9. Figure Captions
10. Figures

Structure of a paper: The hour glass

1. # Introduction
   - The problem
   - Prior work
   - Overview

2. Method
   - Materials
   - Procedure

3. Results
   - Use paragraphs for different findings
   - Words, Numbers, Statistics
   - Figures and tables are not the subject nor object of sentences

4. # Discussion
   - Wake up Grandma
   - General discussion
   - Take home message

Title Page

1. Title
2. Author(s)
3. affiliation
4. running head

Abstract

1. In less than 100-150 words tell
   - What was the problem
   - What was done
   - Who were the participants
   - What was found
   - What does it mean

2. Write the abstract last once you know what you have found

Introduction

1. Theoretical question being examined
   - Why is it interesting?
   - Why is it important?
2. Review of previous work
   - What has already been found?
   - What unsolved problems are raised by prior research?
   - Are there methodological flaws in previous work that needs to be addressed?
3. Overview of study
   - Brief paragraph describing basic design
   - Variables (both constructs and observed) of interest

Methods/Procedures

1. Enough information to allow someone to replicate the study if they chose to do so
   - Subjects/participants
   - who were they
   - how were they chosen
   - what special characteristics do they have
2. Apparatus/materials
   - any special equipment or forms
3. Procedure
   - what was said by the experimenter
   - what was asked of the participant

Results

1. Any finding worth discussing is introduced here
   - say it in words (doing X led to an increase in Y)
   - say it in numbers (mean Y for low X = , mean Y for high X =
   - say it in statistics ($F_{a,b}$ = xx.xx, $p < .0y$

2. references are made to tables and figures
   - Use parenthetical references to figures and table
   - Don't make them subject or objects of sentences

3. Any number to be introduced in paper needs to be mentioned here

Discussion and Conclusion

1. What do the results mean
   - In a manner that a generalist can understand (Wake up Grandma)
   - In a manner than a specialist will appreciate
2. How do the results relate to the original hypothesis?
   - Why are they different (if they are)?
3. Implications for further study
   - What should be the next set of studies to be conducted?
4. Final paragraph gives the "take home message"

Final sections

1. References
   - literature cited (and read by you)
2. Tables
   - See Leary, Plonsky, etc.
3. Figure Captions (one page for captions for all of the figures).
   - Captions are more than titles. They can explain what the graphs mean.
   - If you have any thing like error bars that need to be explained, do so.
4. Figures (do not include figure captions on these figures)

Additional Comments

1. Stylistic Considerations
   - Write for the intelligent but uniformed reader
   - Remember topic sentences and what is important in each section

2. Special things to consider - scientific readers are different. They do not read straight through, but rather
   - abstract
   - First paragraph of intro
   - First paragraph of discussion
   - Last paragraph of discussion
   - then, and only then, the whole paper

3. So, "punch up" those critical paragraphs

Guides to writing an APA paper

1. APA manual of style - The official reference
2. Leary (Chapter 15) detailed example
3. Plonsky "cheat sheet" to the APA paper
   http://www.uwsp.edu/psych/apa4b.htm
4. Also possible to use sophisticated typesetting language: LaTex
   with the apa.cls style sheet at
   http://personality-project.org/revelle/syllabi/
   205/apa.style.html

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Smillie, L. D., Geaney, J., Wilt, J., Cooper, A. J., & Revelle, W. (2013). Aspects of extraversion are unrelated to pleasant affective reactivity: Further examination of the affective reactivity hypothesis. *Journal of Research in Personality*, *47*(5), 580=587.

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social processes, and extraversion. *Personality and Individual Differences*, *9*(1), 15–24.

Wilt, J., Oehlberg, K., & Revelle, W. (2011). Anxiety in personality. *Personality and Individual Differences*, *50*(7), 987–993.

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