So simple, yet so effective

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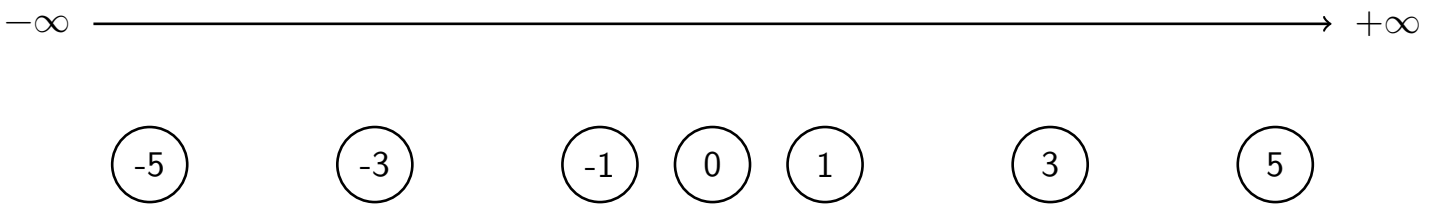
Table of contents

An example: The SNARC effect



Small numbers: Perceived on the left

Large numbers: Perceived on the right

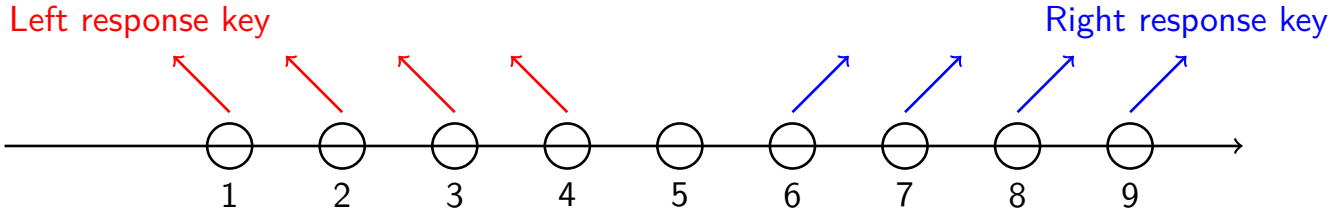
How do we ivestigate such an effect?

Small numbers:
$1, 2, 3, 4$

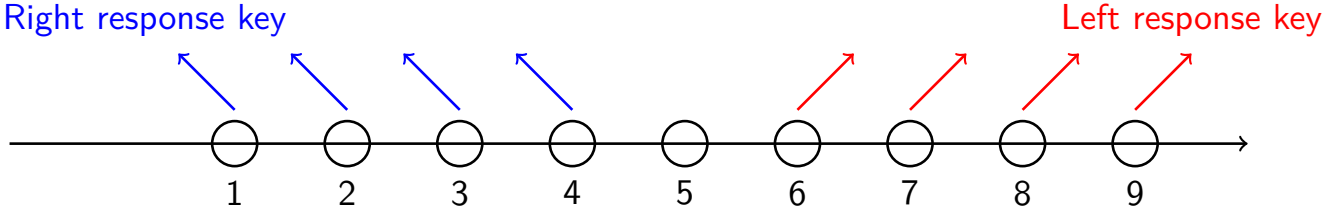
Large numbers:
$6, 7, 8, 9$

Two conditions:

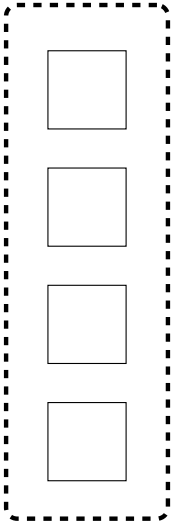
The "natural" one



The "innatural" one



p_1



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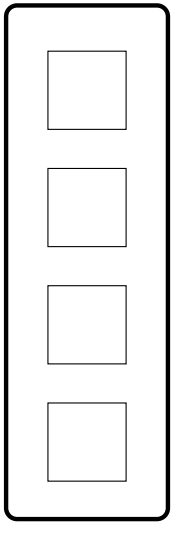
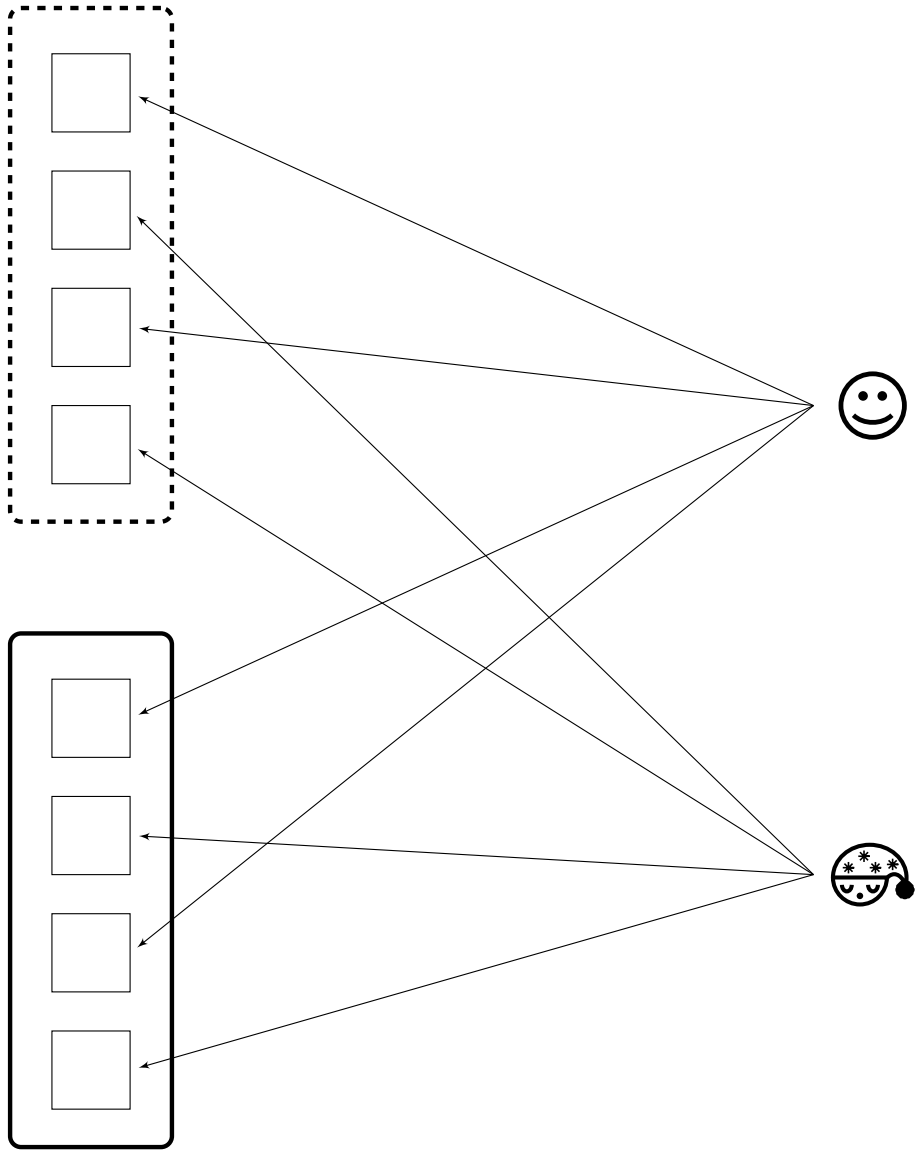


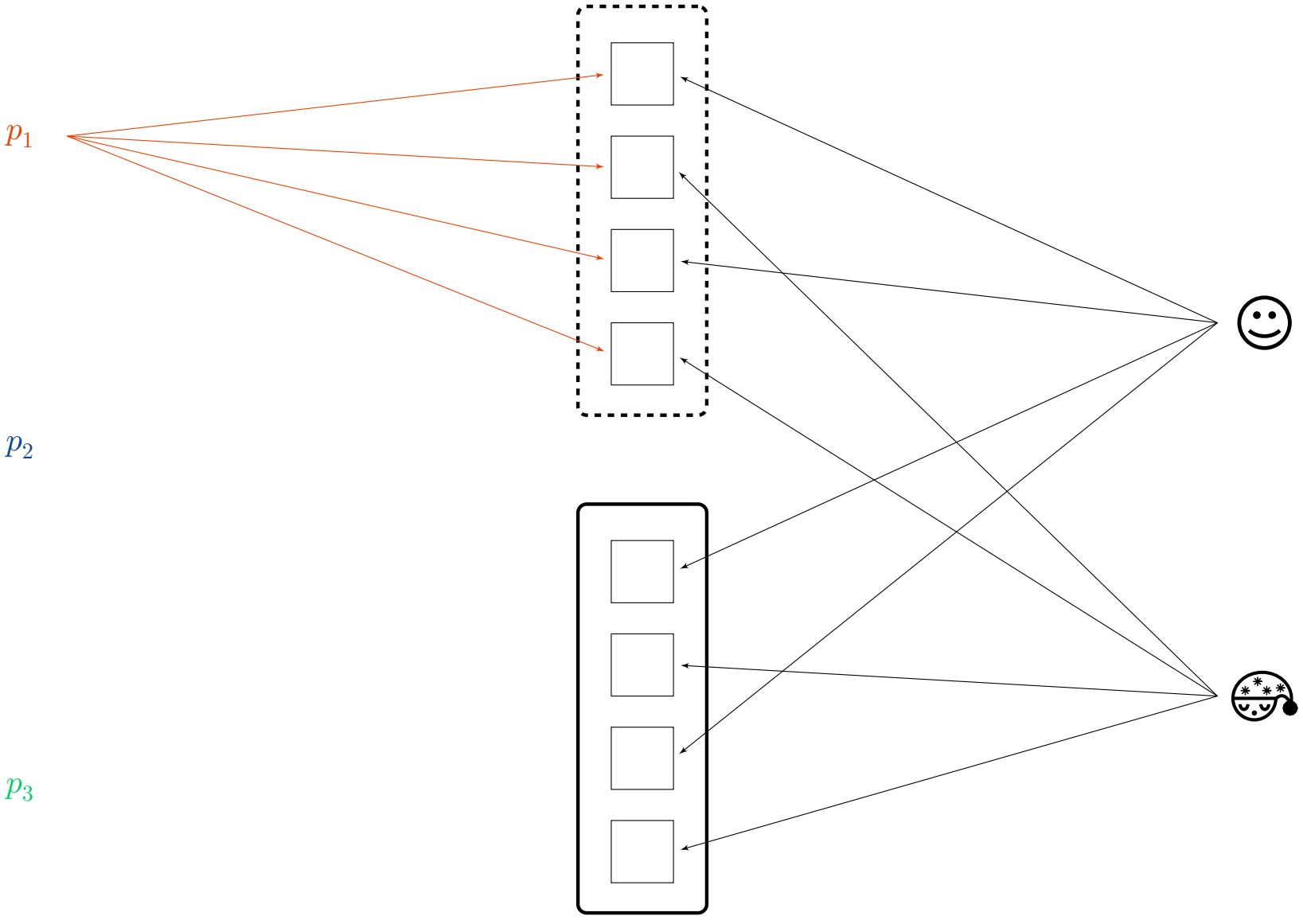
p_3

p_1

p_2

p_3

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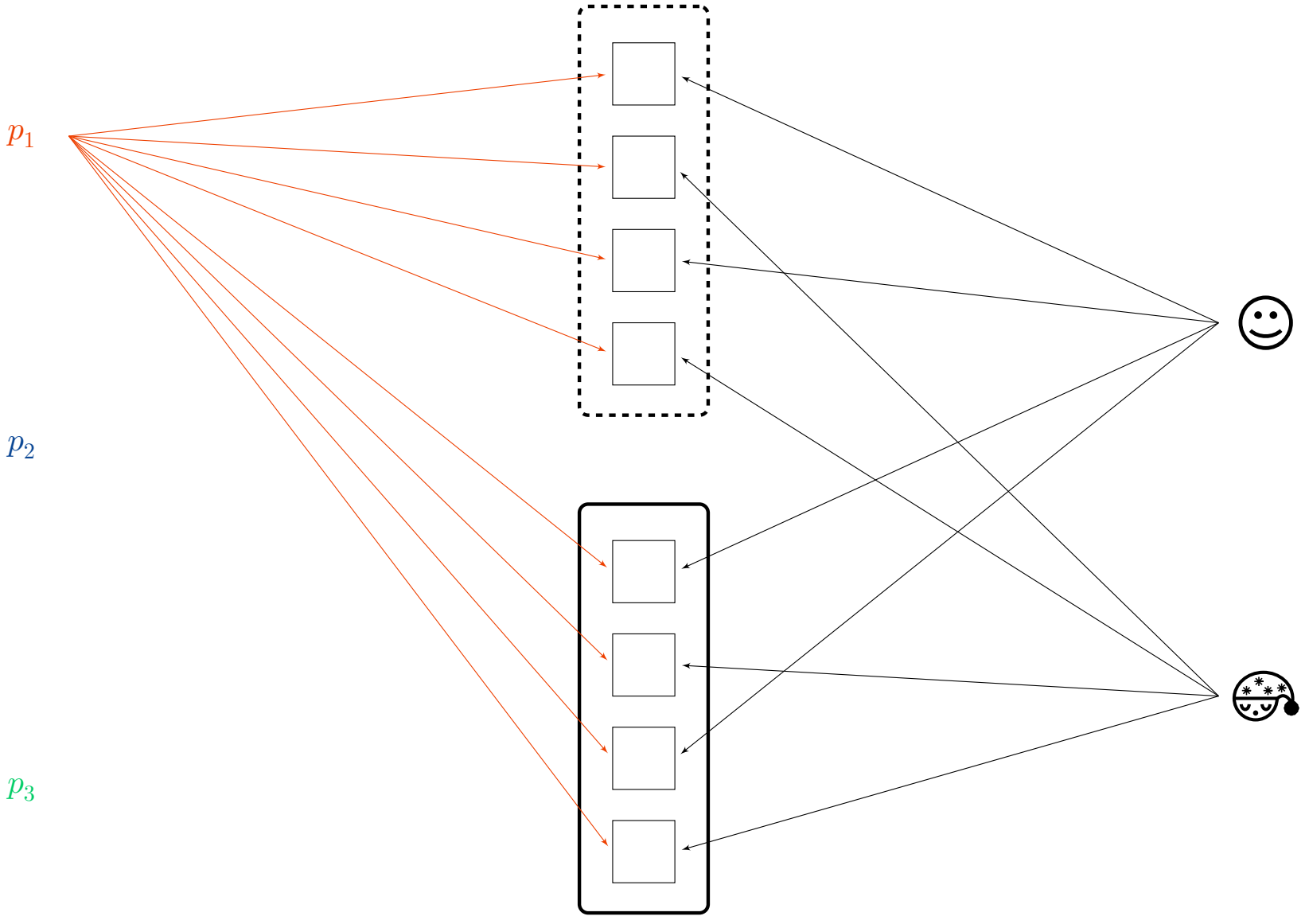
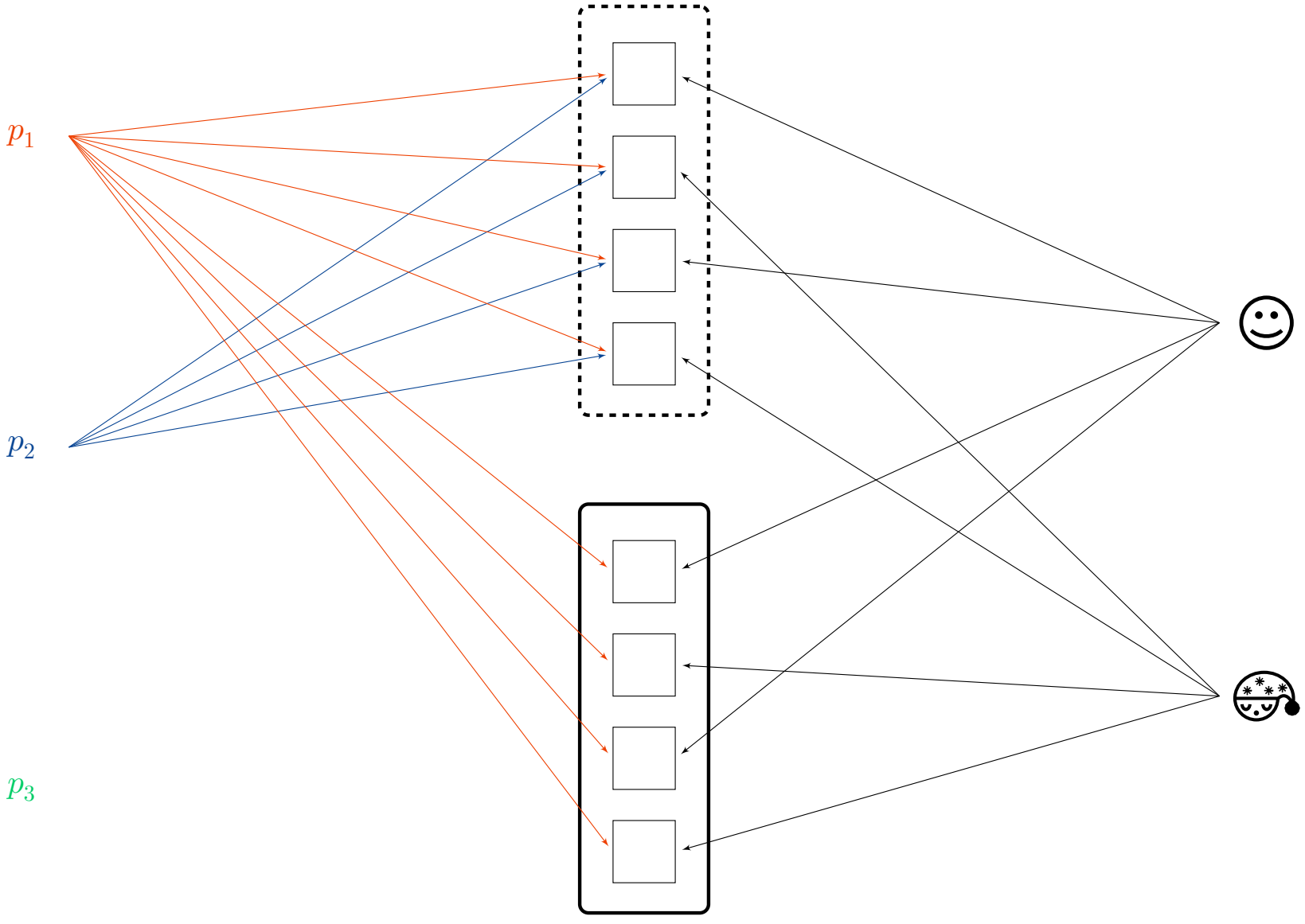
p_2
p_3


p_1
p_2
p_3


p_1
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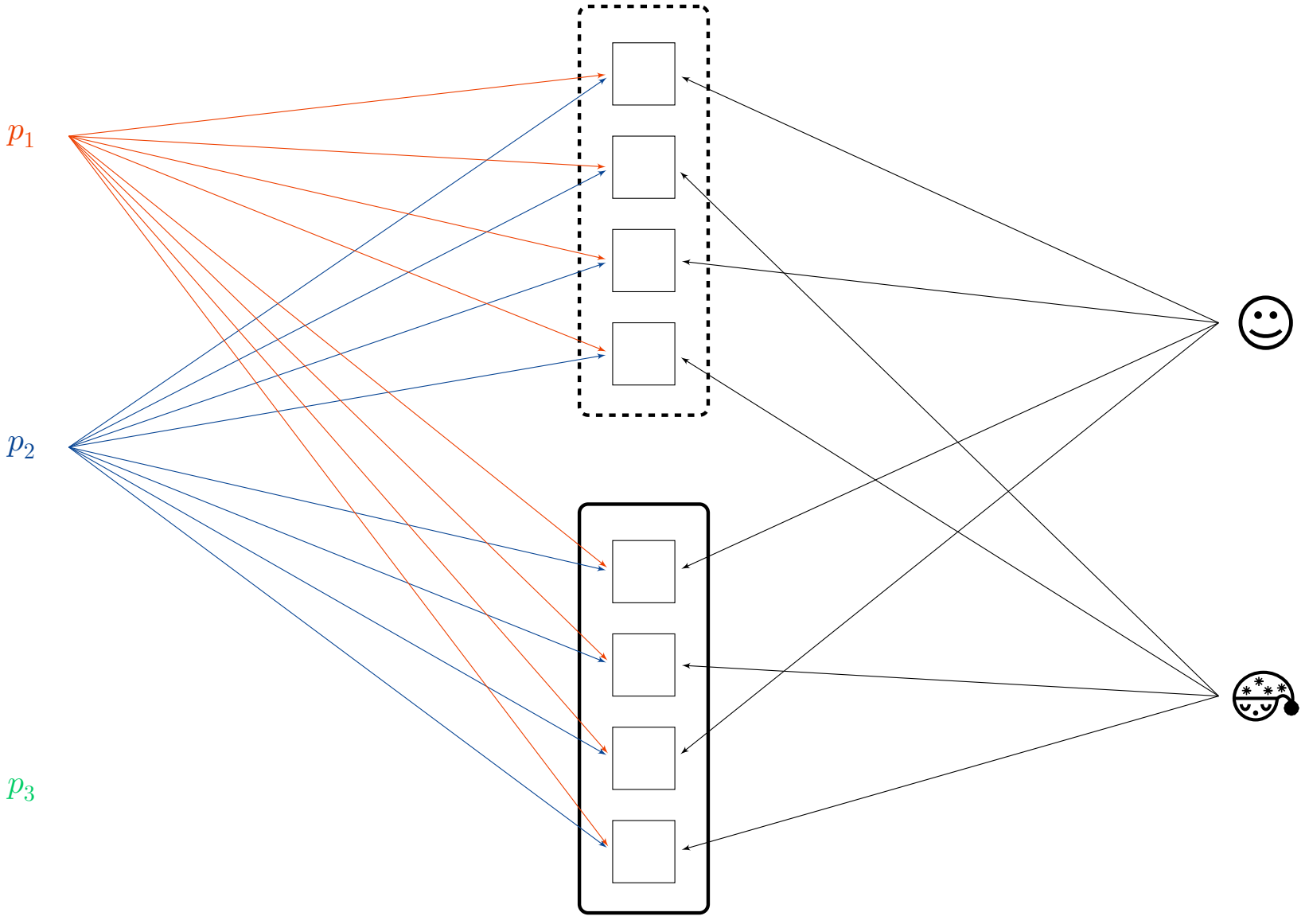
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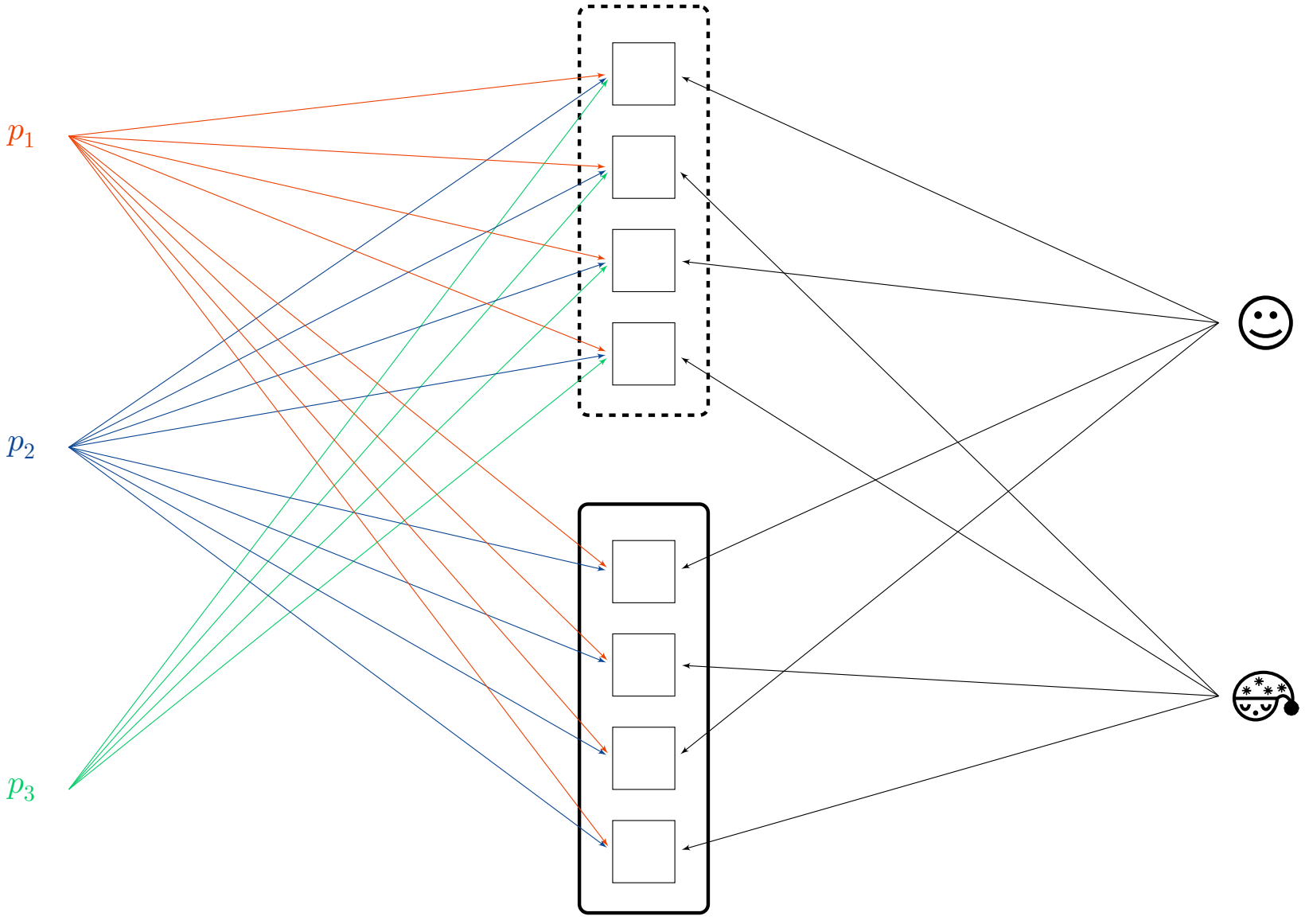
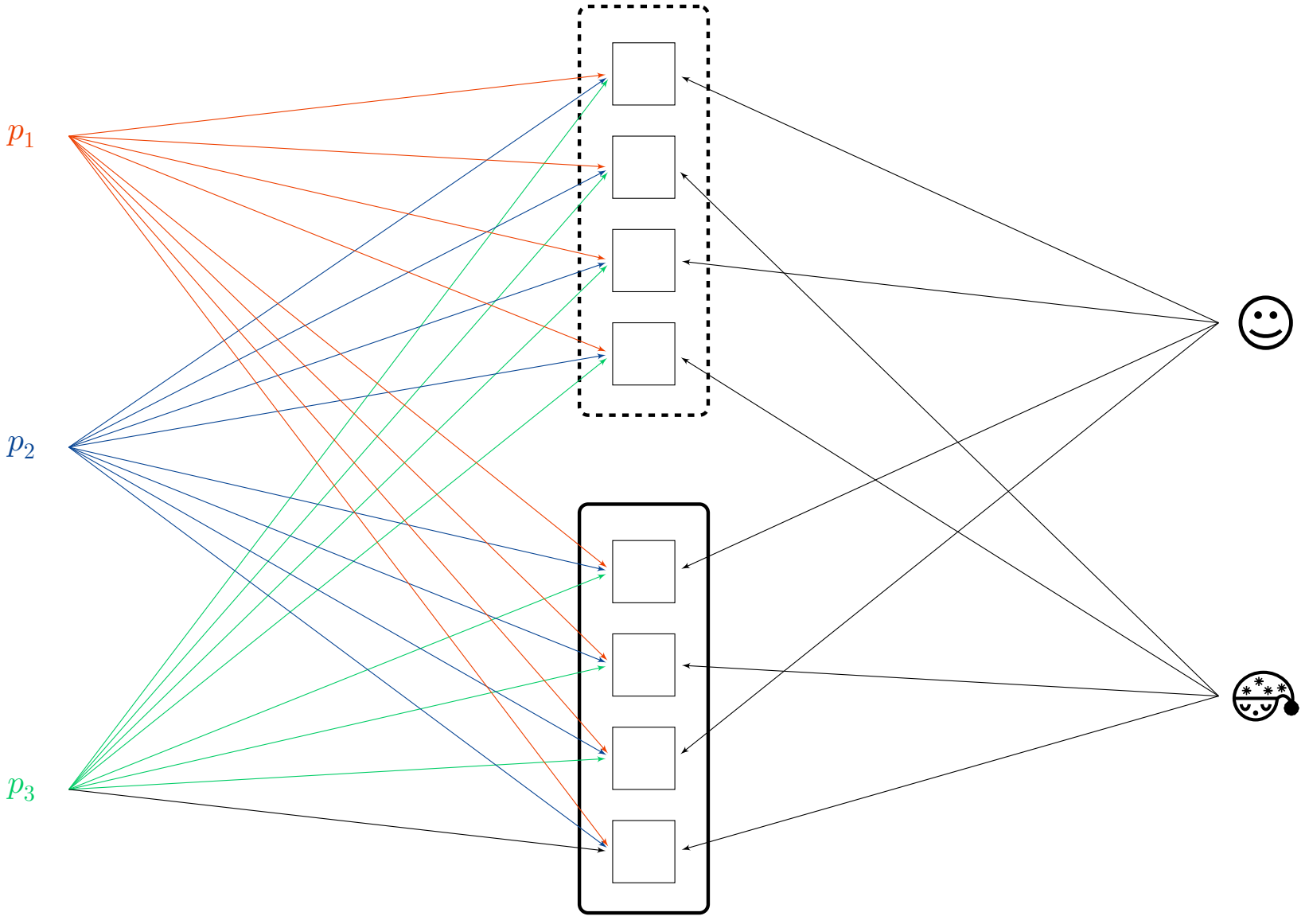
p_2
p_3


p_1
p_2
p_3


p_1
p_2
p_3

Forse qui metterei Jane e John Does

Every experiment where the same set of stimuli is administered multiple times within and between associative conditions within and between respondents

Sample-level differences

Individual differences

Typical Scoring methods

Inventa qualcosa di carino per rappresentare le medione attraverso i trial

Mettere come key concept il fatto che i soggetti sono effetti random e gli stimoli sono effetti fissi, ma che in questo ambito non ha senso perché gli stimoli sono dei rappresentati eccetera, riprendi la presentazione di berlino

Issues of Typical scoring methods

Two main big enourmous terrible issues:

1. Completely ignore all the sources of error variance
2. Ignoring the stimuli variability implies ignoring the information at the stimulus level

Problem 1: Linear Mixed Effects Models

Problem 2: Rasch model

The best solution: Rasch-like parametrization estimated with Linear Mixed Effects Models

The Rasch Model

A GLM for dichotmous responses

The log-normal model

A linear model

When psychometrics meets statsitics

La tabellina delle similarità

Model matrix e cose varie con tanto di esempio con il gamma

I BLUP e le conditional modes

The maximal model

Too complex

The models that are uself for ones aim

Given the structure of the experiments:

Common goal: Investigate the changes in the performance of the respondents between the associative conditions

Less common: Investigate the changes in the functioning of the stimuli between the associative conditions

Preliminarities

Index	Meaning	Variable
$p = 1, \ldots, P$	Respondent	`respondents`
$s = 1, \ldots, S$	Stimulus	`stimuli`
$c \in \{0, 1\}$	Associative condition	`condition`
i	Trial	

Accuracy:

GLMM

$y = [0, 1]$

Log-time response

LMM

$y = [0, +\infty]$ (log-transformed)

$\varepsilon\ \mathcal{N}(0, \sigma^2)$

Model 1

Mathematical Notation

$$y = \beta_c X_c + \alpha_p[i] + \alpha_s[i]$$

lme4 notation

```
y ~ 0 + condition + (1|stimuli) + (1|respondents)
```

Rasch-like parametrization

	GLMM	LMM
respondents	θ_p	τ_p
stimuli	b_s	δ_s

Model 2

Mathematical Notation

$$y = \beta_c X_c + \alpha_p[i] + \beta_s[i] c_i$$

lme4 notation

```
y ~ 0 + condition + (0+condition|stimuli) + (1|respondents)
```

Rasch-like parametrization

	GLMM	LMM
respondents	θ_p	τ_p
stimuli	b_{sc}	δ_{sc}

Model 3

Mathematical Notation

$$y = \beta_c X_c + \beta_p[i] c_i + \alpha_s[i]$$

lme4 notation

```
y ~ 0 + condition + (1|stimuli) + (0+condition|respondents)
```

Rasch-like parametrization

	GLMM	LMM
respondents	θ_{pc}	τ_{pc}
stimuli	b_s	δ_s

All models are wrong...

Find the useful model via model comparison: AIC and BIC

The lower the value, the better the model

! AIC, BIC, and model complexity:

Total number of parameters: β and Γ
NOT the levels in d

Model 2 and Model 3: Same complexity, different focus

The chosen model is the least wrong model *given the models considered*:
Relativity applies everywhere

1. Introduction
   - Experiments with fully-crossed structures
   - Random Factors and Random Effects
   - Random structures

2. Real data

Get set

```
library(lme4) # Fitting LMMs
library(ggplot2) # Plots
```

The Implicit Association Test

Individual Differences!

copia e incolla direttamente la slide del predoc!!

```
[1] "C:/Users/Ottavia/Documents/GitHub/beyond-summer-school/a
```