matRiks

An R package for the automatic generation of Raven-like matrices

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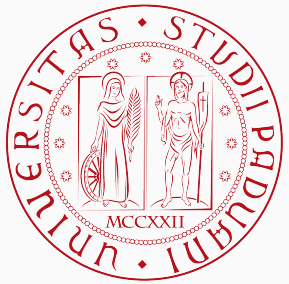
Universty of Padova, IT

Meeting of European Mathematical Psychology Group, 2023



Assessment of fluid intelligence or abstract reasoning
Beyond clinical assessment $\rightarrow$ Job recruitment

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Issue

- Can only be administered once (o after a long time period)
- Difficulty in the generation of "true" parallel forms

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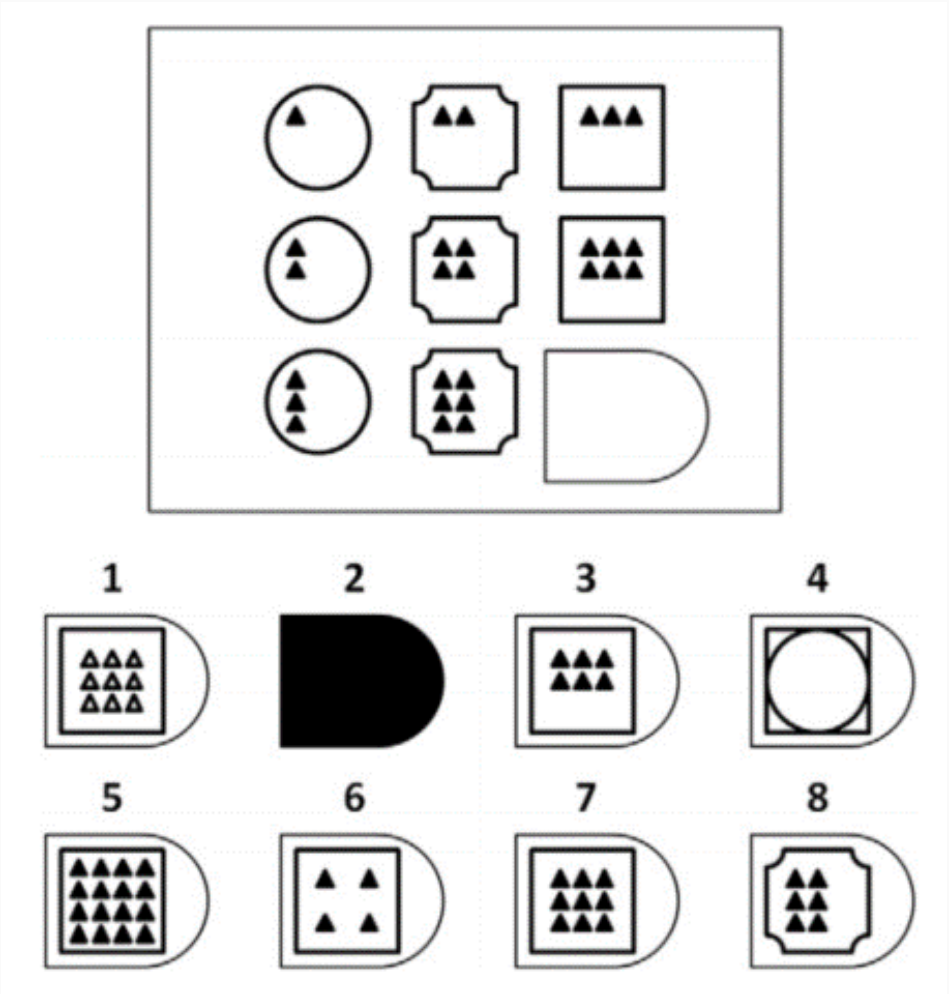
Aim

Development of an open-source easy-to-use tool for the automatic (and reproducible) generation of Raven-like matrices

An example



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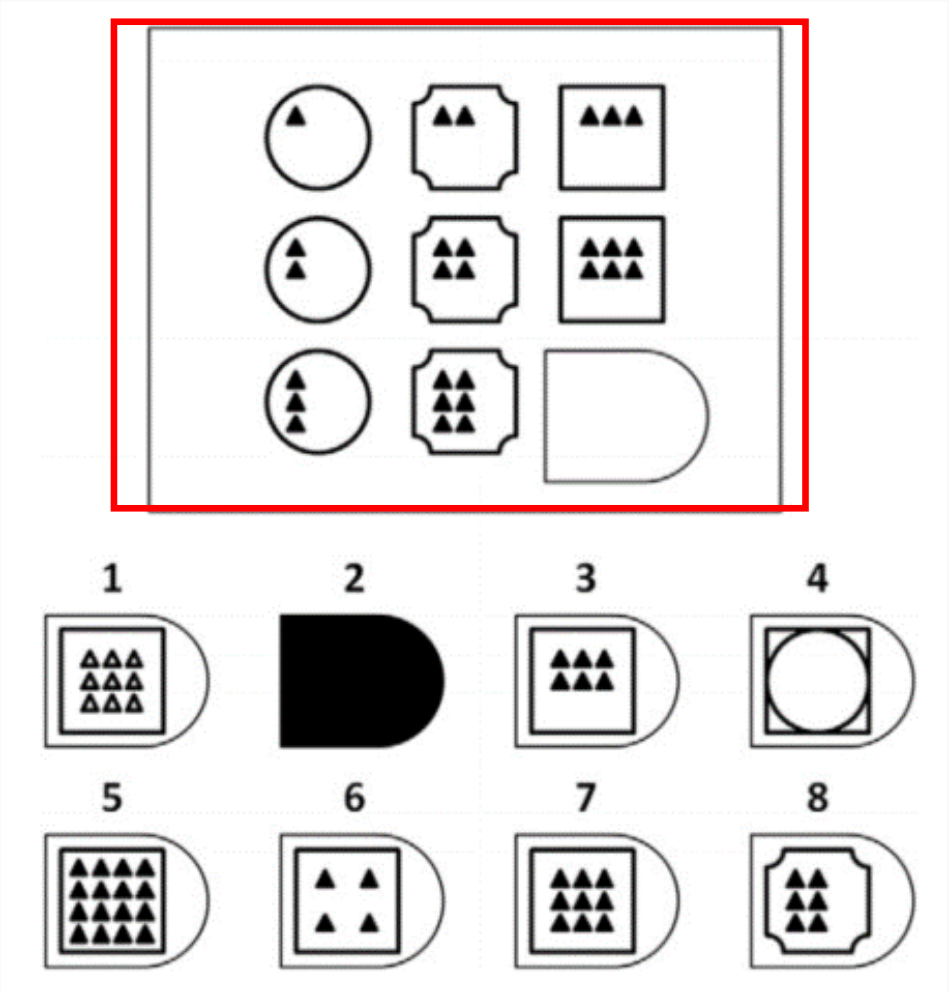

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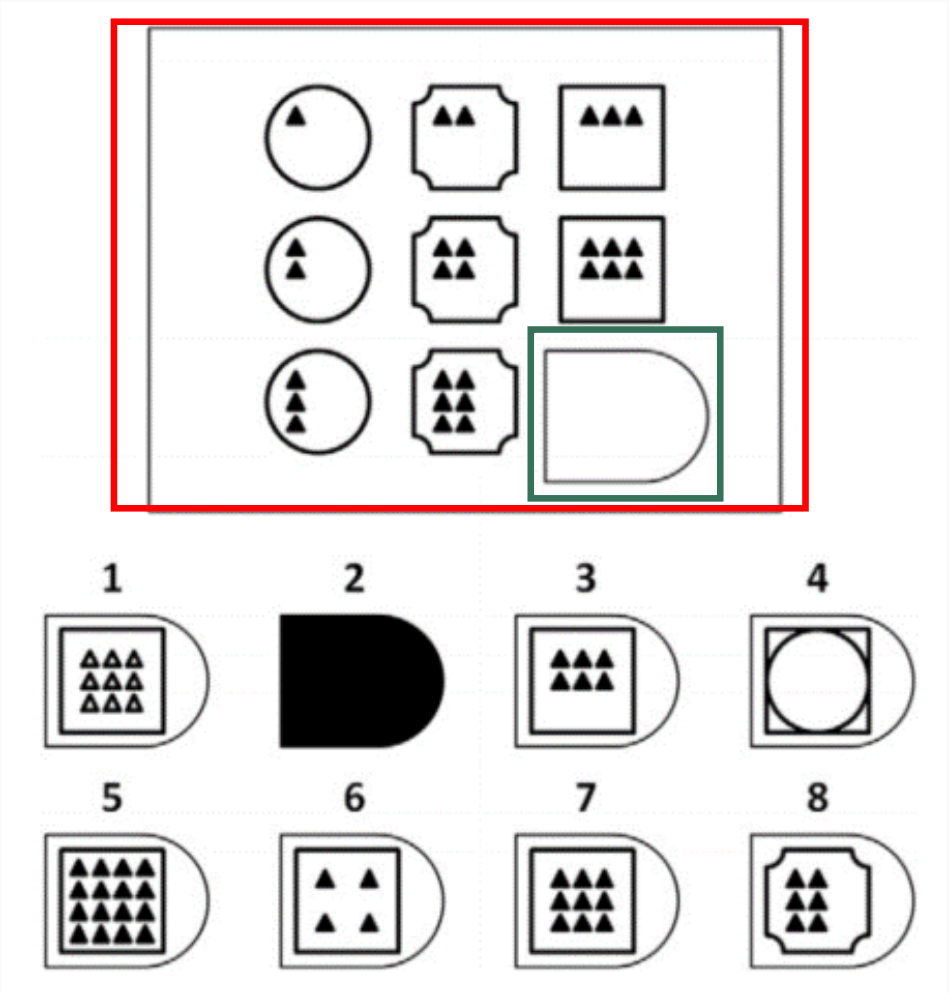

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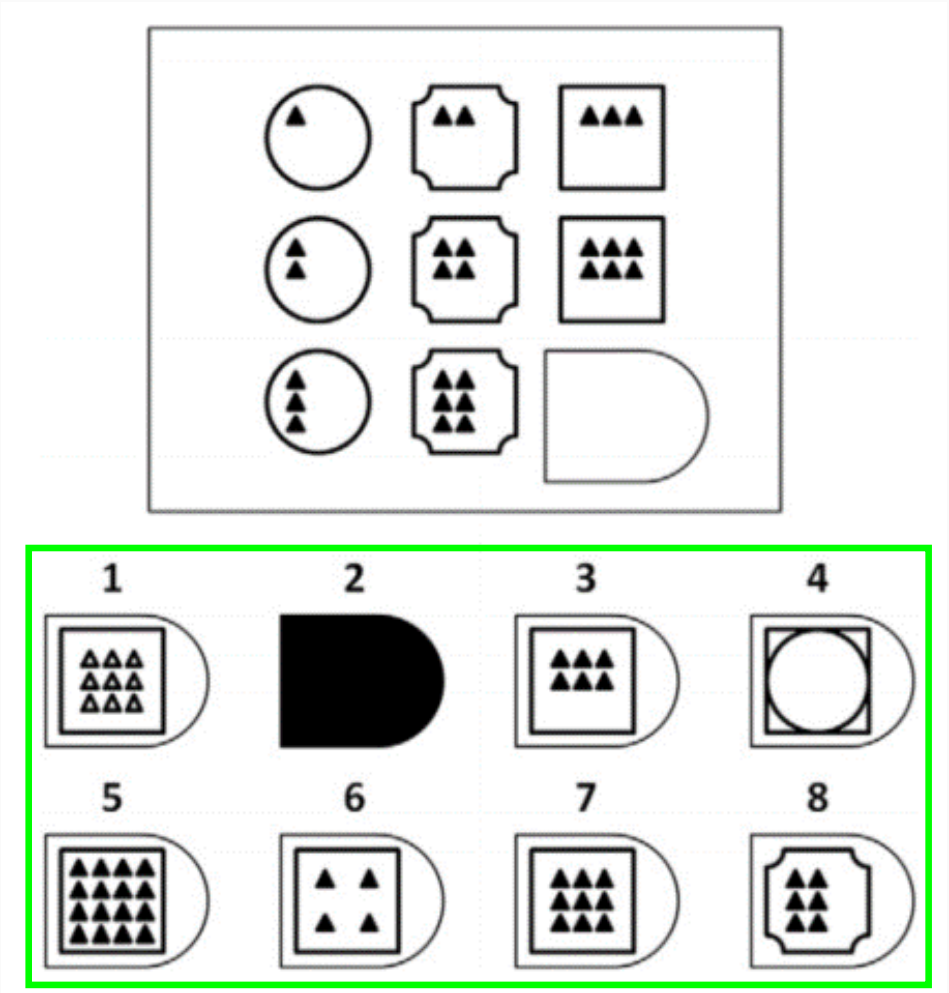
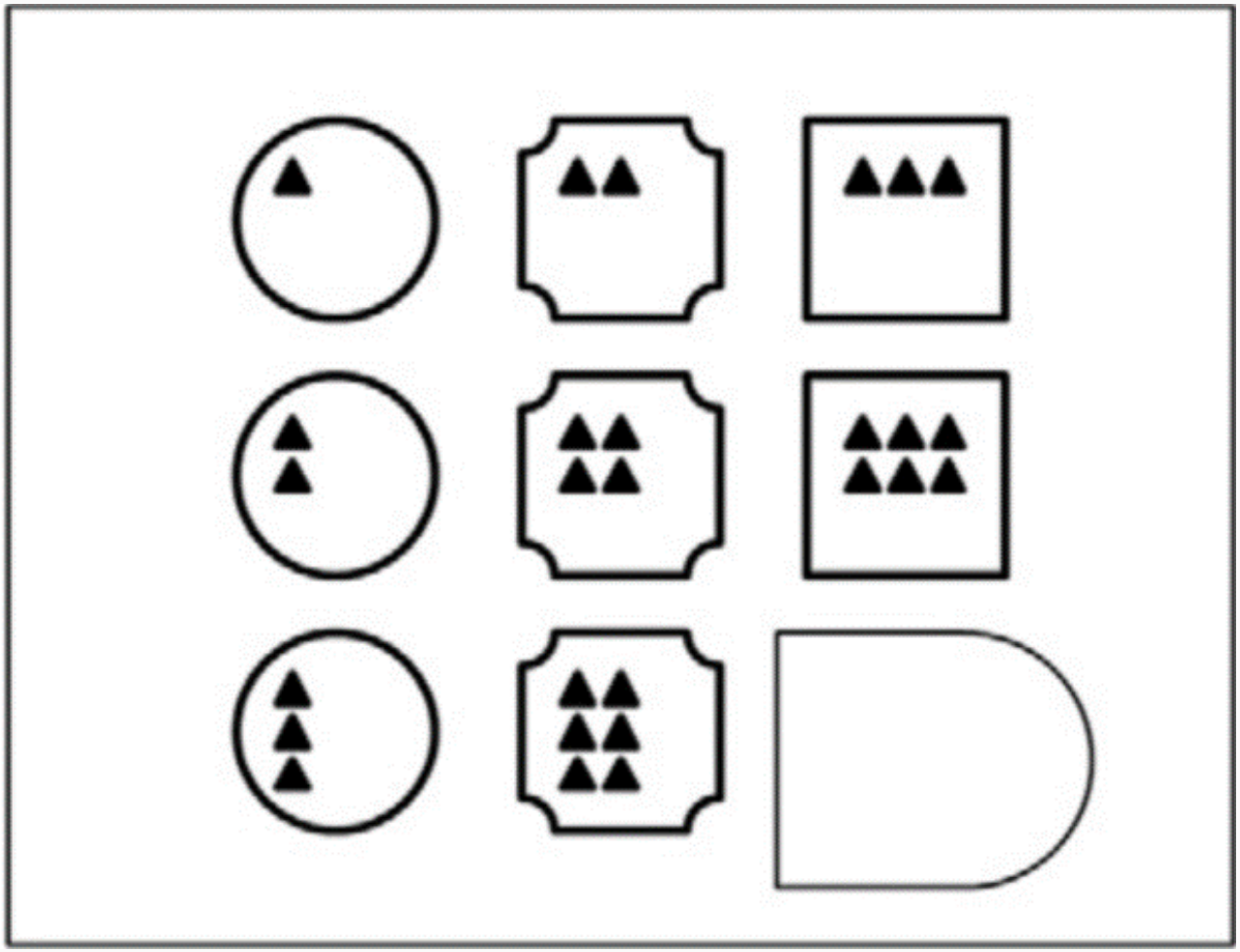


An example: The matrix



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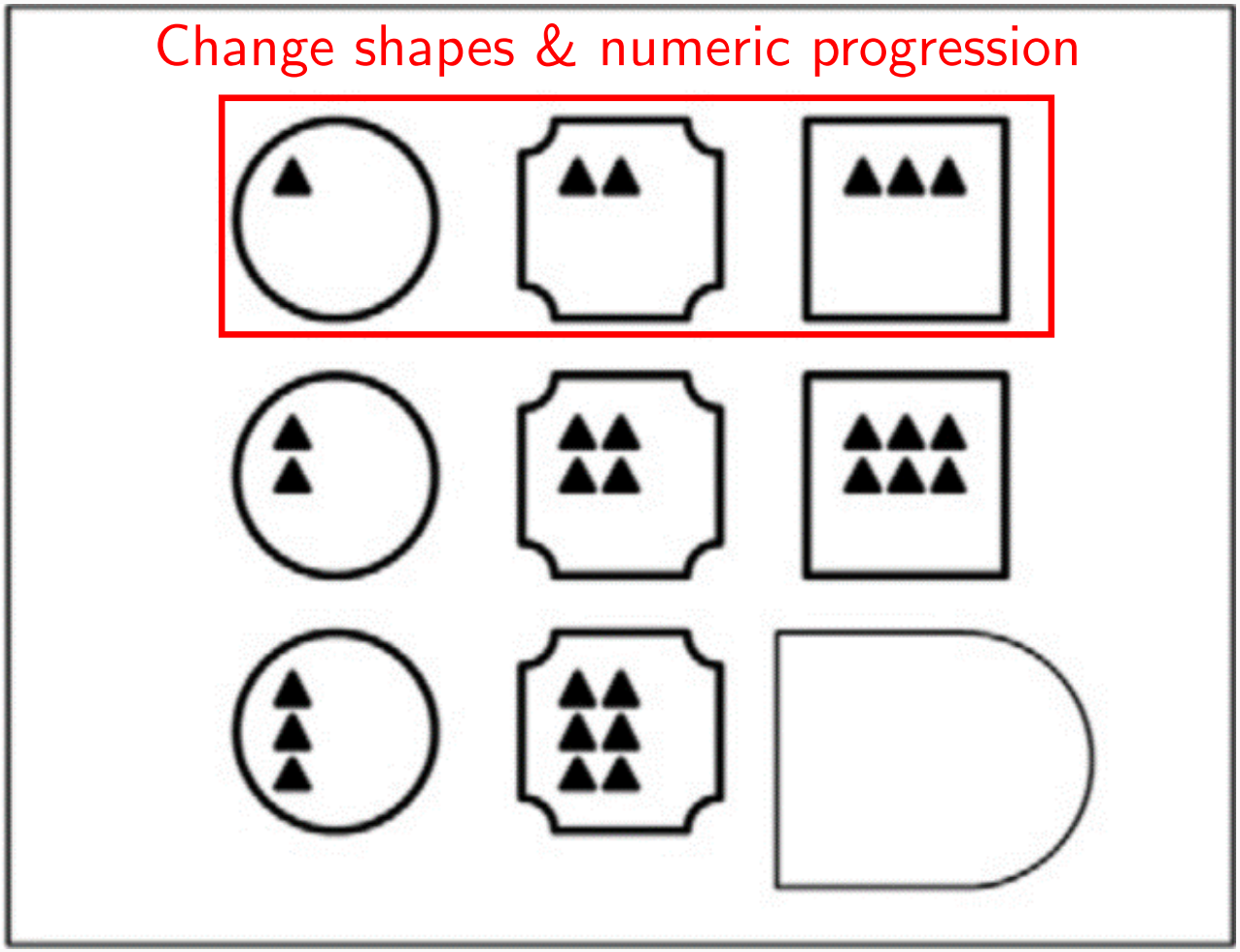

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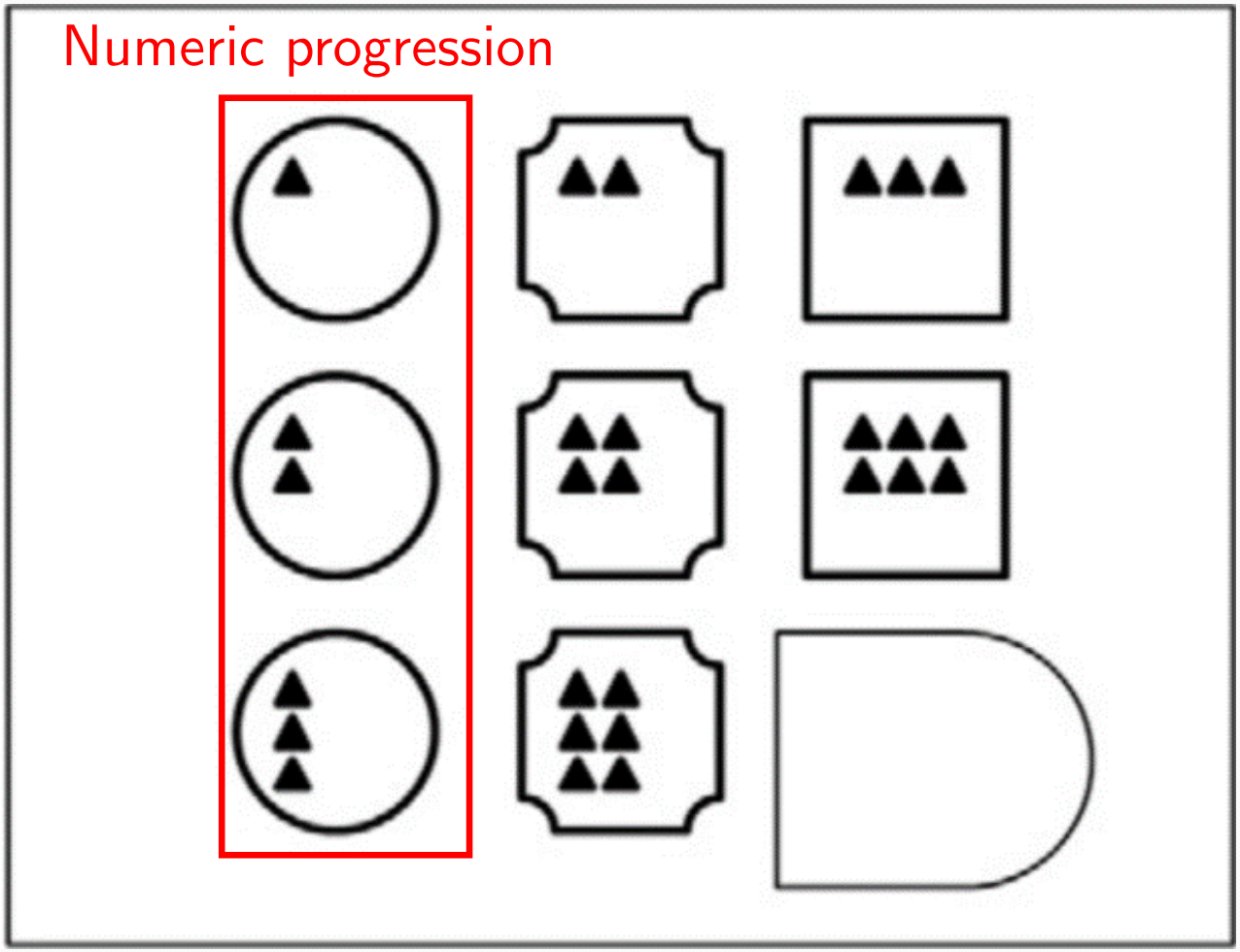
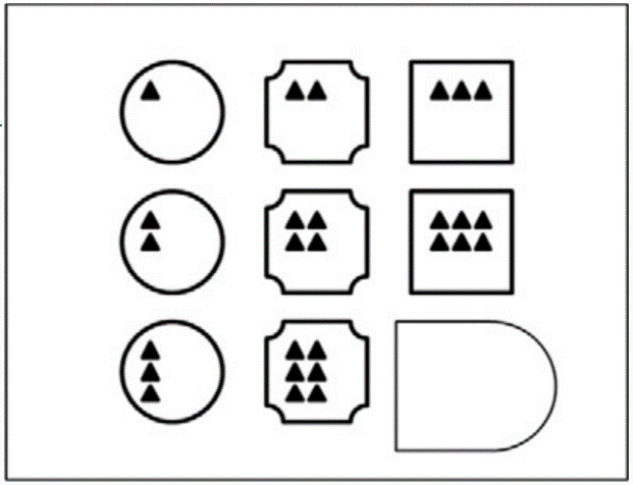
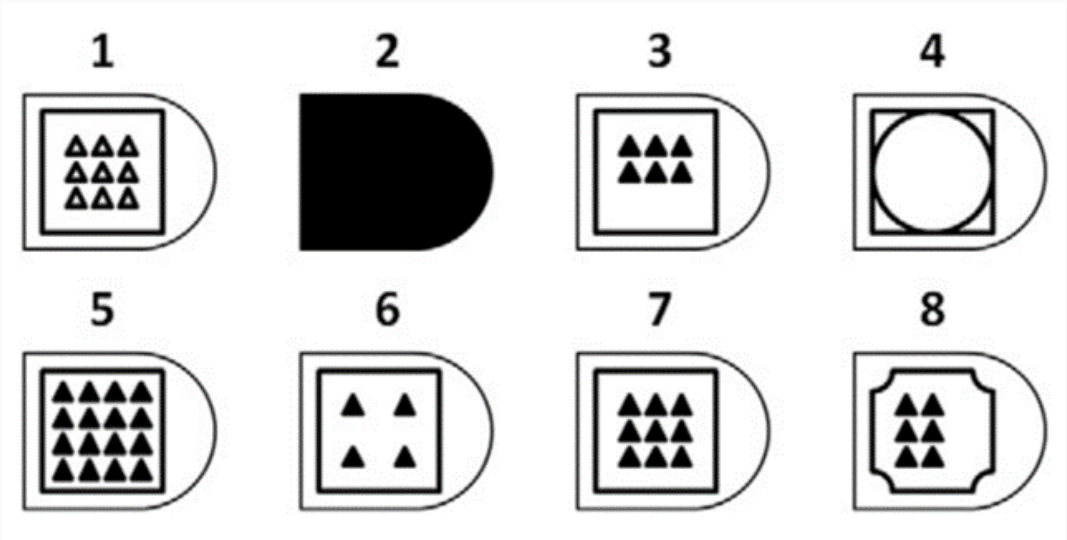


An example: The response list





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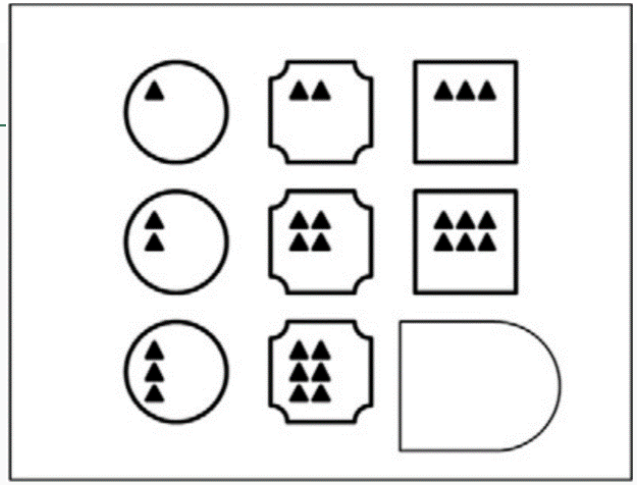

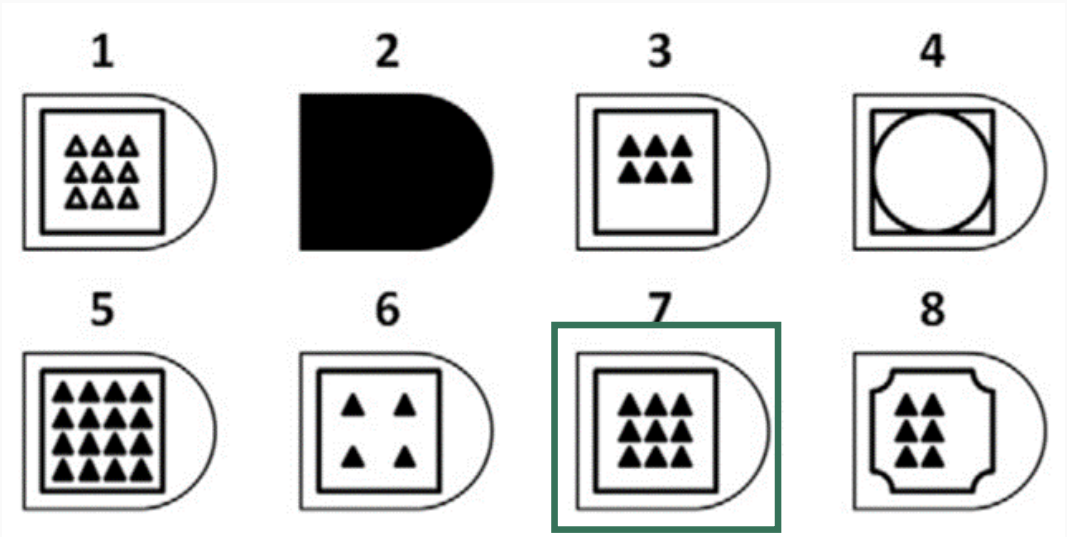

Repetition	Repetition of a cell **adjacent** to the blank space
Difference	Different in appearance from every element of the matrix
Wrong Principle	Copy of a cell or combination of cells
Incomplete Correlate	**Almost** the correct response

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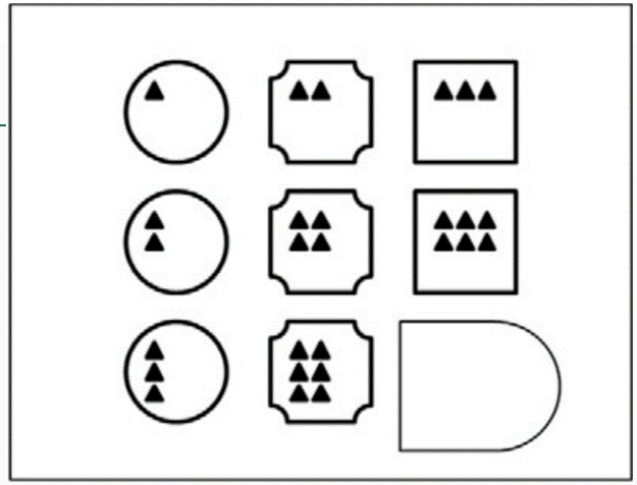

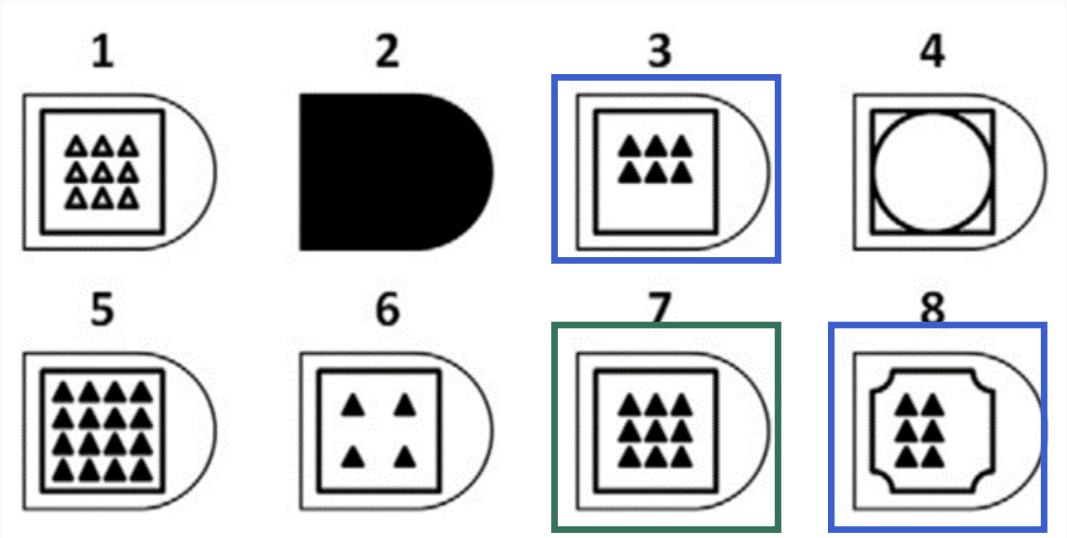

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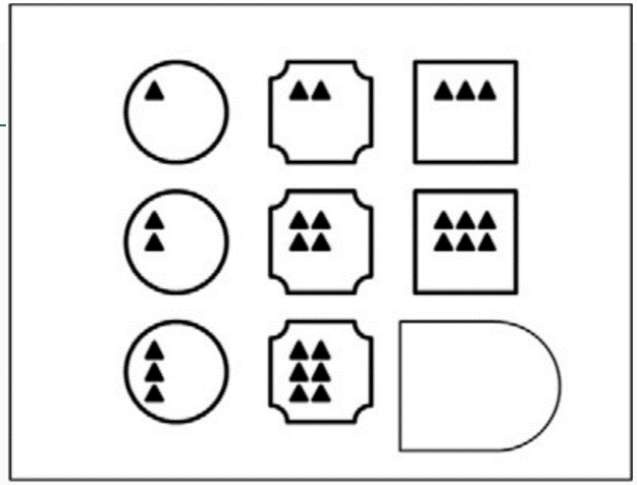

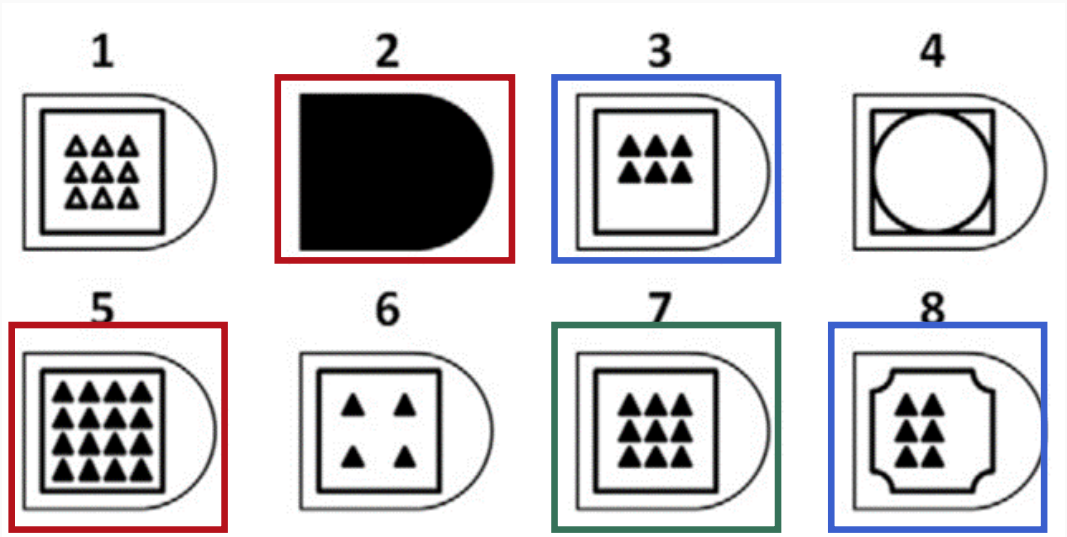

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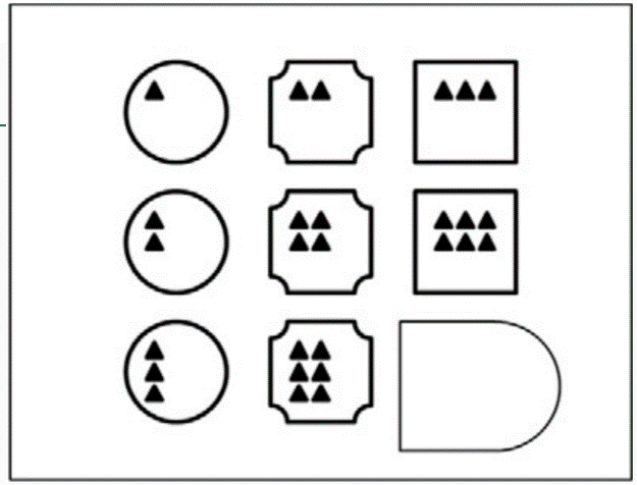

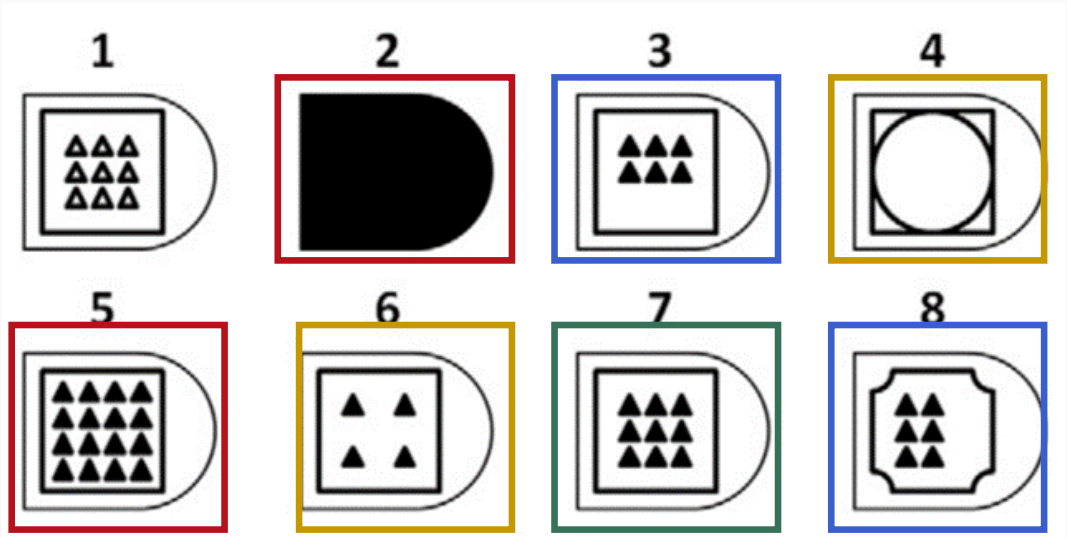

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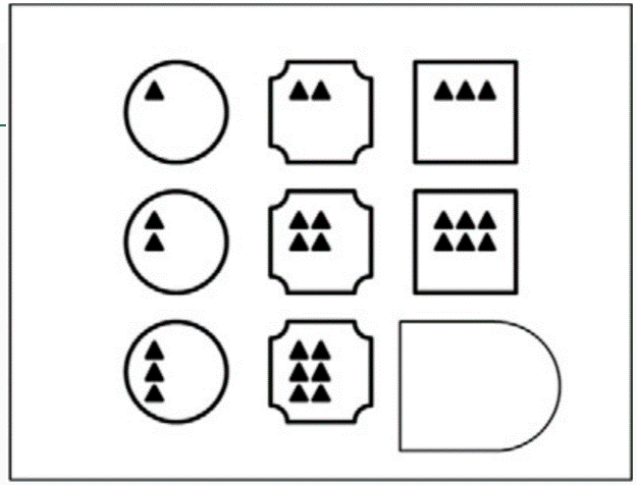

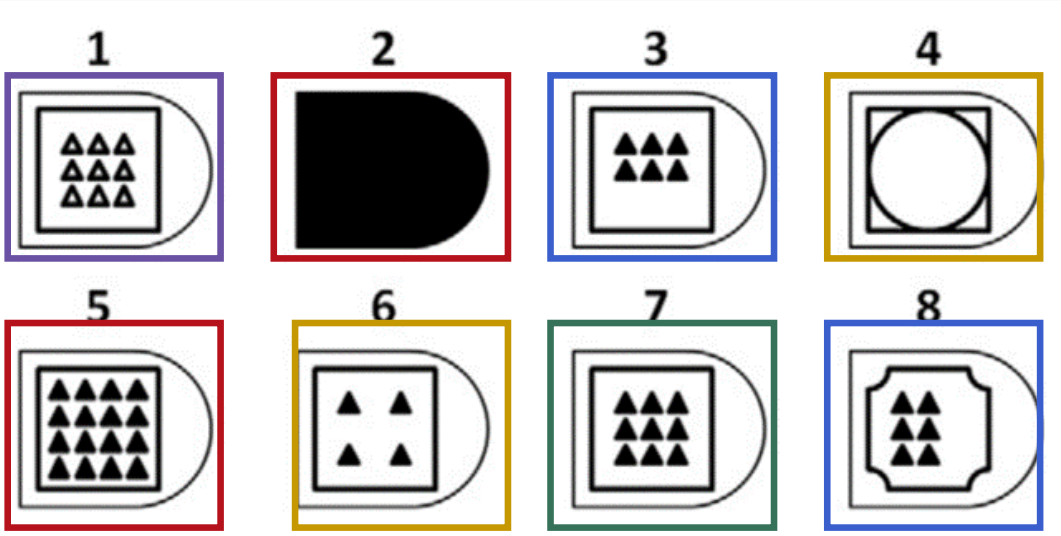

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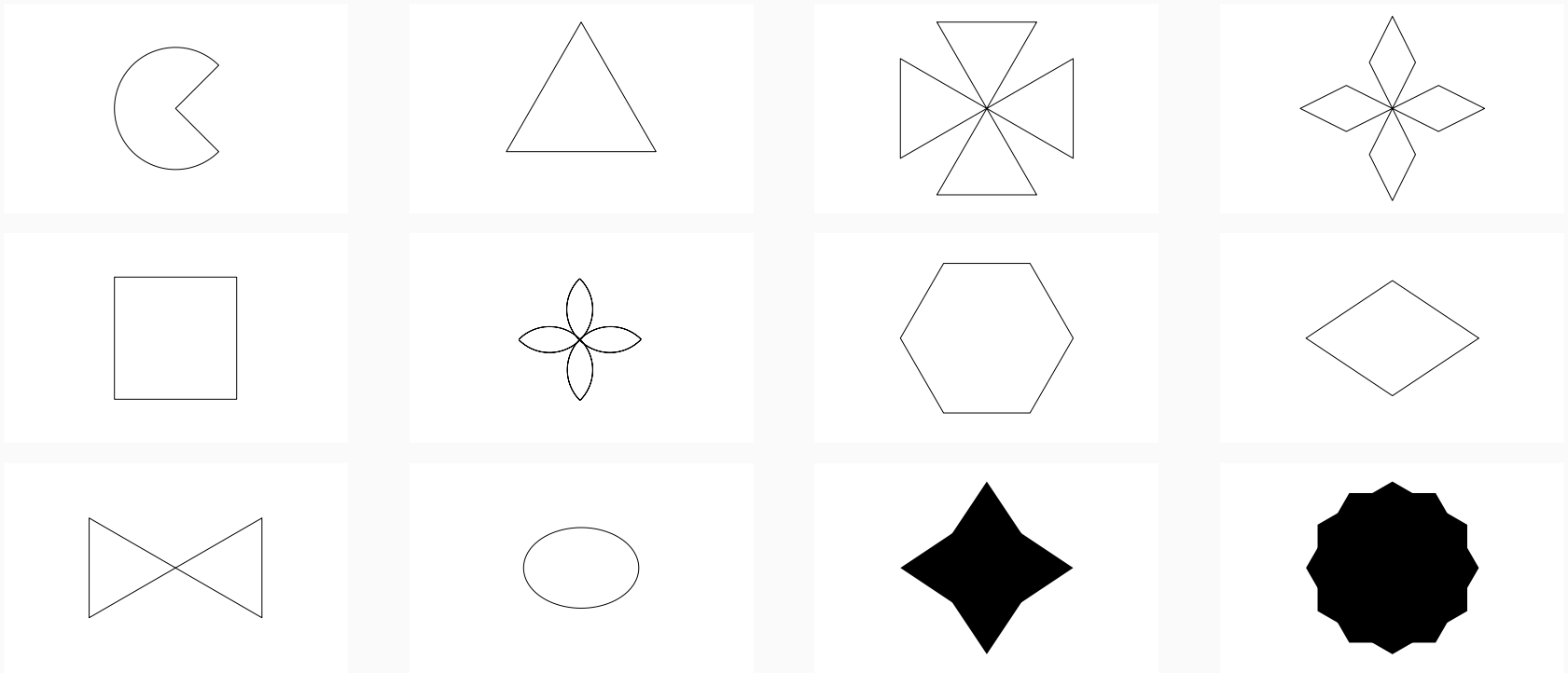
Rules Category	Rule name	Definition
Visuospatial	Object addition/subtraction	Visually merge two elements
	Movement	With a steady background, the movement is created by changing the position of an object across the cells
	Rotation	The spatial orientation of the figure changes across the cells
	Mental transformation	The third cell results from the application of the characteristics in the second cell to the figures in the first cell.
	Numeric progression	Quantitative increase or decrease in the number of features from cell to cell
	Changes in shape	The figures change across cells
	Changes in shade	The shading of the figures changes across cells
	Changes in size	The size of the figures changes across cells
	Changes in margins	The margins of the figures change across cells
Logical	AND	The third cell contains ONLY the elements that appeared in both the first and second cells
	OR	The third cell contains ALL the elements in the first and second cells
	XOR	The third cell contains the elements in the first cell not present in the second cell and viceversa

```
devtools::install_github("https://github.com/OttaviaE/matRiks")
```

- Generates 2×2 or 3×3 Raven-like matrices
- Generates the response list associated with the matrix (1 correct response + 10 distractors)
- Core elements:

  Objects *Rules* *Matrix generator* *Response options generator*

(Some) of the available figures



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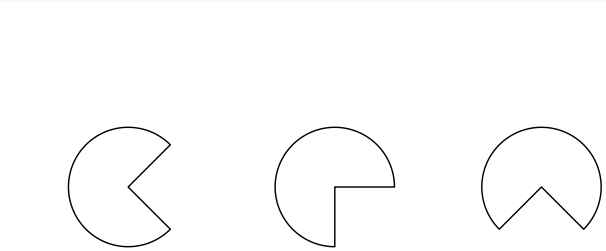
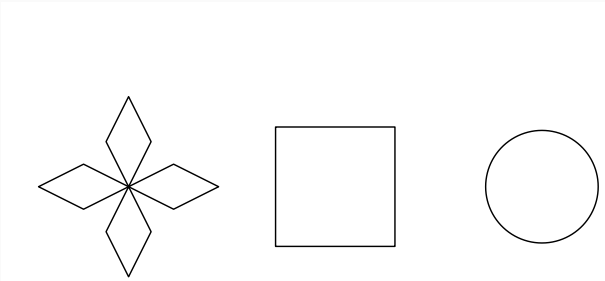
Visuospatial rules

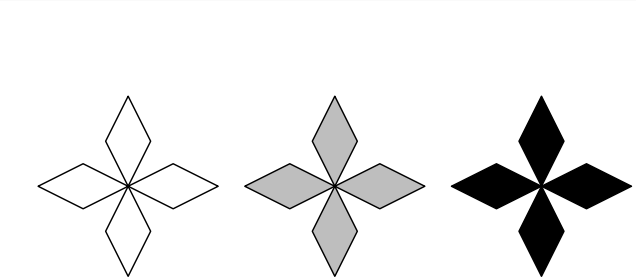
Rotate



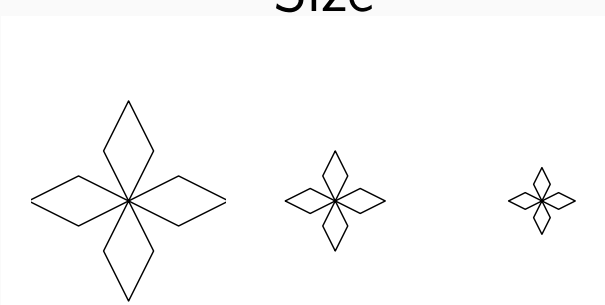
Shape



Shade



Size



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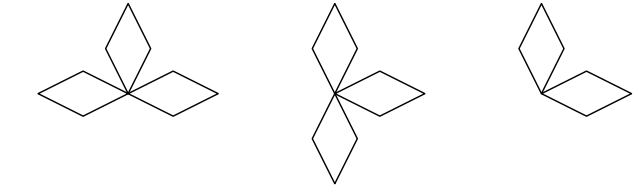
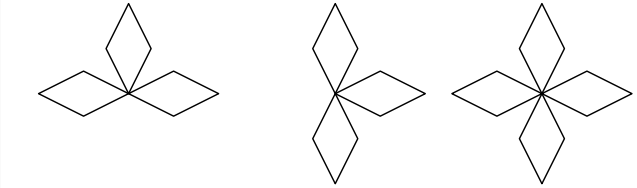
Logical rules

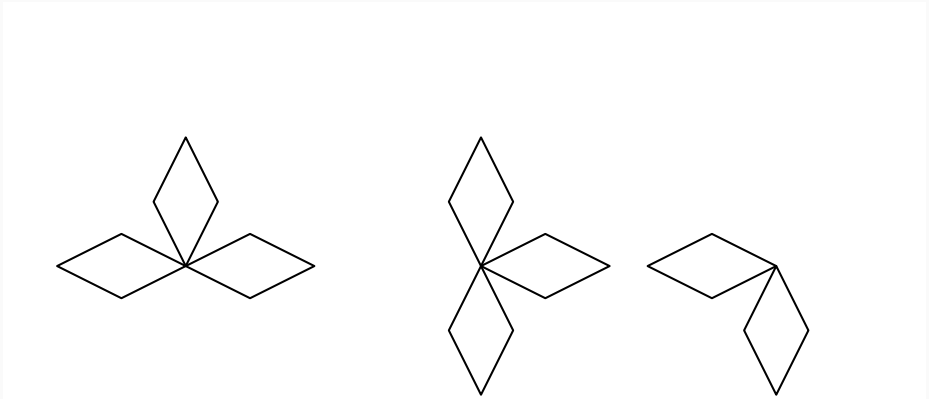
AND ($\cap$)



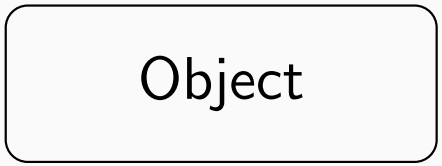
OR ($\cup$)



XOR (Δ)



The matRiks architecture: Matriks generator

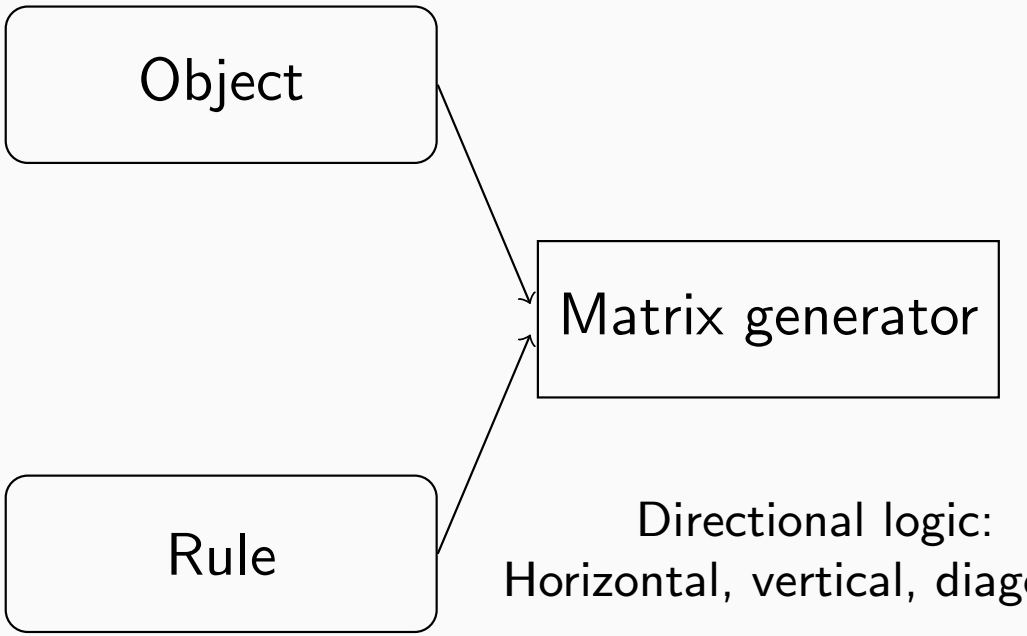


The matRiks architecture: Matriks generator

Object

Rule

The matRiks architecture: Matriks generator



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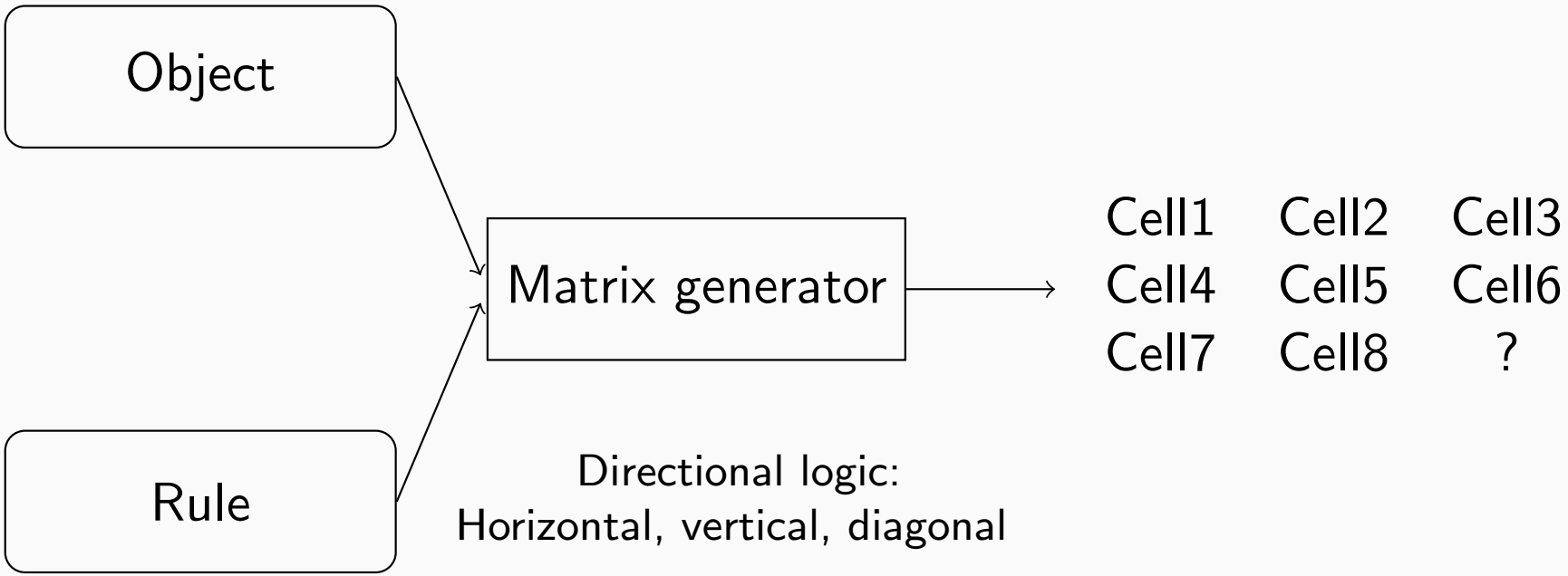
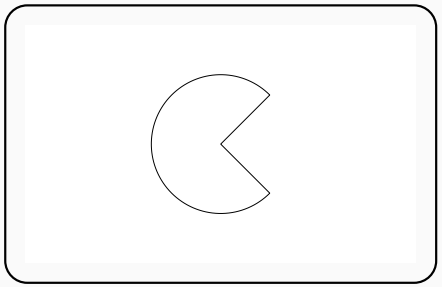
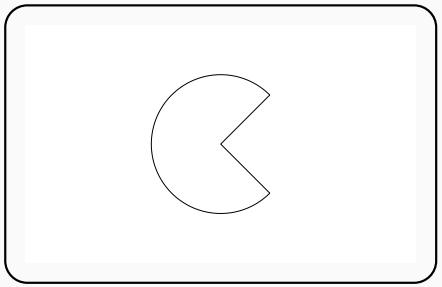
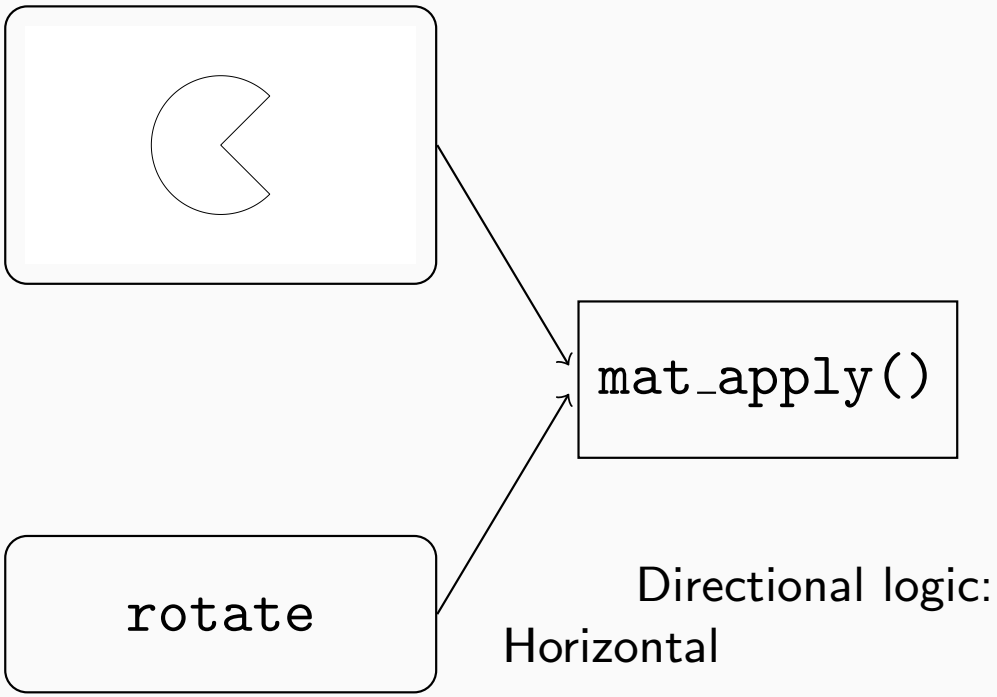
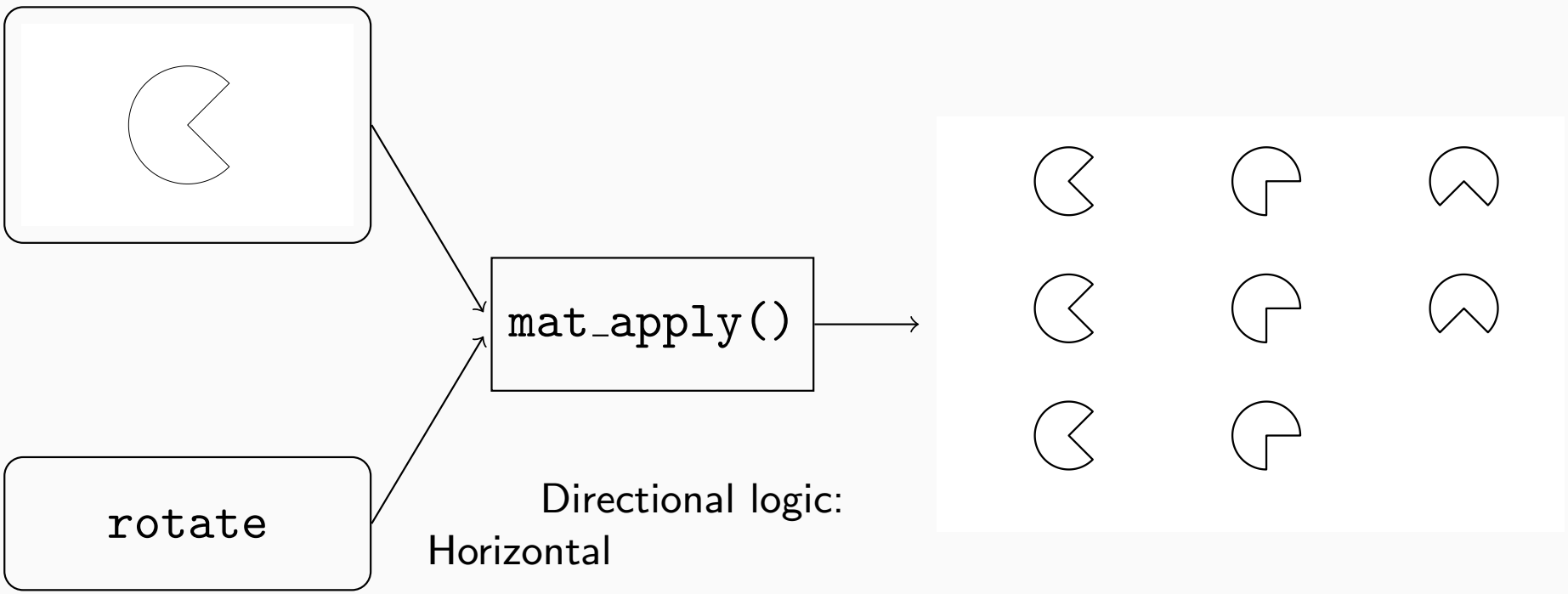






`rotate`


mat_apply()
rotate
Directional logic:
Horizontal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rotate
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The matRiks architecture: Response options generator

Cell1	Cell2	Cell3
Cell4	Cell5	Cell6
Cell7	Cell8	?

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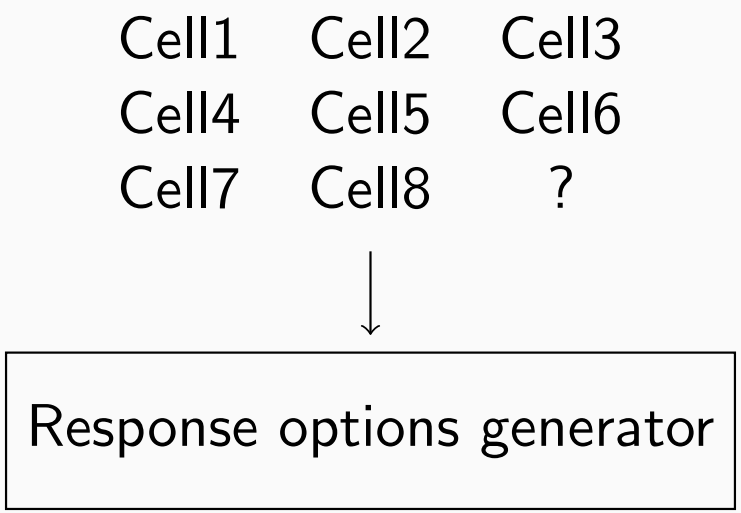

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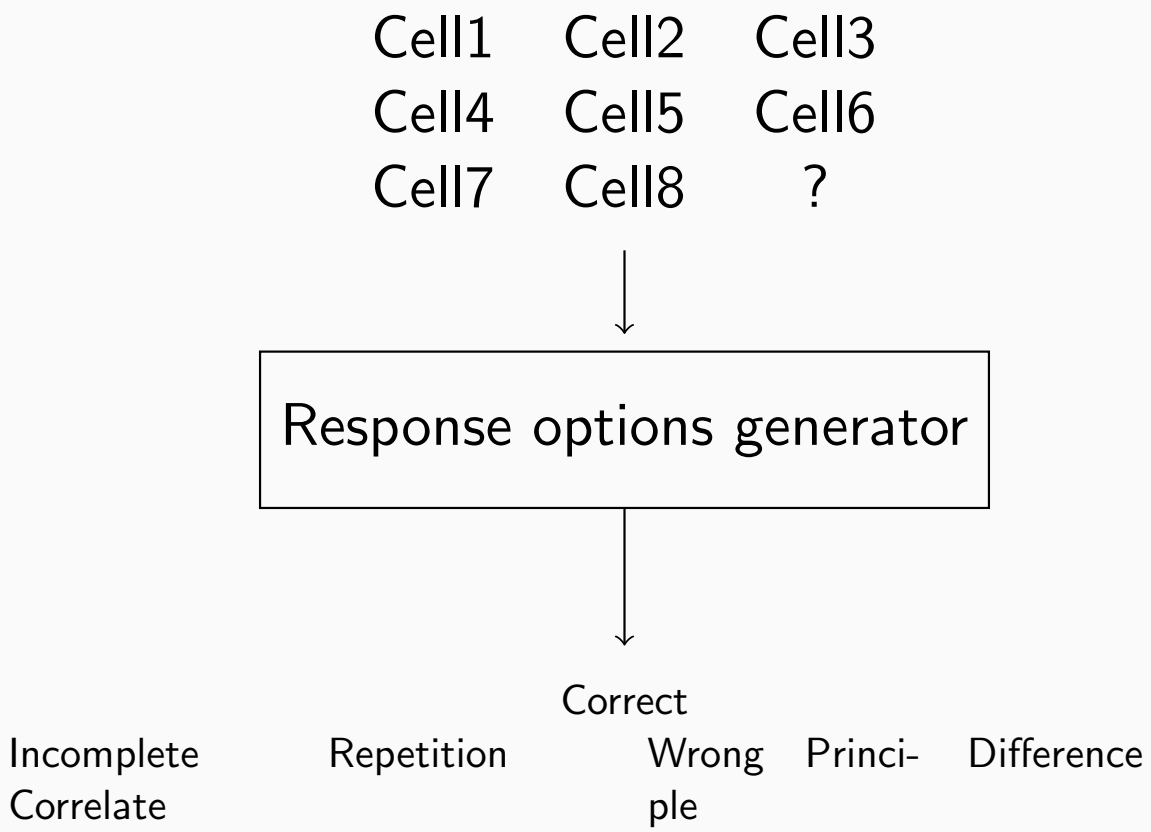
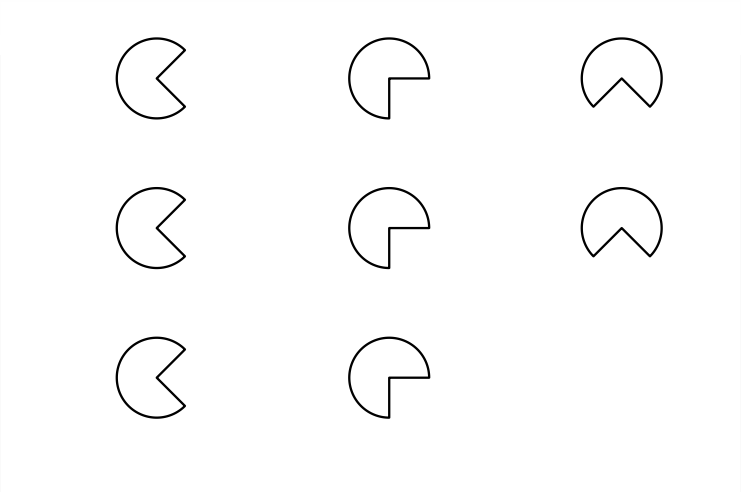
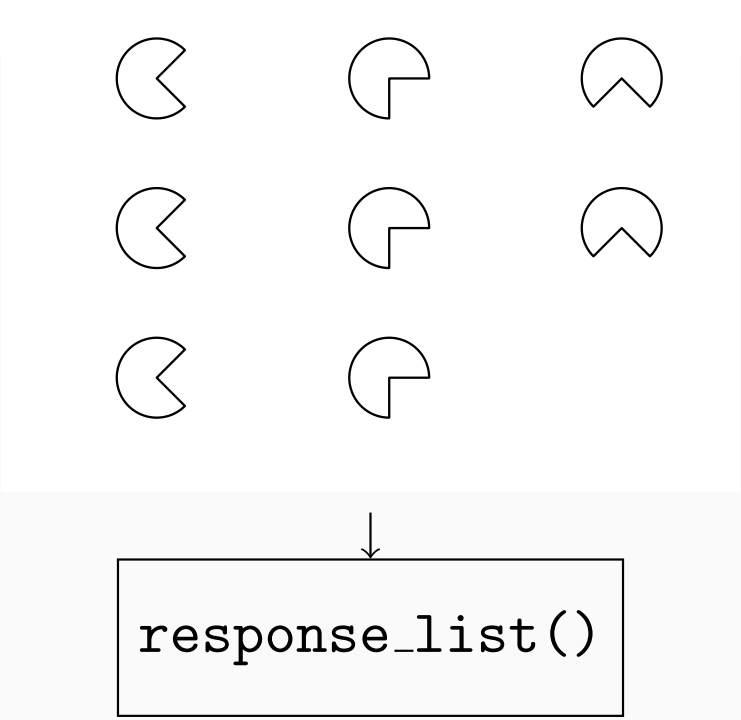
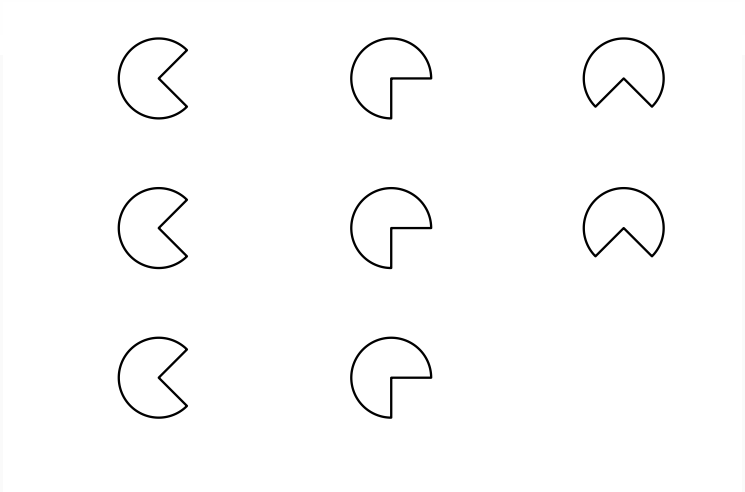
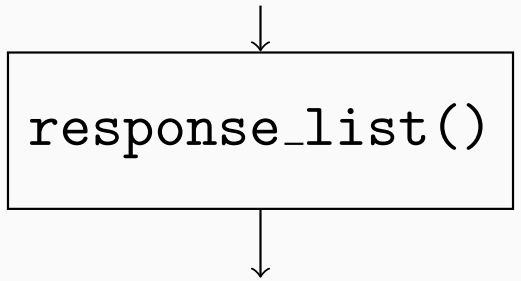





response_list()

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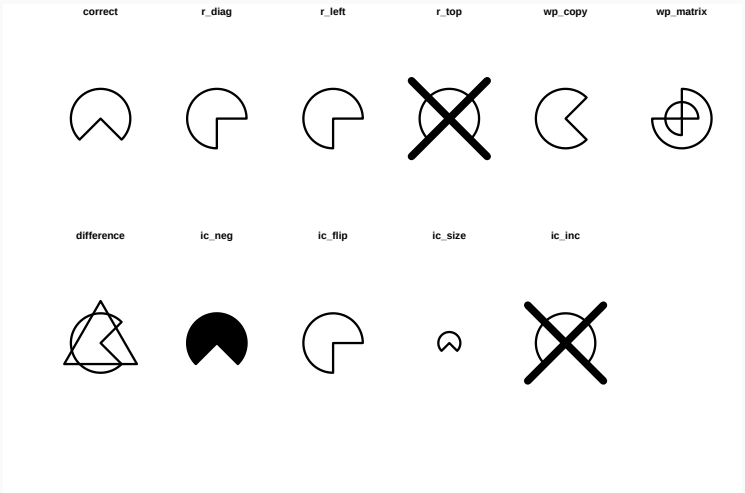
correct
r_diag
r_left
r_top
wp_copy
wp_matrix
difference
ic_neg
ic_flip
ic_size
ic_inc

PsycAssist


PsycAssist
A Psycological Assistent for accurate and adaptive neuropsychological assessments

PsycAssist

Sample

$n = 600$ children aged 4-11, recruited in Italian schools
$F = 48\%$
30% preschoolers

PsycAssist

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Stimuli

40 Raven-like matrices:

- 5 Mono images
- 2×2 matrices
- 3×3 matrices

Rasch validation

- Monotonicity check
- Fit the Rasch model:
  1. Item infit and outfit
  2. Local dependence

Rasch validation

Note

2 matrices were eliminated because of technical issues
4 matrices were eliminated because of a lack of monotonicity

Rasch validation

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The starting model included 34 matrices:

Madcov	SRMR	p-value
0.97	0.06	< 0.001

Oufit statistic suggested the underfit of one matrix (item 21) $\rightarrow$ removed and refitted the model

- Check for infit/outfit $\rightarrow$ no matrices were identified as underfitting
- Check for local dependence:
  - Matrix $37 - 36 \rightarrow$ Matrix 37 eliminated
  - Matrix $28 - 40 \rightarrow$ Matrix 40 eliminated

The final model

Madcov	SRMR	SRMSR	MADaQ3	p-value
0.96	0.06	0.08	0.05	< 0.001

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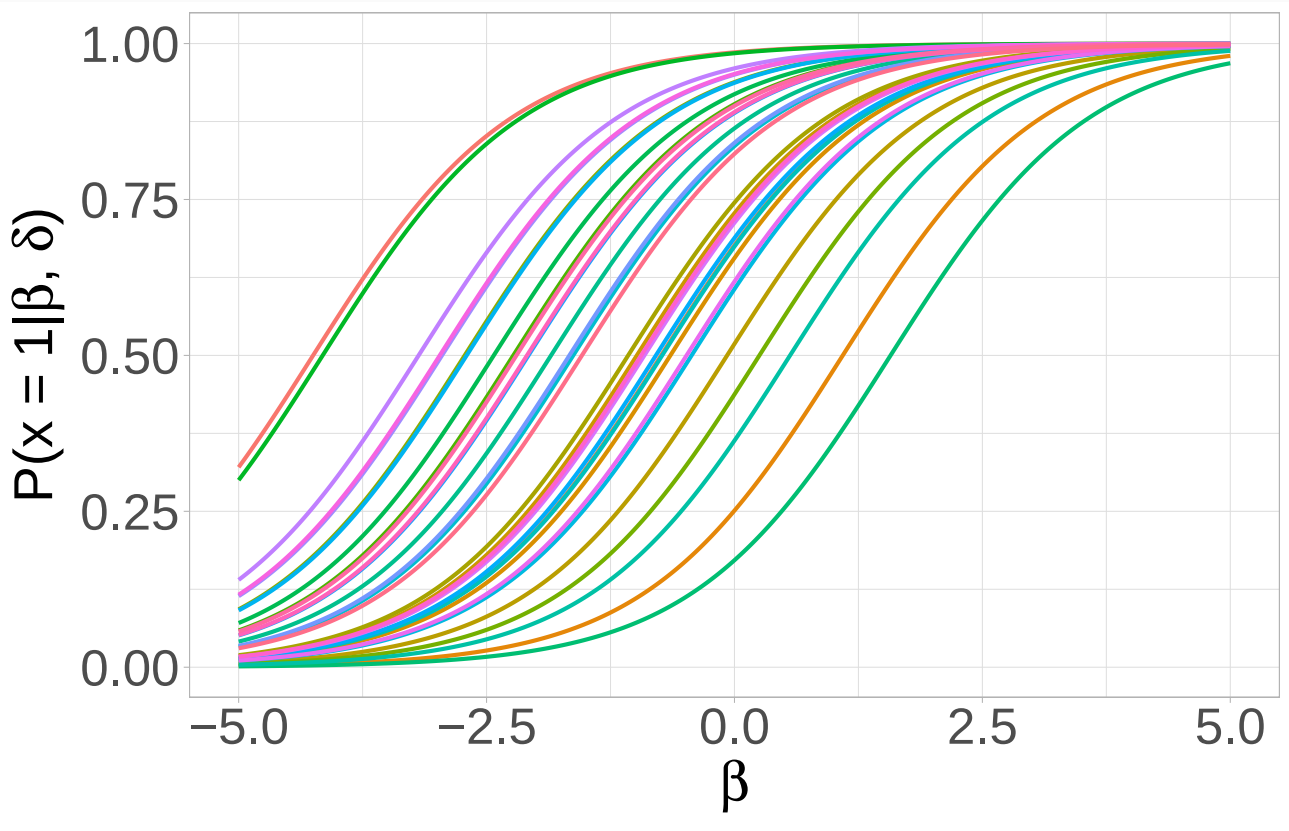

- Generate similar but different matrices $\rightarrow$ parallel forms
- Formalization of the matrix generation and response options generation processes
- Reproducibility of the stimuli
- Ease of use (for useR)

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➡ SOON A shiny app

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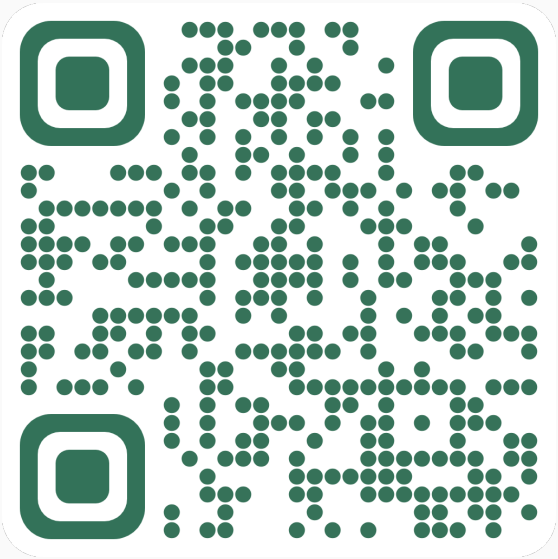
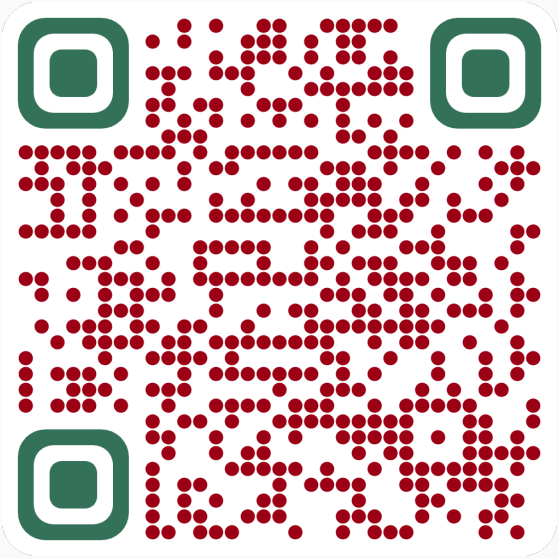


https://github.com/OttaviaE/matRiks

Slides



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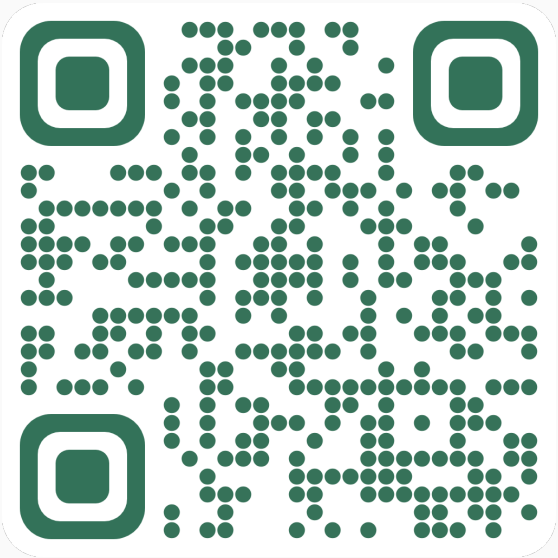

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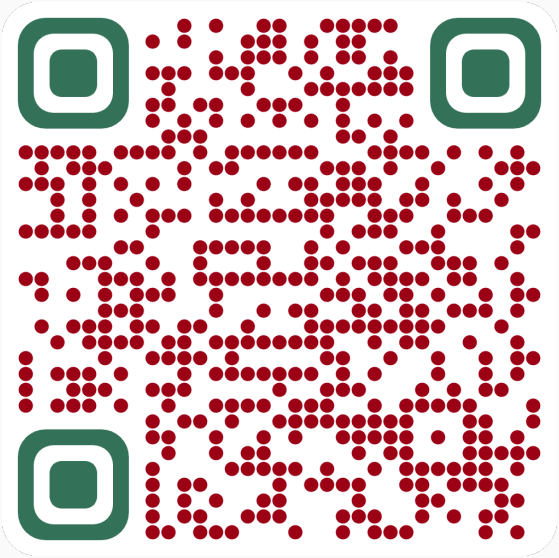

Thank you!

ottavia.epifania@unipd.it