

MATRIKS

AN R PACKAGE FOR THE AUTOMATIC GENERATION OF
RAVEN-LIKE MATRICES

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MathPsych, ICCM, EMPG, July 2023



1 Introduction

2 Generating rules

3 The matRiks package

4 Why?

5 Final remarks

Assessment of fluid intelligence or abstract reasoning
Beyond clinical assessment → Job recruitment



Assessment of fluid intelligence or abstract reasoning
Beyond clinical assessment → Job recruitment



Issue

Can only be administered once (or after a long time period)



Assessment of fluid intelligence or abstract reasoning
Beyond clinical assessment → Job recruitment



Issue

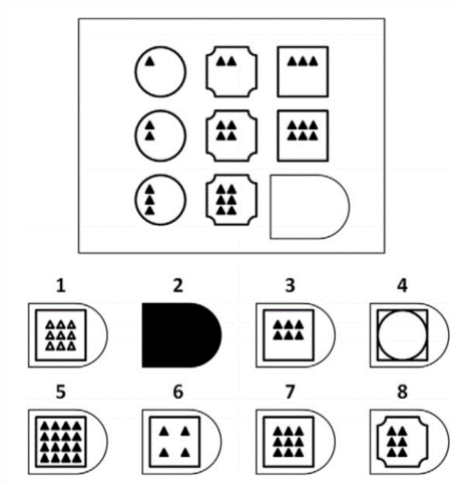
Can only be administered once (or after a long time period)

Aim

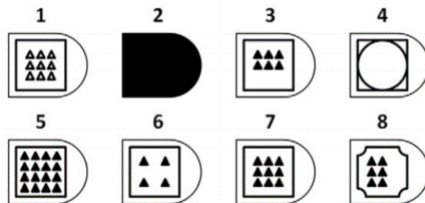
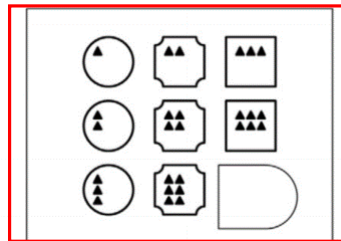
Development of an open-source easy-to-use tool for the automatic and rule-based generation of Raven-like matrices



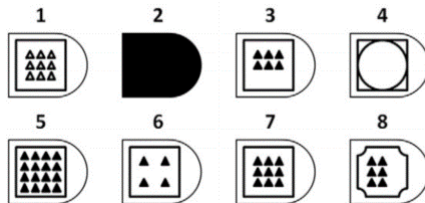
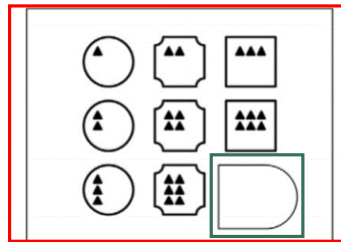
An example



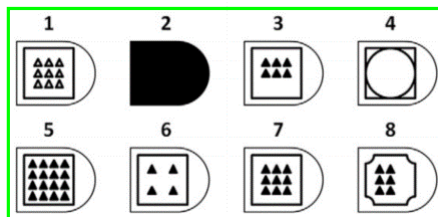
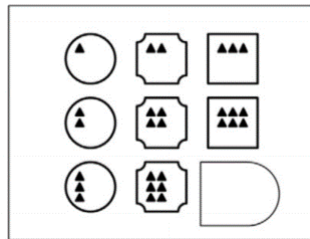
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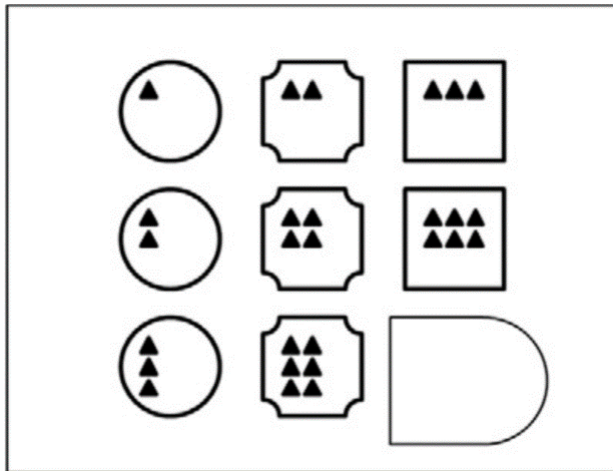
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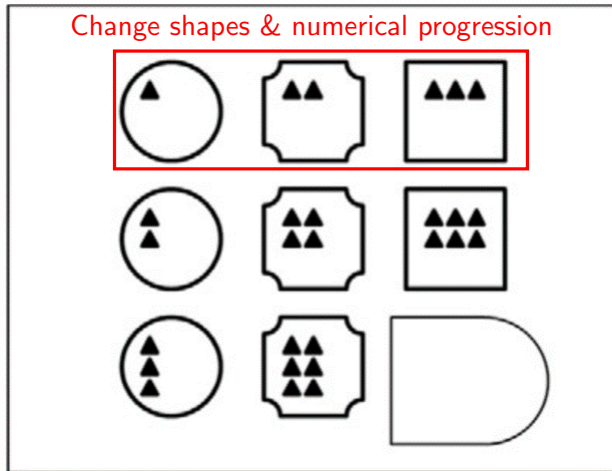
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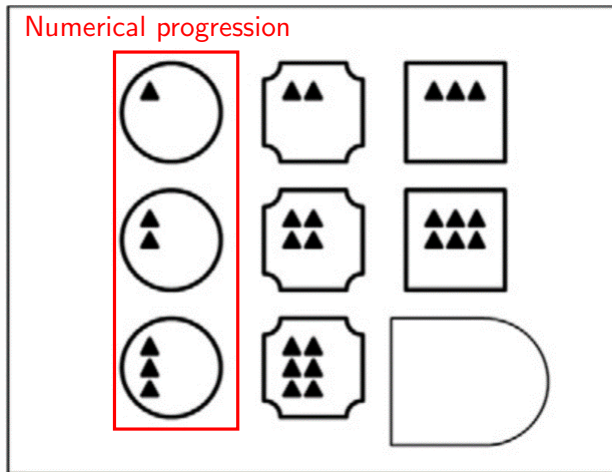
An example: The matrix



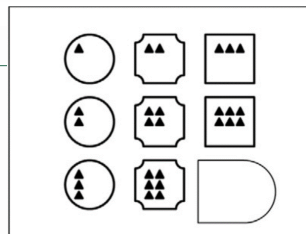
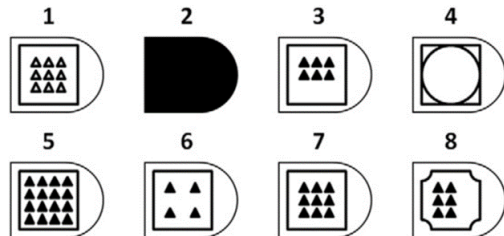
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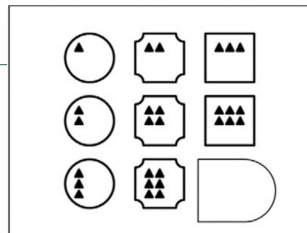
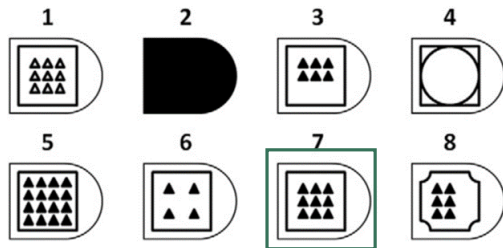
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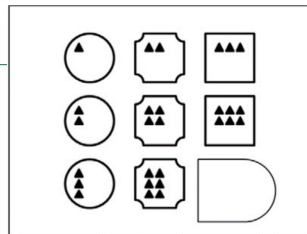
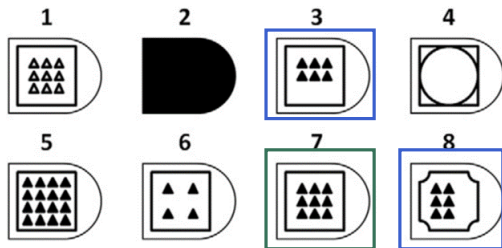
An example: The response list



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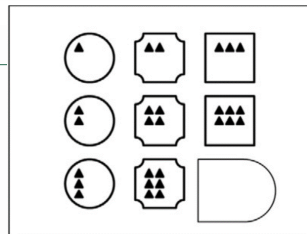
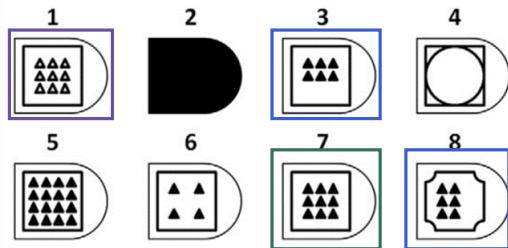


Repetition

Incomplete Correlate
Wrong Principle
Difference

Repetition of a cell adjacent to the blank space
Almost the correct response
Copy of a non adjacent cell or combination of cells
Different in appearance from every element of the matrix

An example: The response list



Repetition

Incomplete Correlate

Wrong Principle

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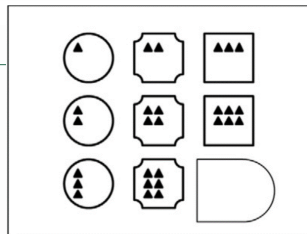
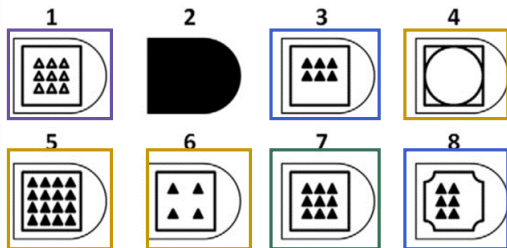
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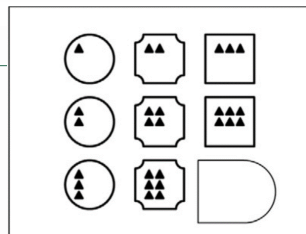
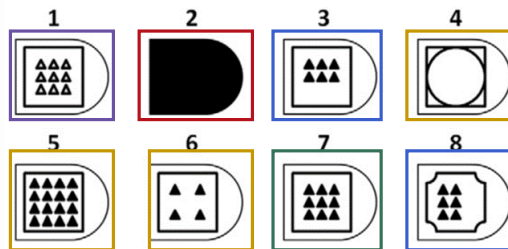
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Category	Rule name	Definition
Visuospatial	Object addition	Visually merge two objects
	Movement	Change the position of an object across the cells
	Rotation	Change the spatial orientation of the objects across the cells
	Mental transformation	Apply the characteristics of the objects in the second cell to the objects in the first cell to obtain the object in the third cell.
	Numerical progression	Quantitative increase or decrease in the number of objects from cell to cell
	Changes in shape	Change objects across cells
	Changes in shade	Change the shade of the objects across cells
	Changes in size	Change the size of the objects across cells
Logical	Changes in outline	Change the outline of the objects across cells
	AND	The third cell contains only the elements that appeared in both the first and second cells (\cap)
	OR	The third cell contains all the elements in the first and second cells (\cup)
	XOR	The third cell contains the elements in the first cell not present in the second cell and vice-versa (Δ)

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```
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



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

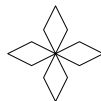


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(Some) of the available objects



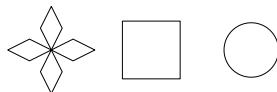
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Visuospatial rules

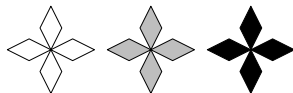
Rotate



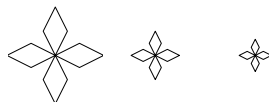
Shape



Shade



Size



...

Logical rules

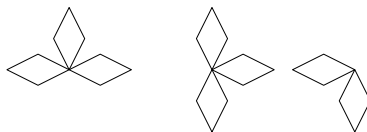
AND (\cap)



OR (\cup)



XOR (Δ)



The matRiks architecture: Matriks generator

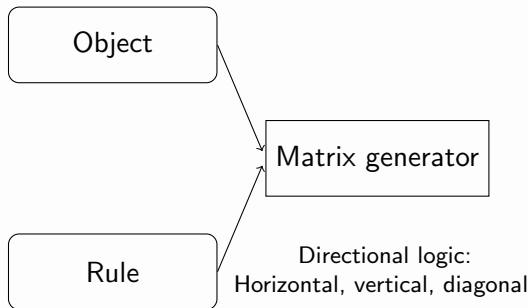
Object

The matRiks architecture: Matriks generator

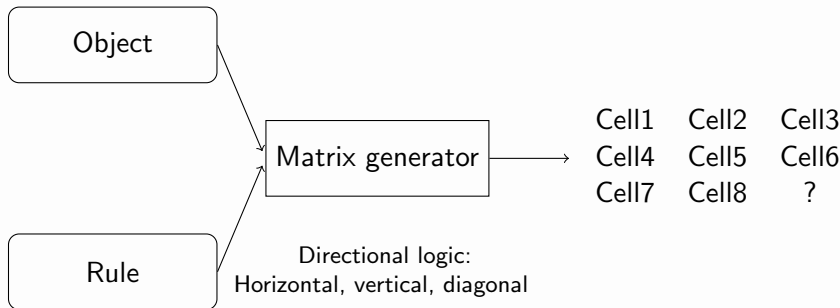
Object

Rule

The matRiks architecture: Matriks generator



The matRiks architecture: Matriks generator



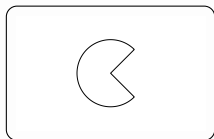
Introduction
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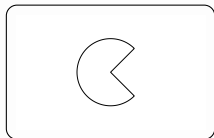
Generating rules
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The matRiks package
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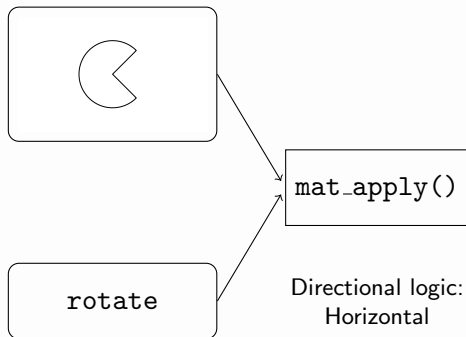
Why?
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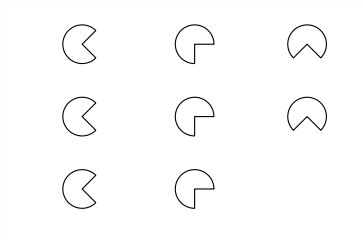
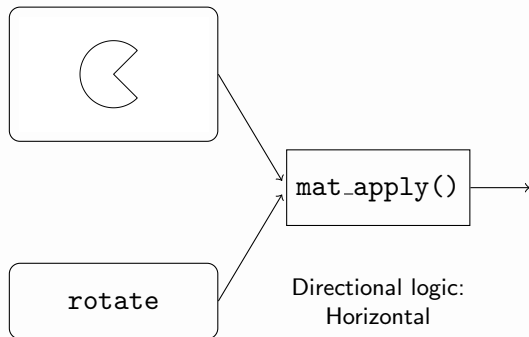
Final remarks
○○○





rotate





The matRiks architecture: Response options generator

Cell1	Cell2	Cell3
Cell4	Cell5	Cell6
Cell7	Cell8	?

The matRiks architecture: Response options generator

Cell1	Cell2	Cell3
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Response options generator

The matRiks architecture: Response options generator

Cell1	Cell2	Cell3
Cell4	Cell5	Cell6
Cell7	Cell8	?



Response options generator →

Correct	×1
Repetition	×3
Incomplete Correlate	×4
Wrong Principle	×2
Difference	×1

Introduction
○○○○○

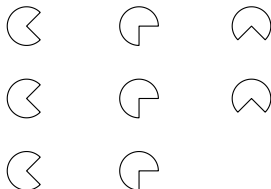
Generating rules
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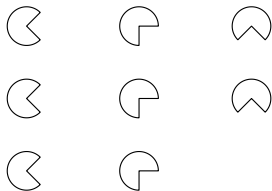
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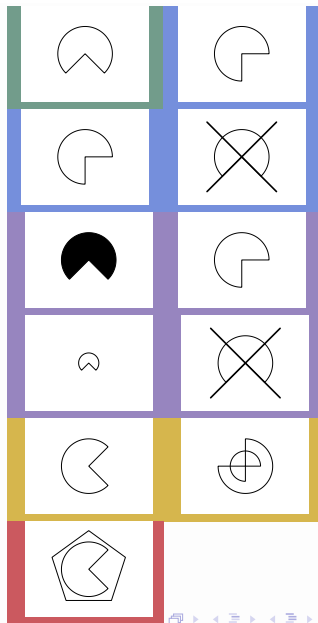




```
response_list()
```

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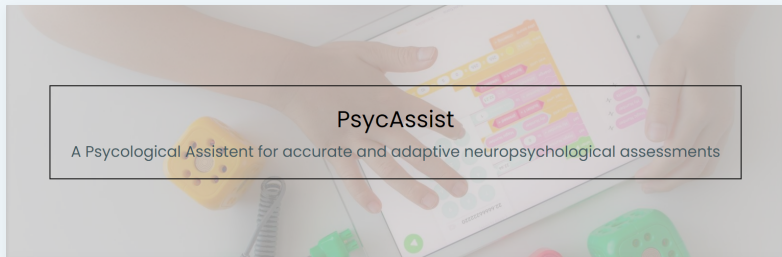
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PsycAssist



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Missione del progetto

Sviluppare un **sistema intelligente di web-app per la valutazione neuropsicologica** che somministra test, raccoglie e analizza dati, fornisce report personalizzati comprensivi di suggerimenti per la riabilitazione.

Stimuli

40 Raven-like matrices:

- 1×1 matrices (jigsaw puzzle) , $n = 5$
- 2×2 matrices, $n = 20$
- 3×3 matrices, $n = 15$

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Sample

$n = 600$ children aged 4-11 ($M = 8.39 \pm 2.17$), recruited in Italian schools
 $F = 48\%$
30% preschoolers

Rasch validation

- Monotonicity check
- Fit the Rasch model:
 - 1 Check for item with infit and/or outfit statistics ≥ 2 (underfit)
 - 2 Local dependence (Yeu's $Q3 \geq .20$)

Rasch validation

Note

2 matrices were eliminated because of technical issues

4 matrices were eliminated because of a lack of monotonicity

The starting model included 34 matrices:

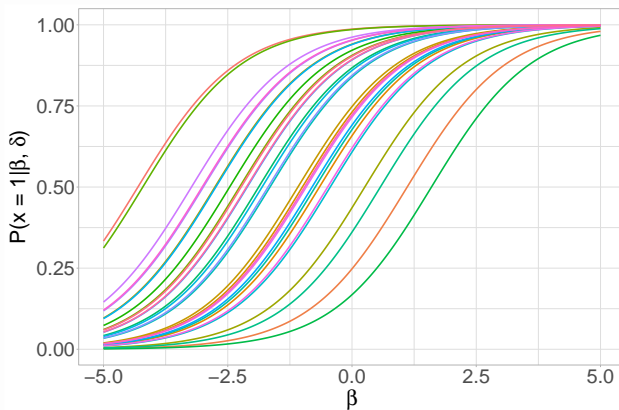
Madcov	SRMR	p -value
0.95	0.06	0.001

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

- Check for infit/outfit → no matrices were identified as underfitting
- Check for local dependence:
 - Matrix 37 – 40
 - Matrix 37 – 28 } → Matrix 37 has been eliminated

The final model

Madcov	SRMR	p -value
0.94	0.06	0.001



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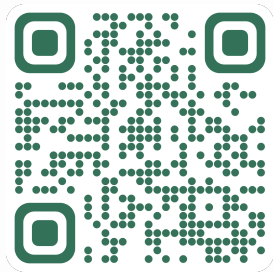
5 Final remarks

- Formalization of the matrix generation
- Generate similar but different matrices → Equivalent matrices (?)
- Reproducibility of the stimuli
- Ease of use (for useR)

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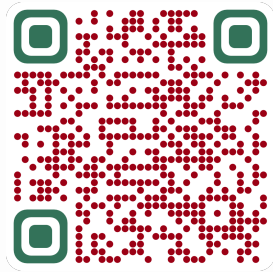
 SOON A shiny app

matRiks

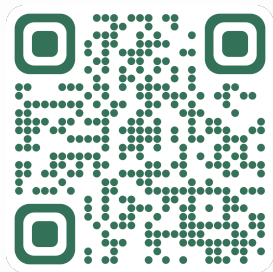


<https://github.com/OttaviaE/matRiks>

Slides

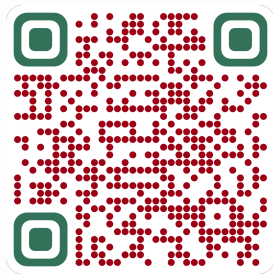


matRiks



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Slides



Thank you!

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