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

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University of Padova

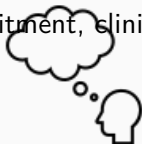European Meeting of the Matemathical Psychology Group
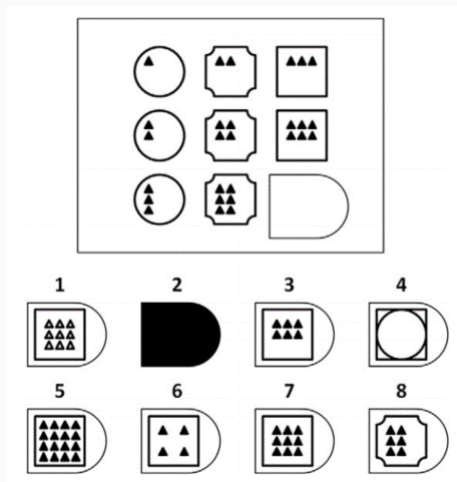
1 Introduction

Raven and Raven-like matrices

Assessment of fluid intelligence or abstract reasoning

Job recruitment, clinical assessment

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An example

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An example: The matrix

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An example: The matrix

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An example: The matrix

An example: The response options
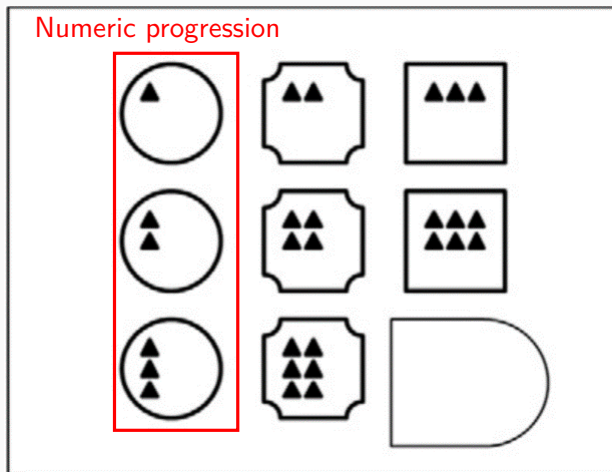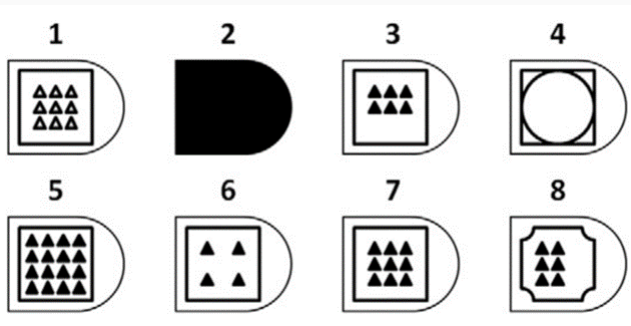
An example: The response options

An example: The response options

Repetition   Repetition of a cell **adjacent** to the blank space
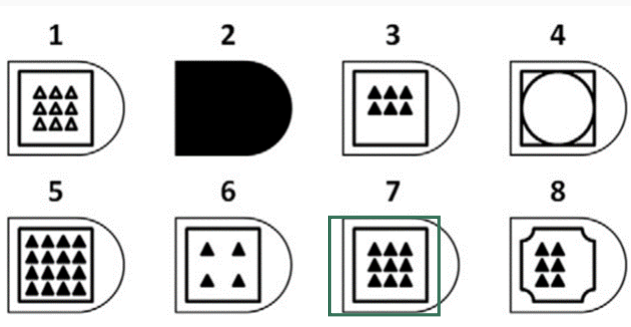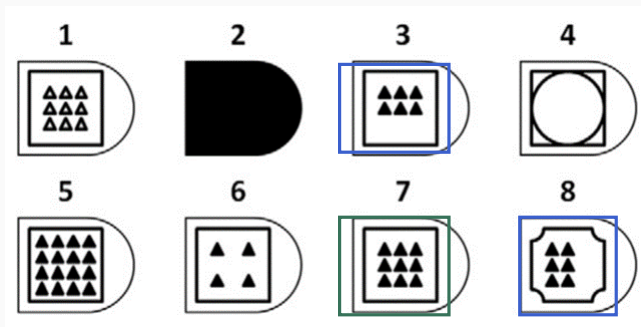
An example: The response options
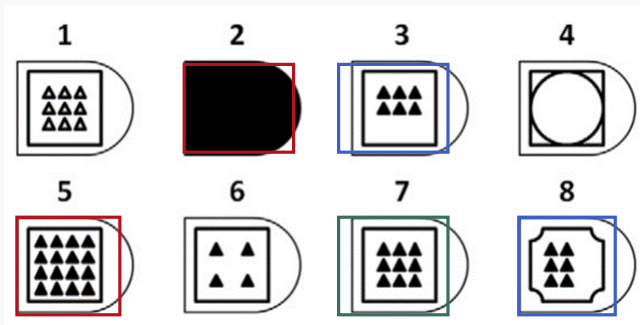
Repetition

Difference

Repetition of a cell **adjacent** to the blank space

Different in appearance from every element of the matrix

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An example: The response options

Repetition

Difference

Wrong Principle

Repetition of a cell **adjacent** to the blank space

Different in appearance from every element of the matrix

Copy of a cell or combination of cells

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An example: The response options

Repetition

Difference

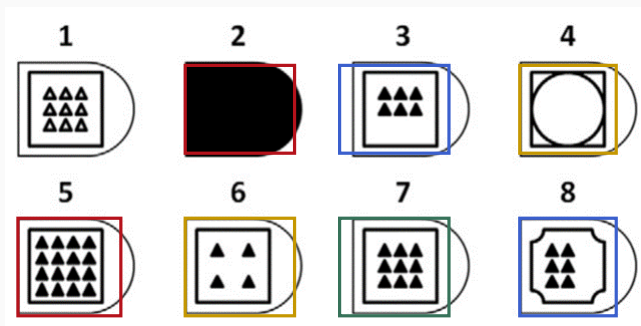Wrong Principle

Incomplete Correlate
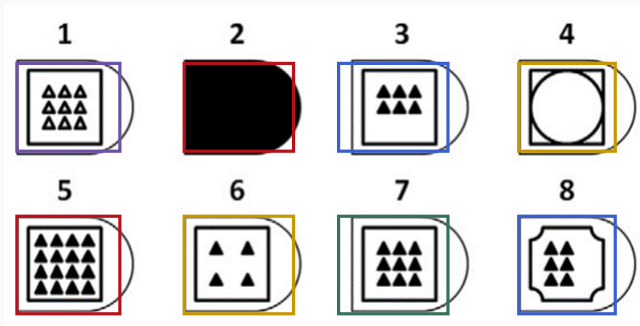
Repetition of a cell **adjacent** to the blank space

Different in appearance from every element of the matrix

Copy of a cell or combination of cells

Almost the correct response

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Rules

Category	Rule name	Definition
Visuospatial rules	Object addition/subtraction	Visually merge two elements
	Movement	With a steady background, the movement changing the position of an object across
	Rotation	The spatial orientation of the figure chang cells
	Mental transformation	The third cell results from the application teristics in the second cell to the figures in
	Completeness	????
	Numeric progression	Quantitative increase or decrease in the n tures from cell to cell
	Changes in shape	The figures change across cells
	Changes in shade	The shading of the figures changes across
	Changes in size	The size of the figures changes across cell

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matRiks

Generates 2×2 and 3×3 Raven-like matrices and the related set of distractors

Allows for concatenating figures together

Allows for creating multi-layer matrices by combining concatenating single-layer matrices together

Allows for creating new figures from scratch

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Visuo-spatial rules

Size

Shape

Shade

Rotate

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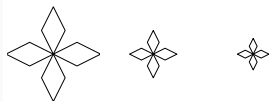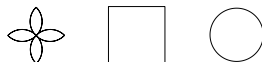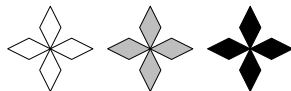
Logical rules

AND   (∩)

OR   (∪)

XOR (Δ)
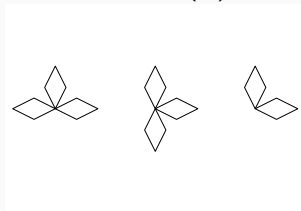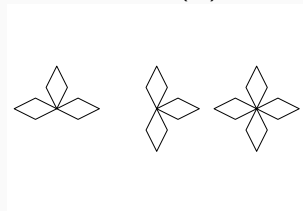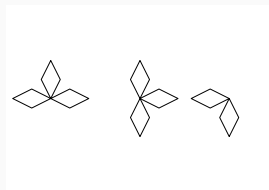
The "workflow"

Qui farò un grafico con le frecce direzionate, ora non ho idea di come farlo

Choose a figure or a concatenation of figures

Choose the rule or a combination of rules to be applied vertically, horizontally, or diagonally.

Generate and draw the matrix

Generate the set of distractors

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figure

```
$shape
[1] "square"

$size.x
$size.x[[1]]
[1] 15


$size.y
$size.y[[1]]
[1] 15


$theta.1
$theta.1[[1]]
[1] 0


$theta.2
$theta.2[[1]]
[1] 0
```

```
$rotation
$rotation[[1]]
[1] 0.7853982


$pos.x
$pos.x[[1]]
[1] 0



$pos.y
$pos.y[[1]]
[1] 0


$lty
$lty[[1]]
[1] 1



$lwd
$lwd[[1]]
[1] 3
```

```
$num
$num[[1]]
[1] 1


$nv
$nv[[1]]
[1] 4


$shade
$shade[[1]]
[1] NA


$visible
[1] 1

$tag
$tag[[1]]
[1] "simple" "fill"   "d.ex
```

Built-in figures

cof()

concatenation of figures

single = FALSE

```
draw(cof(square(),
    size(ninja())))
```

single = TRUE

```
draw(cof(square(),
    size(ninja())),
    single = TRUE,
    name = "my_figure")
```

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cof()

concatenation of figures

single = FALSE

```
draw(cof(square(),
    size(ninja())))
```

single = TRUE

```
draw(cof(square(),
    size(ninja())),
    single = TRUE,
    name = "my_figure")
```
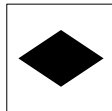
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```
List of 15                                    List of 15
 $ shape   : chr [1:3] "square" "luck" "luck"  $ shape   : chr "my_figure"
 $ size.x  :List of 3                           $ size.x  :List of 2
  ..$ : num 15                                   ..$ : num [1:2] 15 5.56
  ..$ : num 5.56                                 ..$ : num [1:2] 15 5.56
  ..$ : num 5.56                                $ size.y  :List of 2
 $ size.y  :List of 3                            ..$ : num [1:2] 15 8.33
  ..$ : num 15                                   ..$ : num [1:2] 15 8.33
  ..$ : num 8.33                                $ theta.1 :List of 2
  ..$ : num 8.33                                 ..$ : num [1:2] 0 0
 $ theta.1 :List of 3                            ..$ : num [1:2] 0 1.57
  ..$ : num 0                                   $ theta.2 :List of 2
  ..$ : num 0                                    ..$ : num [1:2] 0 0
  ..$ : num 1.57                                 ..$ : num [1:2] 0 1.57
 $ theta.2 :List of 3                           $ rotation:List of 2
  ..$ : num 0                                    ..$ : num [1:2] 0.785 1.571
  ..$ : num 0                                    ..$ : num [1:2] 0.785 3.142
  ..$ : num 1.57                                $ pos.x   :List of 2
 $ rotation:List of 3                            ..$ : num [1:2] 0 0
  ..$ : num 0.785                                ..$ : num [1:2] 0 0
 ....                                           ....
```
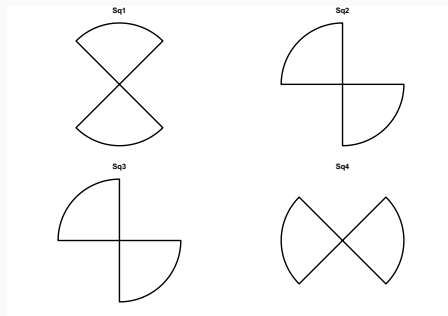
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mat_apply(): 2×2

```
mat_apply(Sq1, hrules, vrules, mat.type)
```

```
mat_apply(axe(),
          vrules = "rotate",
          hrules = "rotate",
          mat.type = 4)
```
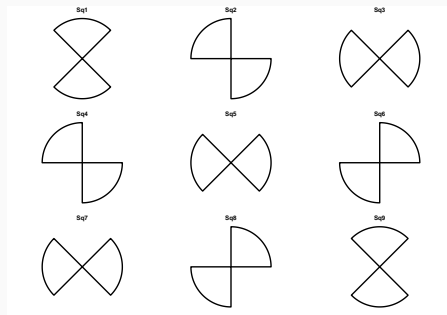
```
         [,1]  [,2]
[1,] "Sq1" "Sq2"
[2,] "Sq3" "Sq4"
```

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mat_apply(): 3×3

```
mat_apply(axe(),
          vrules = "rotate",
          hrules = "rotate",
          mat.type = 4)
```

```
          [,1]  [,2]  [,3]
[1,] "Sq1" "Sq2" "Sq3"
[2,] "Sq4" "Sq5" "Sq6"
[3,] "Sq7" "Sq8" "Sq9"
```

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Single-layer vs. multi-layer matrices

```
draw(mat_apply(cof(square4()), hrules = "AND"), hide = TRUE)
```

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Single-layer vs. multi-layer matrices

concatenation of matrices: com()

```
draw(com(mat_apply(square4(), hrules = "AND"),
         mat_apply(size(maxi(), 2), vrules = "OR", hrules = "OR")), hide = TRUE)
```

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Single-layer vs. multi-layer matrices

concatenation of matrices: com()

```
draw(com(mat_apply(square4(), hrules = "AND"),
         mat_apply(size(maxi(), 2), vrules = "OR", hrules = "OR")), hide = TRUE)
```

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The distractors

Distractors	Definition
R-Left	Sq8
R-Top	Sq6
R-diag	Sq5
Wp-Copy	One within SQ1, SQ2, SQ3, SQ4, SQ7
WP-Matrix	One within SQ1, SQ2, SQ3, SQ4, SQ7 with the superimposition of another cell.
Difference	One within SQ1, SQ2, SQ3, SQ4, SQ7 with the superimposition of a figure which is not manipulated in the matrix.

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The distractors

Distractors	Definition
R-Left	Sq8
R-Top	Sq6
R-diag	Sq5
Wp-Copy	One within SQ1, SQ2, SQ3, SQ4, SQ7
WP-Matrix	One within SQ1, SQ2, SQ3, SQ4, SQ7 with the superimposition of another cell.
Difference	One within SQ1, SQ2, SQ3, SQ4, SQ7 with the superimposition of a figure which is not manipulated in the matrix.
IC-Inc	Correct response with a missing element
	Single-Layer: Not possible
IC-Neg	Multi-layer: Color inversion of the correct response
	Single-layer matrix: Color inversion of the figure in the correct response
IC-Flip	Multi-layer matrix: Rotation of the correct response
	Single-layer matrix: Rotation of the figure in the correct response
IC-Scale	Multi-layer matrix: Resize of the correct response
	Single-layer: Resize of the figure in the correct response
	Multi-layer matrix:

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The distractors

Distractors	Definition
R-Left	Sq8
R-Top	Sq6
R-diag	Sq5
Wp-Copy	One within SQ1, SQ2, SQ3, SQ4, SQ7
WP-Matrix	One within SQ1, SQ2, SQ3, SQ4, SQ7 with the superimposition of another cell.
Difference	One within SQ1, SQ2, SQ3, SQ4, SQ7 with the superimposition of a figure which is not manipulated in the matrix.
IC-Inc	Correct response with a missing element
	Single-Layer: Not possible
	Multi-layer: The most internal figure is removed from the correct response.
IC-Neg	Color inversion of the correct response
	Single-layer matrix: Color inversion of the figure in the correct response
	Multi-layer matrix: Color inversion of the foreground figure of the correct response
IC-Flip	Rotation of the correct response
	Single-layer matrix: Rotation of the figure in the correct response
	Multi-layer matrix: Rotation of the foreground figure of the correct response
IC-Scale	Resize of the correct response
	Single-layer: Resize of the figure in the correct response
	Multi-layer matrix: Resize of the foreground figure of the correct response

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response_list()

```
draw(response_list(my_mat), main = TRUE)
```

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Don't like the difference distractor?

Change the random seed

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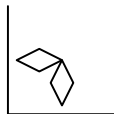## A handful of distractors

```
draw(response_list(my_mat, seed = 17),
     main = TRUE, distractors = c("r_left", "wp_copy",
                                  "difference", "ic_inc"))
```
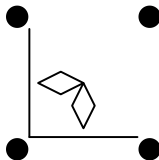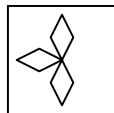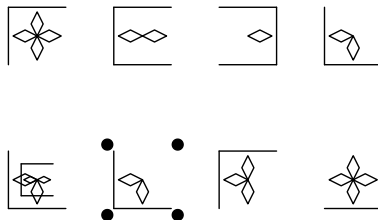
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The final result

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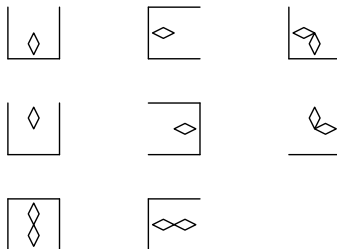
PsycAssist

PsycAssist

A Psycological Assistent for accurate and adaptive neuropsychological assessments

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PsycAssist

Campione

le scuole

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Come è andataa con rasch