# Cognition

**N. Hezkelo-** 4th year Medicine Student
**B. Rotem-** 3rd year Medicine Student
,Tel Aviv University
Supervised by Prof **A. Achiron, MD, PhD**,
**R. Aloni,** MSC

MSC

# What constitutes cognitive dysfunction?

**Cognition:** The mental process of knowing, including aspects such as awareness, perception, reasoning and judgment.

There is no one set of functions defined as “cognition”, but rather various combinations have been used in studies assessing cognitive performance.

# How to assess cognition in MS?

- Screening
- Target-specific tests
- Extensive in-depth evaluations

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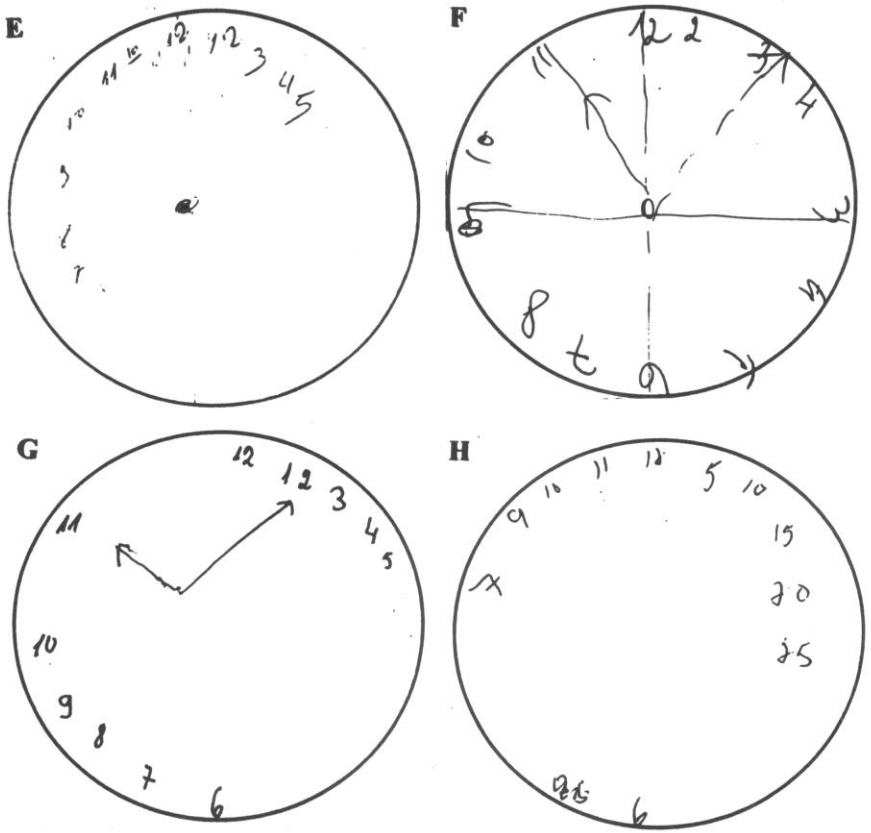
Clinical study

# Screening for early cognitive impairment in multiple sclerosis patients using the clock drawing test

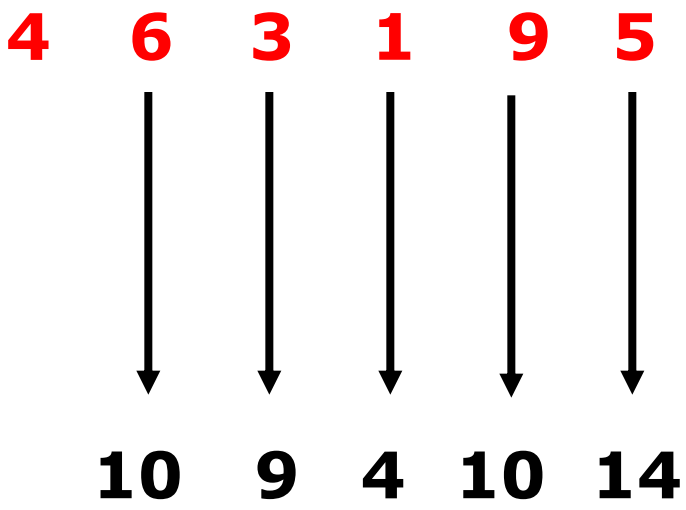
**Yoram Barak,** MD **Mor Lavie** MA, **Anat Achiron** MD, PHD

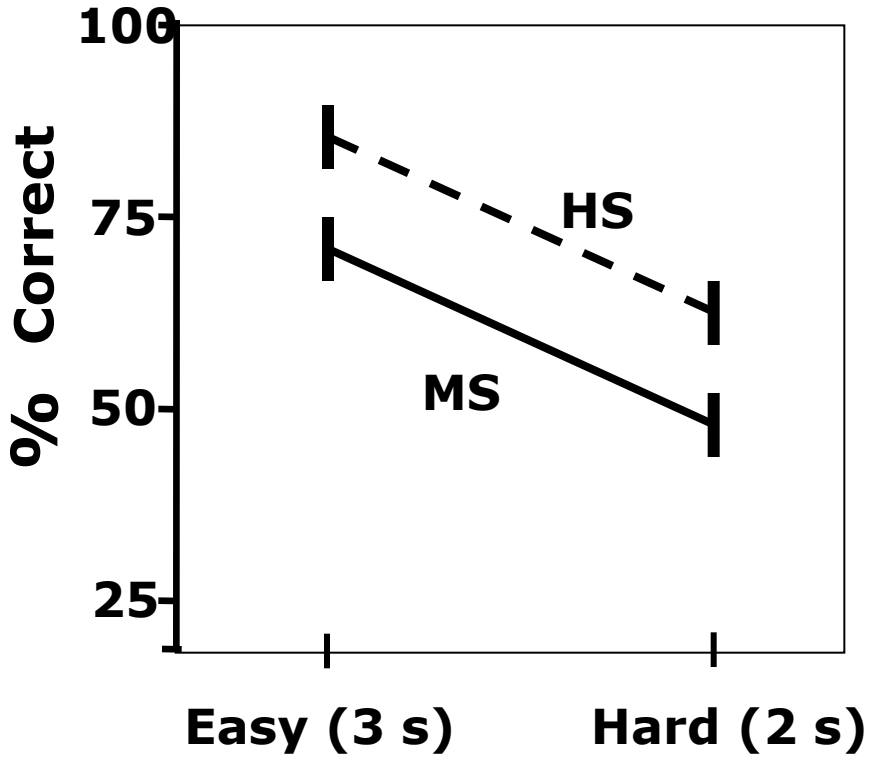


# Target-specific:

## Attention & information processing speed

Paced Auditory Serial Addition Test (PASAT)



# Comprehensive cognitive evaluations

## Paper-based

- Dependence on trained professionals to administer the tests.
- Subjectivity in interpretation.
- Learning effect.

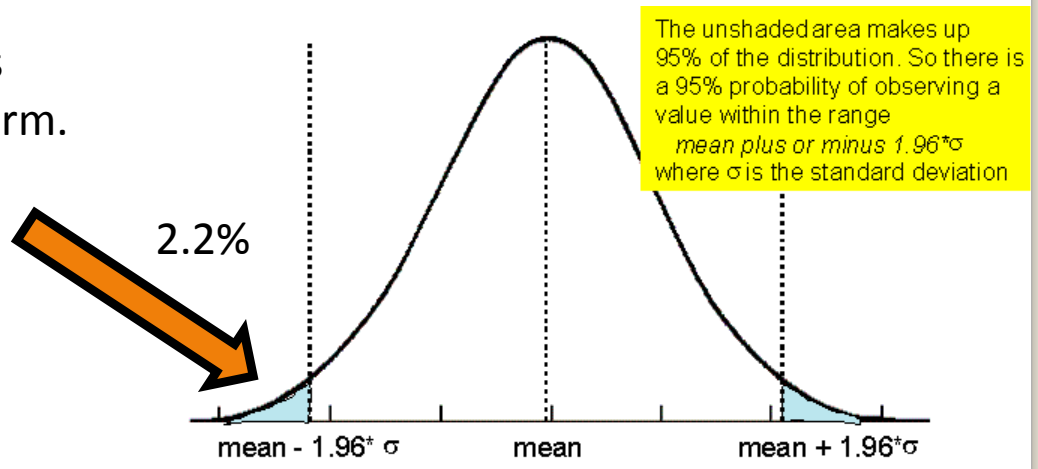
## Computerized

- Response time
- Enhanced sensitivity due to precise measurement of frequency of errors.
- Minimal ceiling or floor effects due to adaptive testing designs.
- High degree of repeatability.
- Low learning curve.

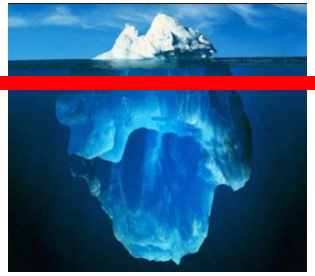
# How to measure cognitive dysfunction?

# Cognitive impairment - The cut-off point

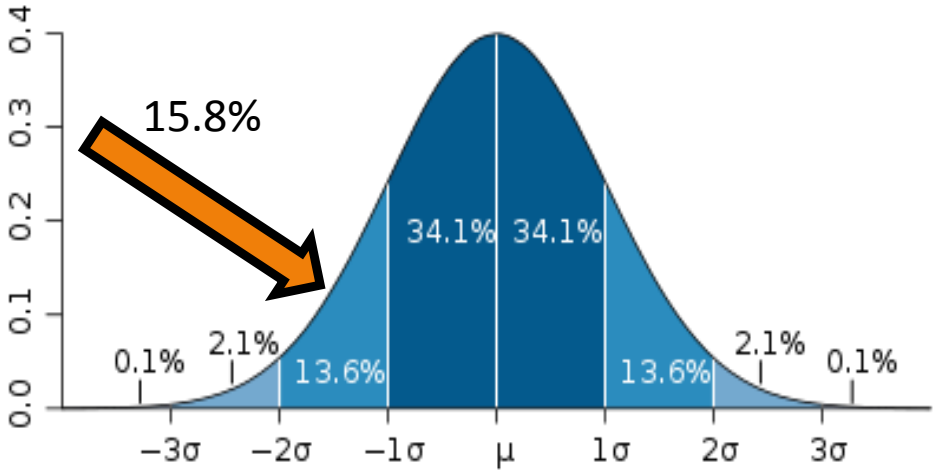
Cognitive impairment based on scores below **2SD** of the mean population norm.




**Late**



Cognitive impairment based on scores below **1SD** of the mean population norm.

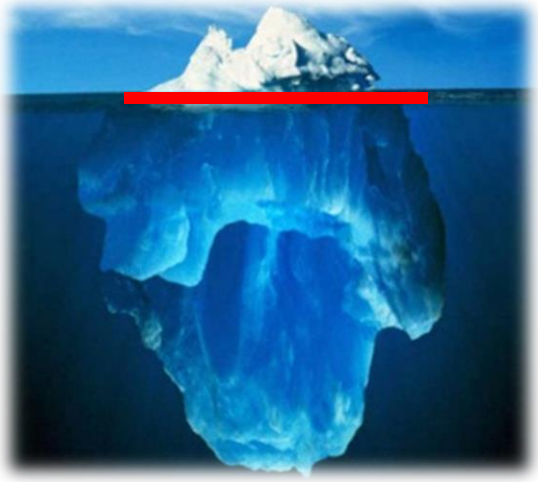



**Early**

# MindStreams Global Assessment Battery - GAB

## Scoring

- For each cognitive domain, index scores are computed and a summarized performance is obtained.
- The weighted average of all cognitive domains scores is defined as the Global Cognitive Score (GCS).
- For GCS and each cognitive domain, scores are normalized to a standardized scale (mean=100, SD=15) based on population age- and education- matched population norms.
- A value < 85 (i.e., -1SD) was defined as the cut-off for cognitive impairment.
- A value < 70 (i.e., -2SD) was defined as the cut-off for severe cognitive impairment.

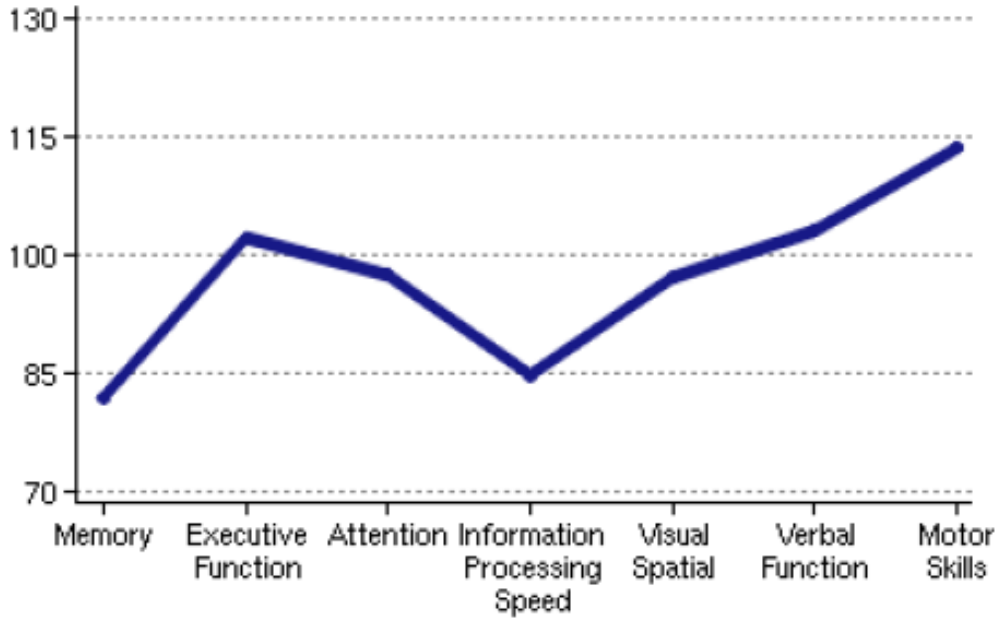


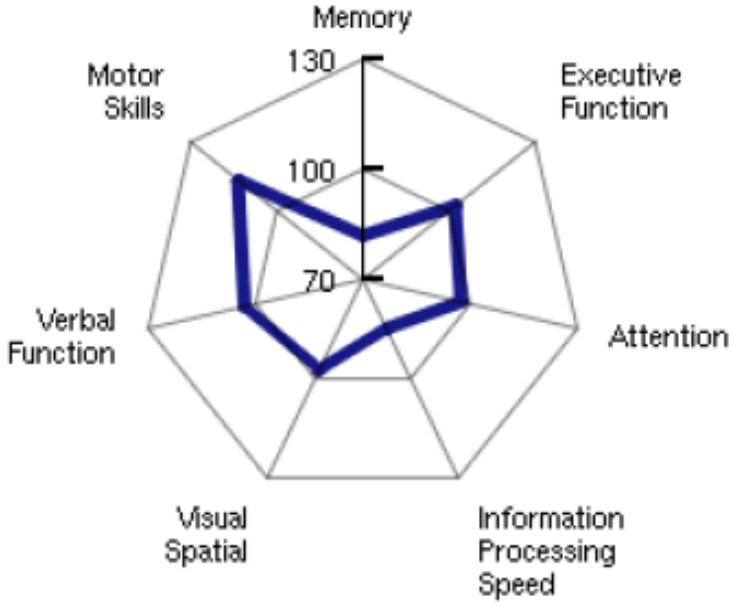
**Testing Battery:** Global Assessment Battery

**Tests Included:** Go-NoGo, Verbal Memory, Problem Solving, Stroop Interference, Non-Verbal Memory, Finger Tapping, Catch Game, Staged Info Proc, Visual Spatial Processing, Verbal Function

## Cognitive Profile

Aug-30-09




**Global Cognitive Score: 97.2**

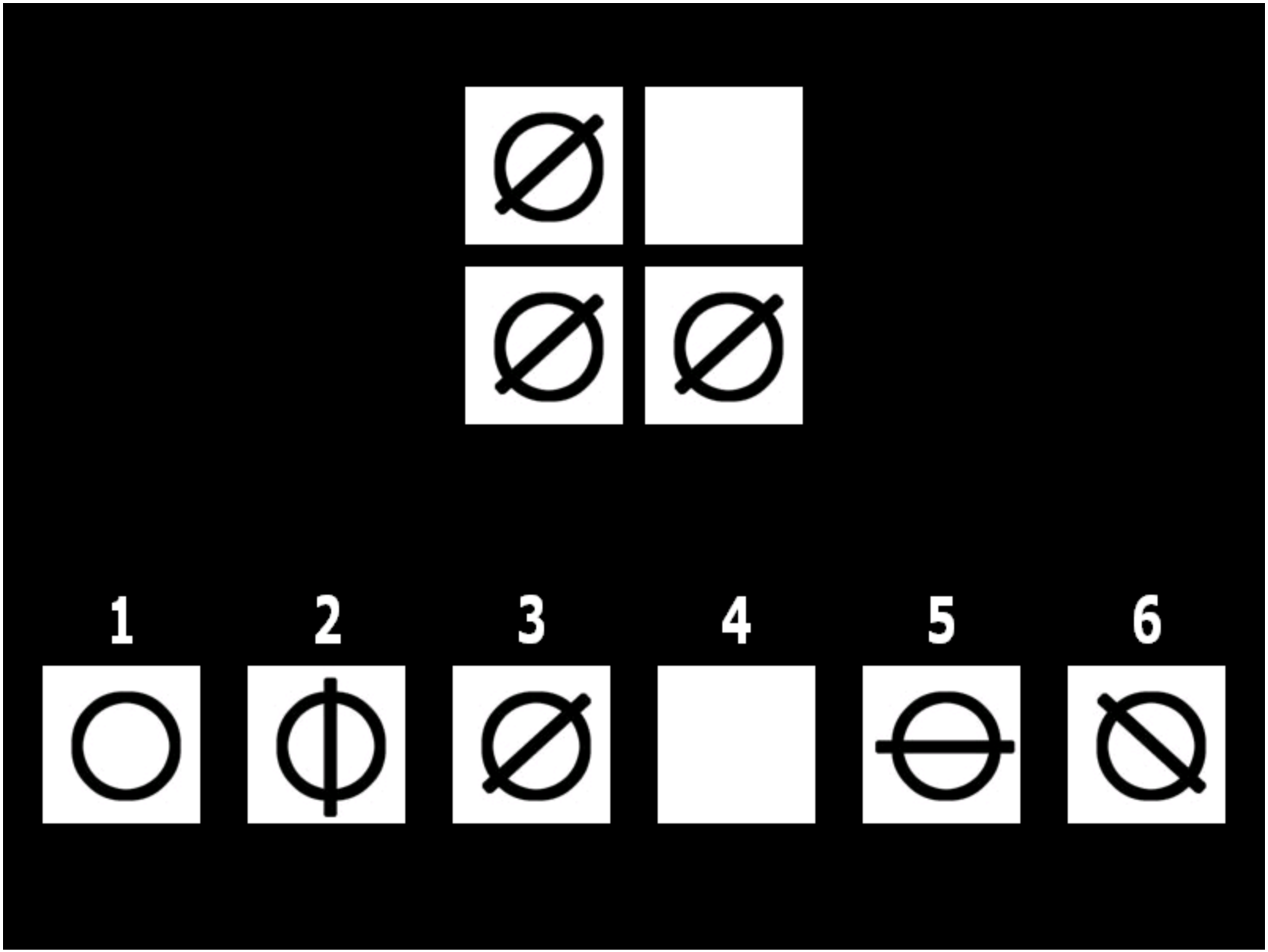
NeuroTrax®

# Problem solving

- Non verbal IQ test that assesses the ability to appreciate the spatial relationship among geometric forms that constitute a pattern.
- The test measures general intelligence and abstract reasoning. As the spatial relationship among the simple geometric forms become more complex as the test progress.
- The test is language free and therefore able assessment of individuals with communication disorders (aphasia, dyslexia etc.)

לדוגמא:


לחץ על כפתור העכבר בכדי להמשיך...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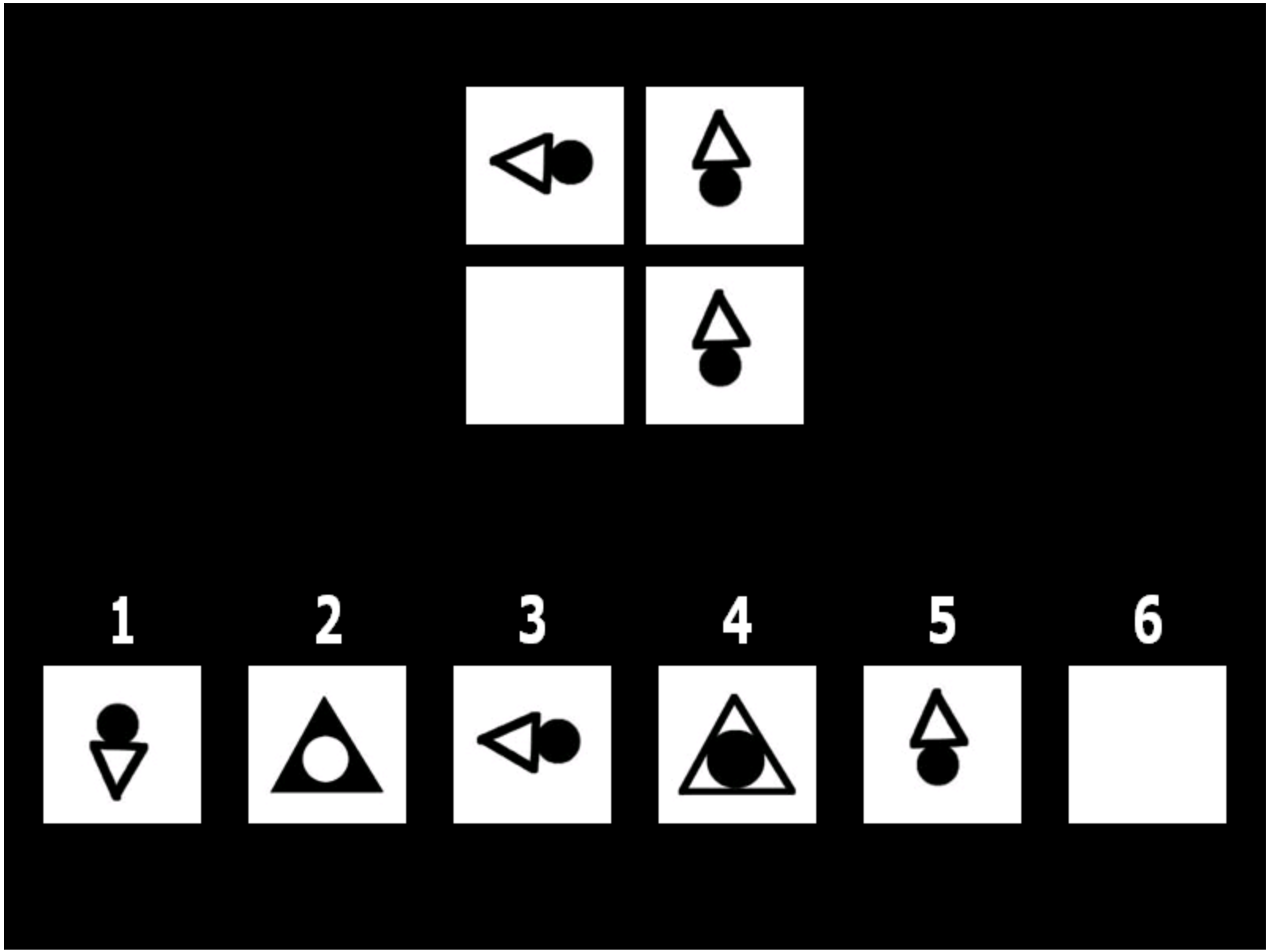
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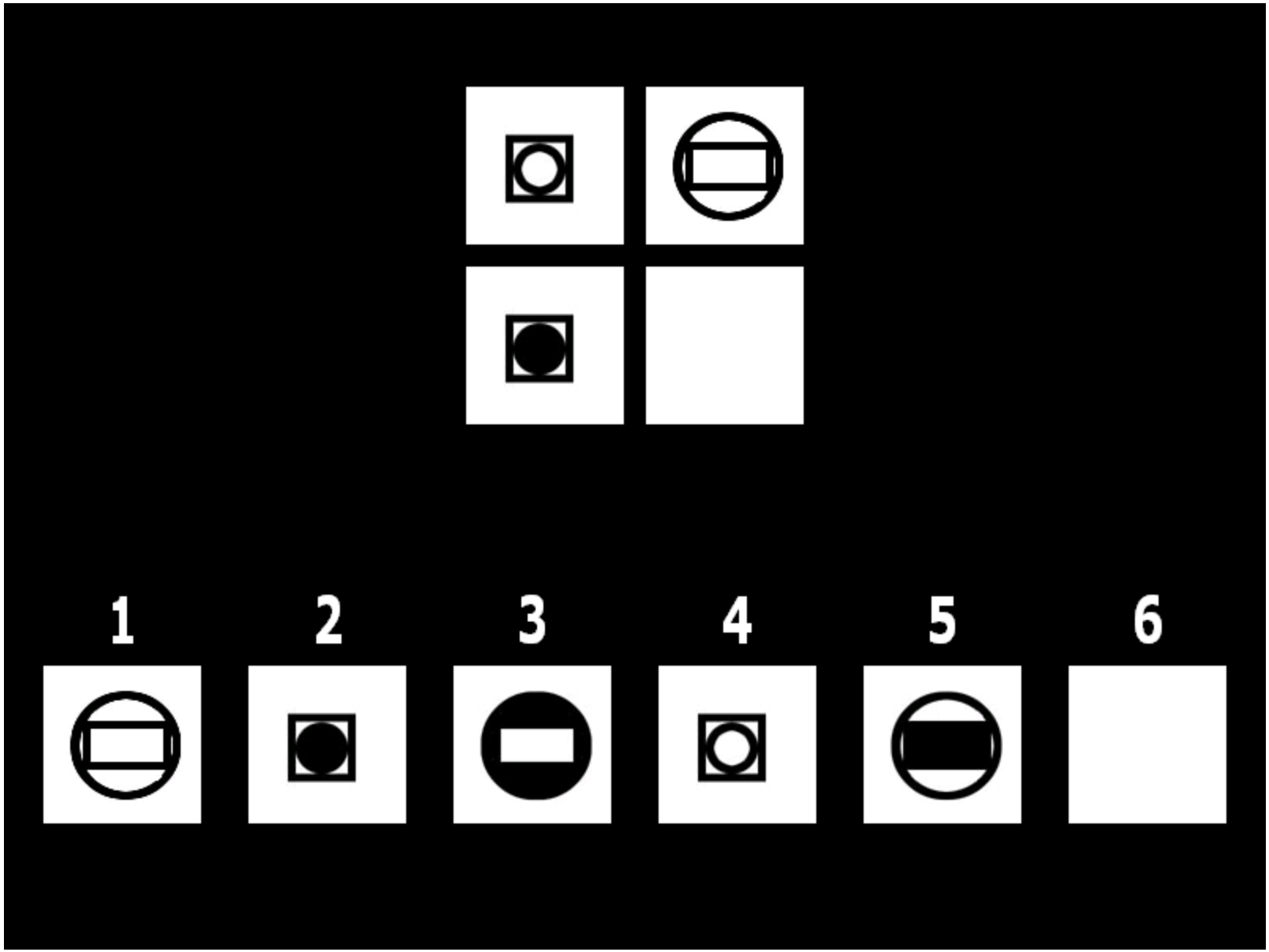
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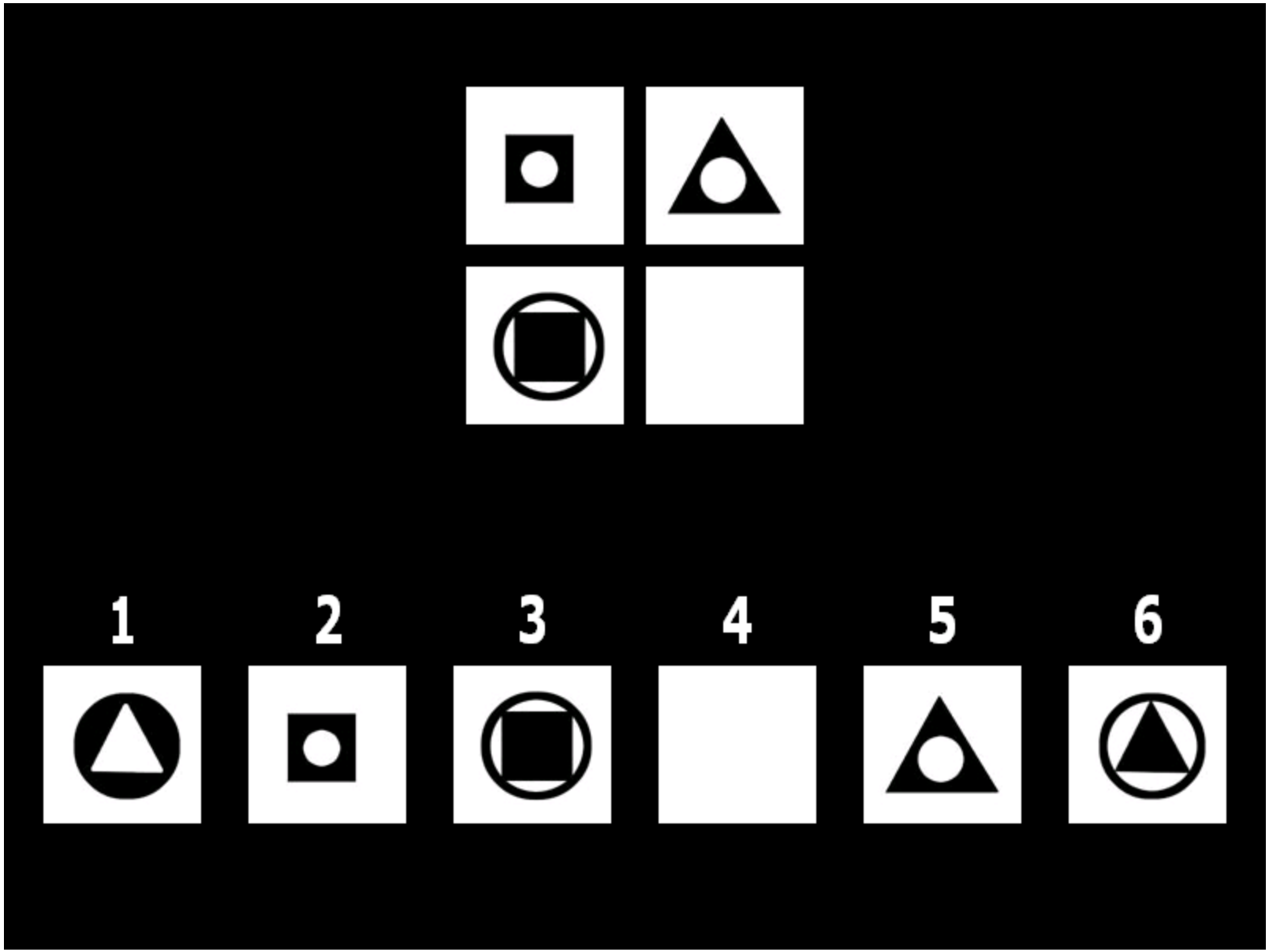
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# Memory

| Memory | 107.4 |
|---|---|
| Verbal Memory: Total Accuracy | 108.7 |
| Delayed Verbal Memory: Accuracy | 108.3 |
| Non-Verbal Memory: Total Accuracy | 101.3 |
| Delayed Non-Verbal Memory: Accuracy | 111.1 |

# Verbal memory

- establishing episodic memory demands the formation of new association between items.
- This ability is impaired in individuals who suffer from cognitive decline.

**Participants are presented rapidly with 10 pairs of words to study, for example:**

**Fruit - Sink**

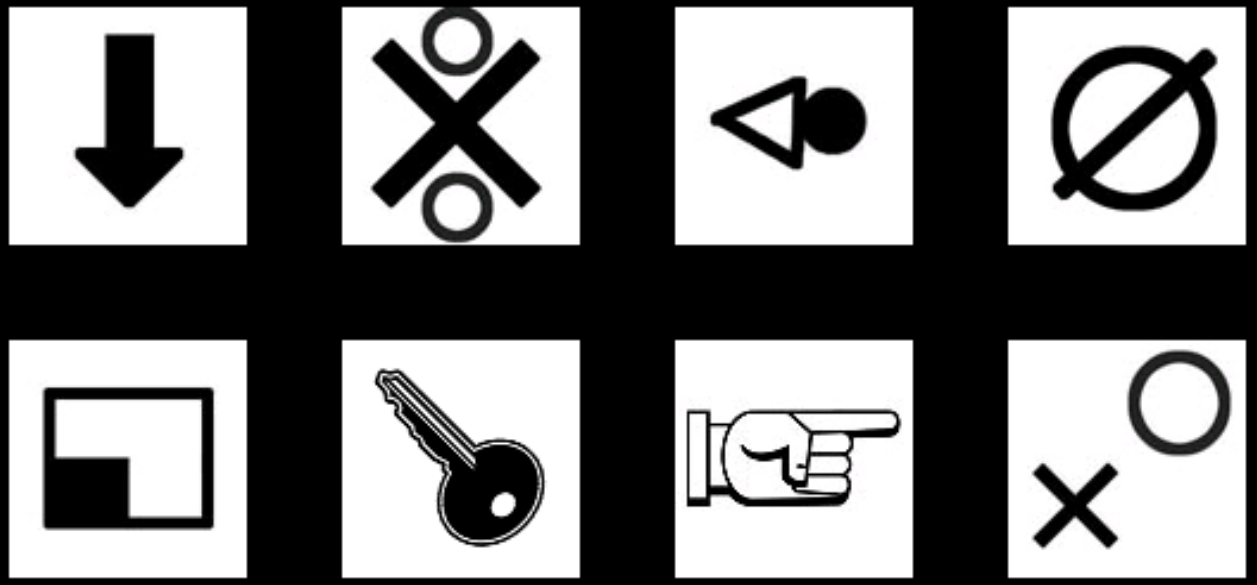
**Fruit**

1. **Gum**
2. **Hand**
3. **Chocolate**
4. **Sink**

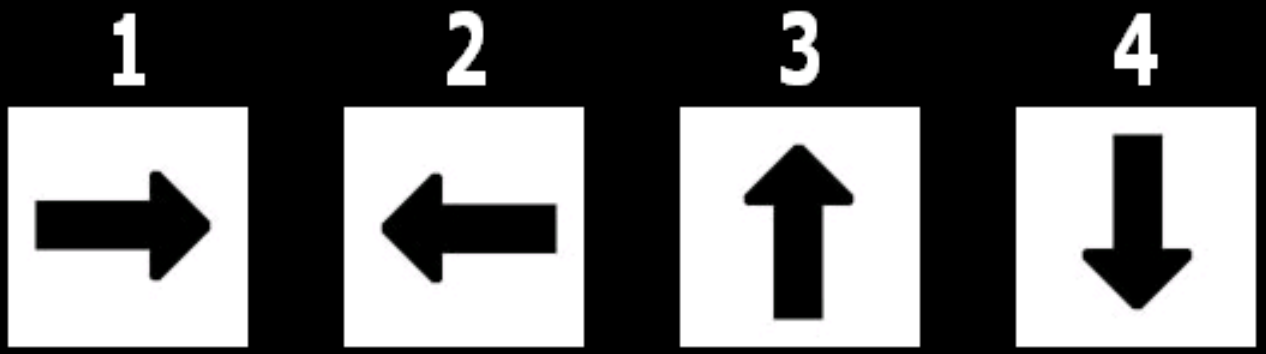
# Non- verbal memory

- Assesses memory for the spatial orientation of geometric visual item.

**Participants are presented with an array of 8 simple geometric patterns for 20 seconds and are required to remember their orientation, for example:**



**The participants have to choose the right orientation between 4 options:**



1 2 3 4

# Executive function

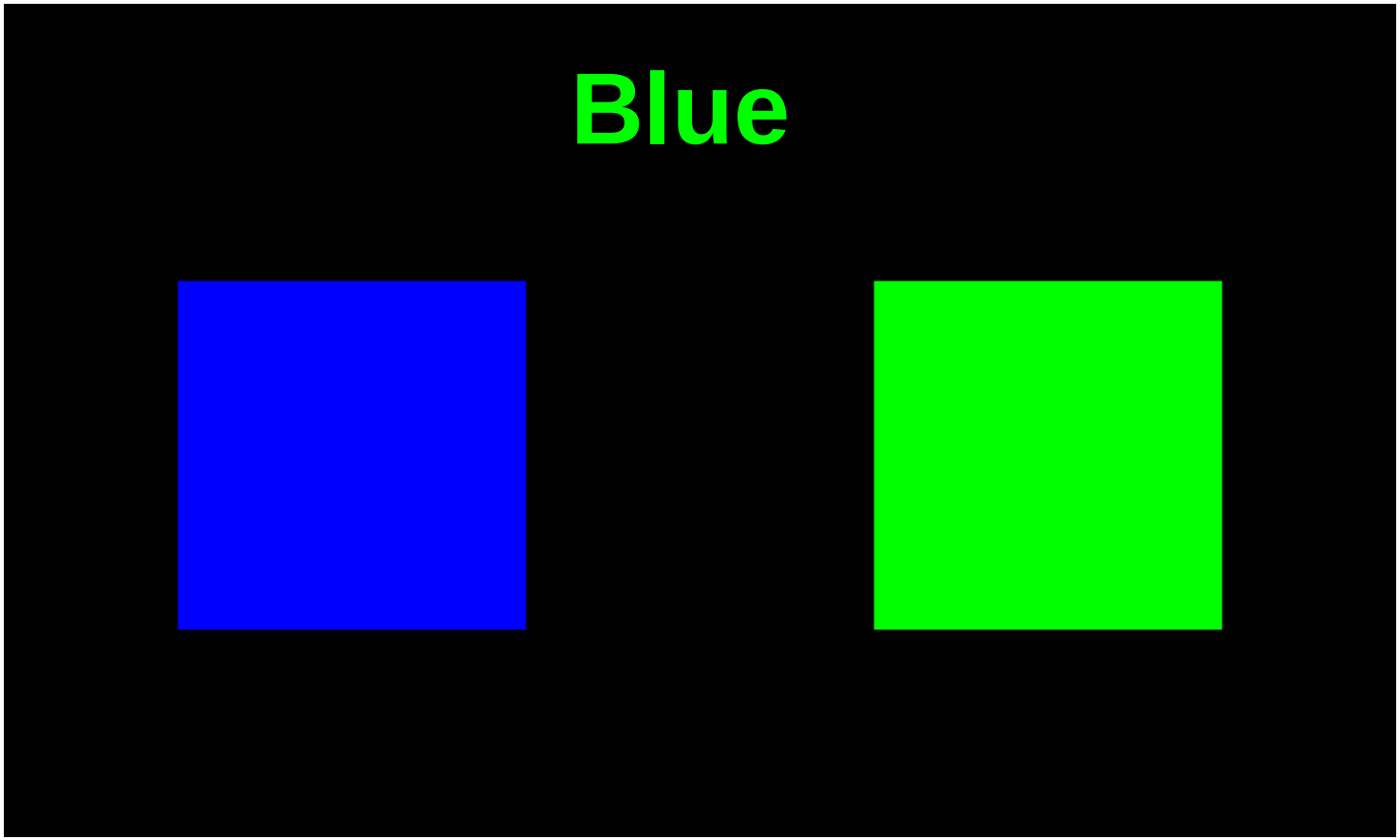
| Executive Function | 100.9 |
|---|---|
| Go-NoGo: Composite Score | 101.9 |
| Stroop Interference: Composite Score, Level 3 | 108.1 |
| Catch Game: Total Score | 92.5 |

# Stroop interference

- The participants mental flexibility is tested:
  the ability to change his perception according to changing demands and suppress a habitual response in favor of an unusual one.

- The participants experience a conflict in which they need to **inhibit** their reflexive response (that responds to the meaning of the word) and produce an unusual response (indicate the color of the letters despite the fact that they spell a different color- word).

**Participants are presented with a word that names a color in letters of a color other than that named by the word. participants must choose which square is the same color as the letters of the word presented immediately prior.**



# “Catch” game

- assesses cognitive domains including motor skills and executive function.
- Assesses participants ability in the fields of: **response time, motor planning and performance speed**.
- participants see a white object falling vertically from the top of the screen. Their task is to “catch” the object before it reaches the bottom of the screen by pressing the left and right mouse button with the participant’s best hand.
- the rate of the falling object increases as the test continues making it difficult to “catch” the object in time.

- participants see a white object falling vertically from the top of the screen. Their task is to “catch” the object before it reaches the bottom of the screen by pressing the left and right mouse button.
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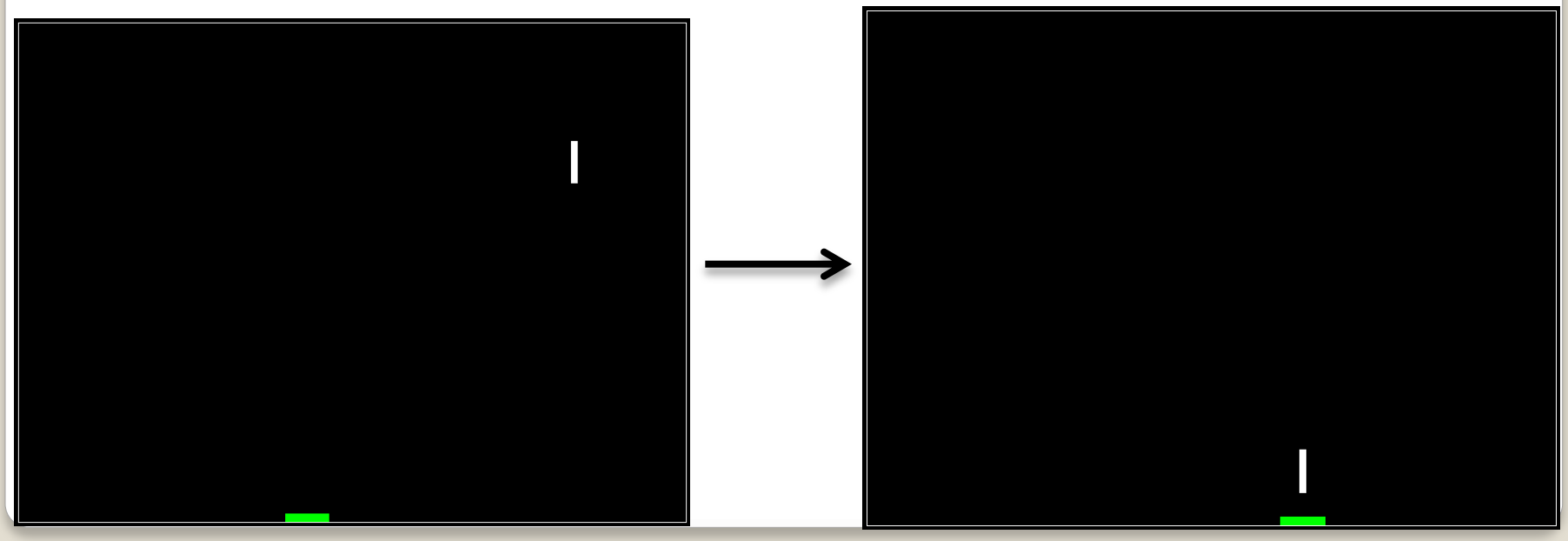


# Attention

| Attention | 106 |
|---|---|
| Go-NoGo: Rsp Time | 105.2 |
| Go-NoGo: Rsp Time Std Dev | 108.5 |
| Stroop Interference: Rsp Time, Level 2 | 112.5 |
| Staged Info Proc: Rsp Time, Level 1.2 | 110.7 |
| Staged Info Proc: Accuracy, Level 2.3 | 92.9 |

# Go –No Go Response inhibition

- This test examines management capabilities and attention capabilities.
- The participant is presented with big squares in different colors with delayed pause. The participant is asked to click the mouse every time he sees a square , except a red square.
- Omission of a click attests to inattention whereas redundant click attests to impulsiveness and memory problems \ inattention.
- The game tests response time and the ability to suppress a response.

# Staged Information Processing Speed

| Information Processing Speed | 109 |
|---|---|
| Staged Info Proc: Composite Score, Level 1.1 | 88.9 |
| Staged Info Proc: Composite Score, Level 1.3 | 92.3 |
| Staged Info Proc: Composite Score, Level 2.1 | 106.7 |
| Staged Info Proc: Composite Score, Level 2.2 | 124.1 |

- computerized test allows for accurate assessment of this speed.
- The test check for information processing by increasing the complexity and speed of the questions as the test progresses.
- The participant must press the left\right mouse buttons if the answer to the mathematical problem is bigger, smaller or equal to 4 (correspondingly).
- The test reveals differences in performance as a dependence on stimulation speed and the information the candidate is exposed to.

**At the first stage the information presented is a mathematical problem composed of a single Number**

**At the first stage the information presented is a mathematical problem composed of a tow Numbers**

$$8 + 1$$

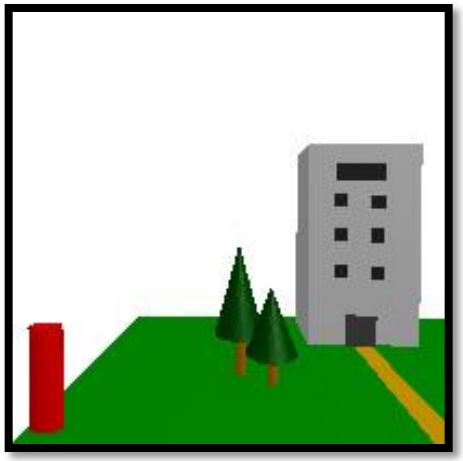
**At the first stage the information presented is a mathematical problem composed of a three Numbers**

$$7 + 2 + 2$$

# Visual spatial processing

# Visual spatial processing

- Cognitive decline can manifest in a lack of recognition of familiar places due to a decline in visual spatial ability
- The test examines the participant ability to evaluate properties of depth, shape, size that contribute each to the accurate visual spatial perception  of the participant's real world



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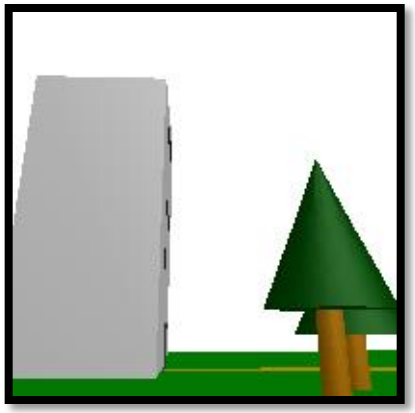

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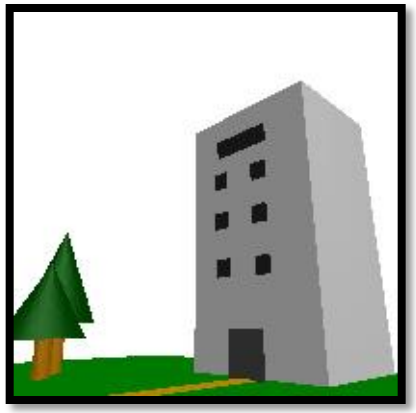

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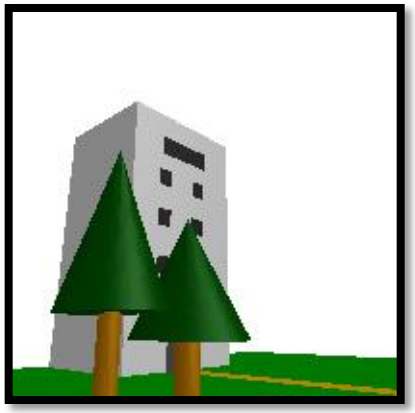

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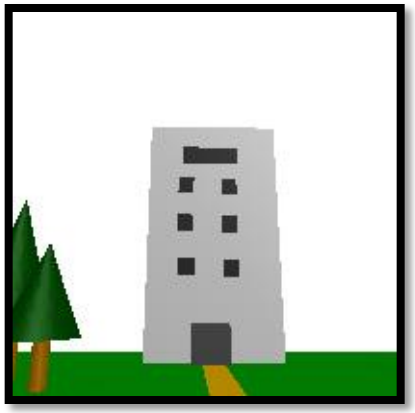


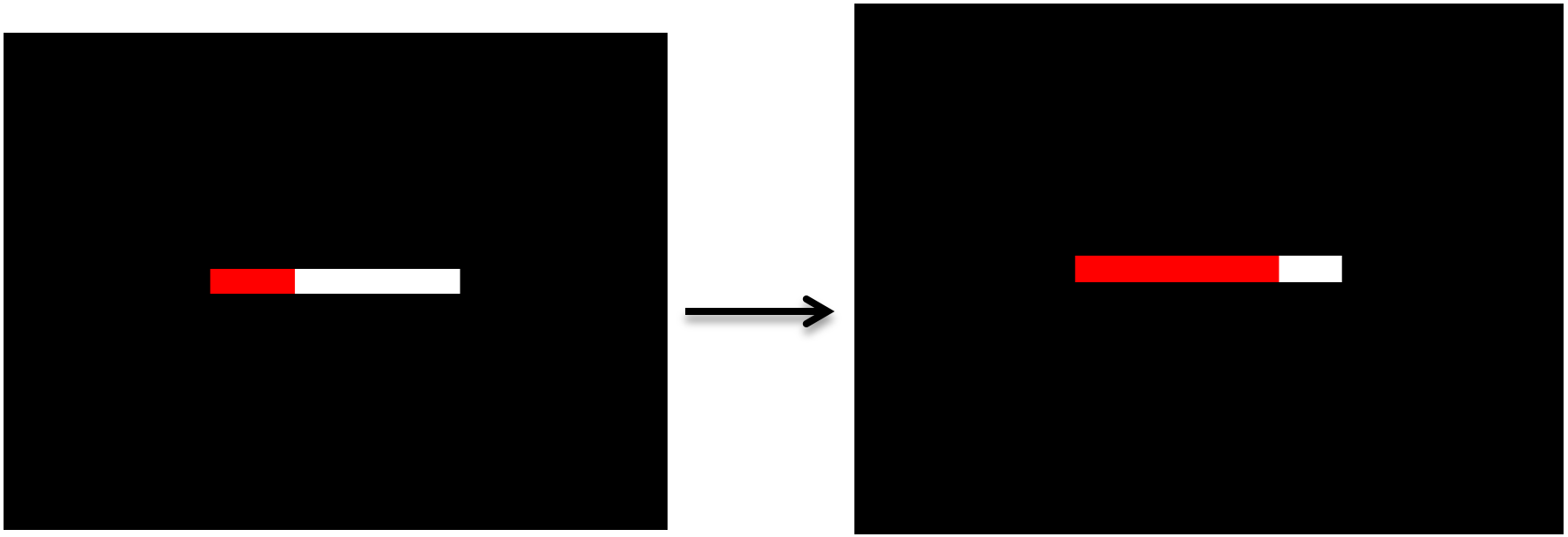
# Verbal function

- the picture identifying assignment serves as a control for the rhyming capabilities.
- It is possible that the candidate will be mistaken in the rhyming test because he didn’t identify the pictures correctly ( the pictures are identical in both assignments ).
- So if the picture wasn’t associated by the candidate correctly, the rhyming assignment for that item is removed from the test score
- The rhyming assignment evaluates high verbal skills (naming, association )

1. Circle
2. Ball
3. Hat
4. Tiger

# Motor Skills

| Motor Skills | 79.1 |
|---|---|
| Finger Tapping: Inter-Tap Interval | 70.0 |
| Finger Tapping: Tap Interval Std Dev | 68.1 |
| Catch Game: Time to Make 1st Move | 99.2 |

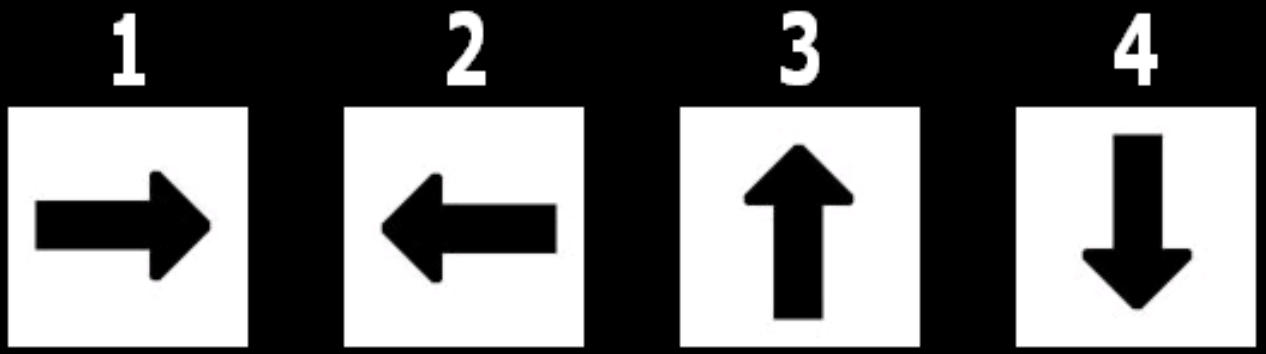


# Do You Remember ?

**Fruit**

1. **Gum**
2. **Hand**
3. **Chocolate**
4. **Sink**

**The participants have to choose the right orientation between 4 options:**



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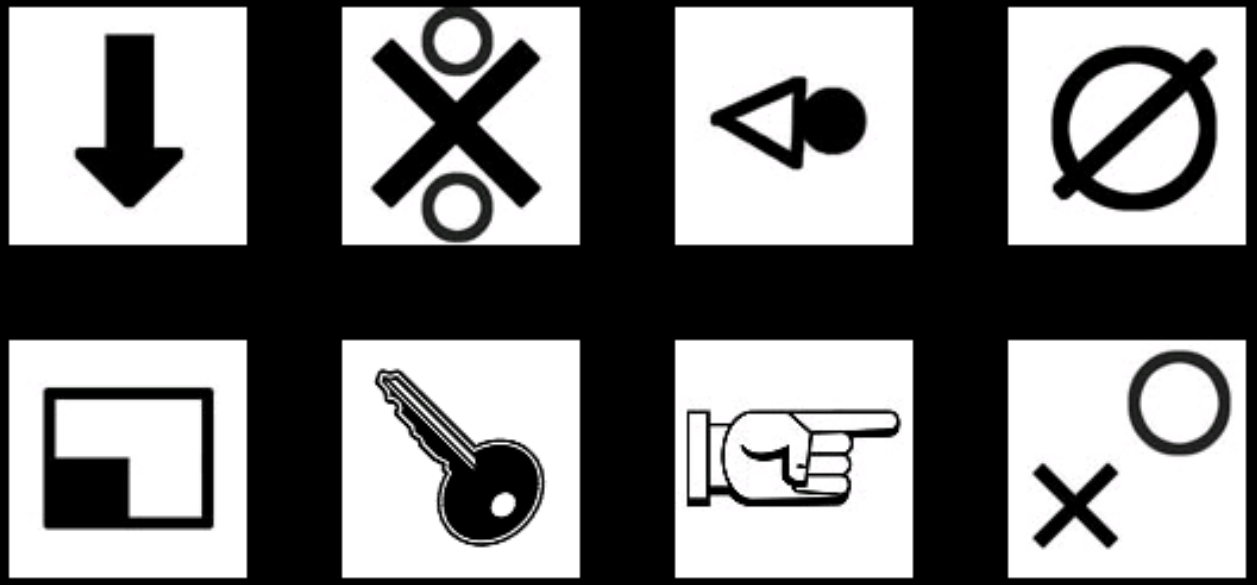


THE END
NO, IT ISN'T