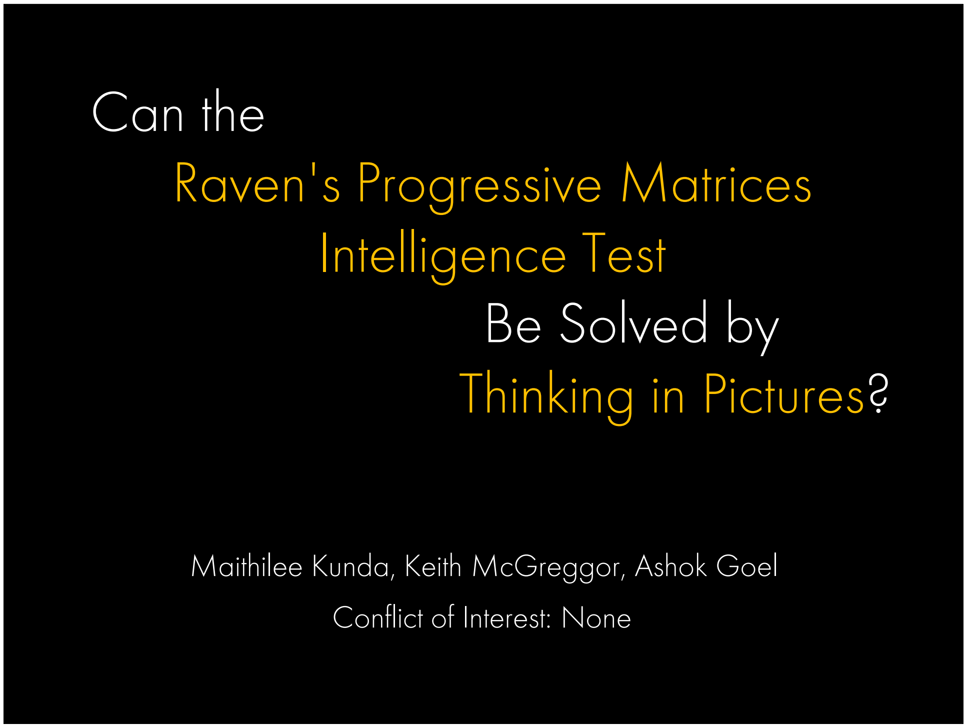
Kunda, M., McGreggor, K., & Goel, A. (2010). Can the Raven's Progressive Matrices intelligence test be solved by thinking in pictures? Oral presentation given at 9th annual *International Meeting For Autism Research (IMFAR)*, Philadelphia, PA.



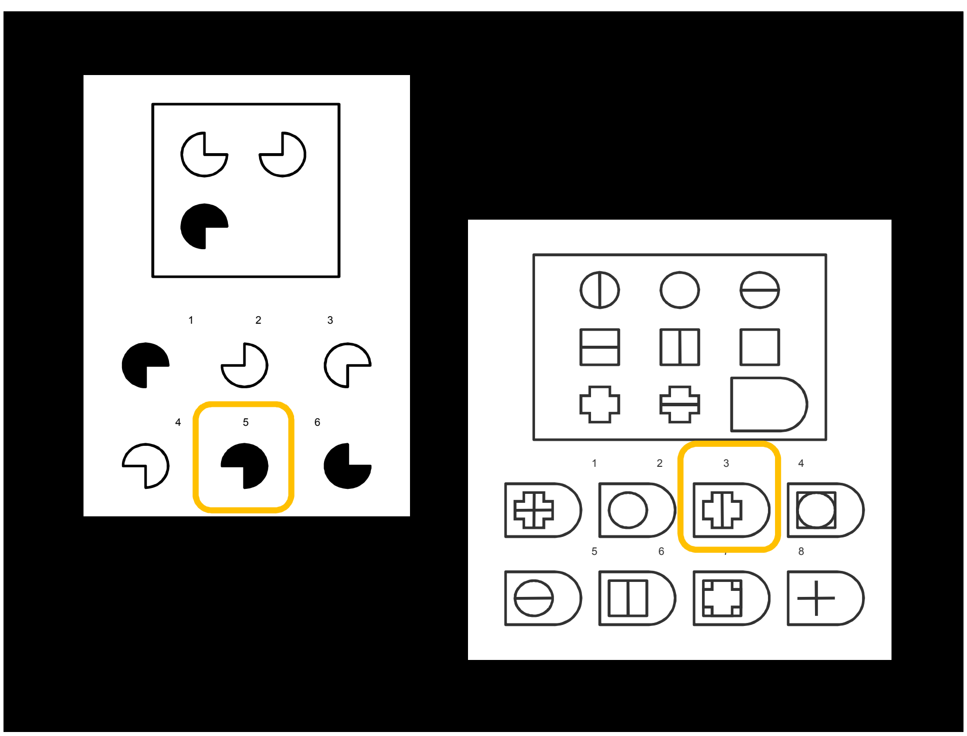
Kunda, M., McGreggor, K., & Goel, A. (2010). Can the Raven's Progressive Matrices intelligence test be solved by thinking in pictures? Oral presentation given at 9th annual *International Meeting For Autism Research (IMFAR)*, Philadelphia, PA.

What is the Raven's Test?

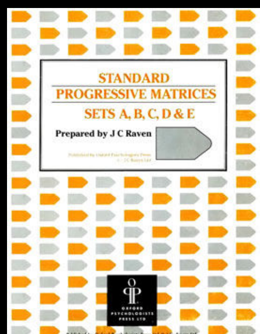
Why a visual solution strategy?

Is a purely visual strategy even possible?
(Our computational models say yes!)

So what?



Kunda, M., McGreggor, K., & Goel, A. (2010). Can the Raven's Progressive Matrices intelligence test be solved by thinking in pictures? Oral presentation given at 9th annual *International Meeting For Autism Research (IMFAR)*, Philadelphia, PA.

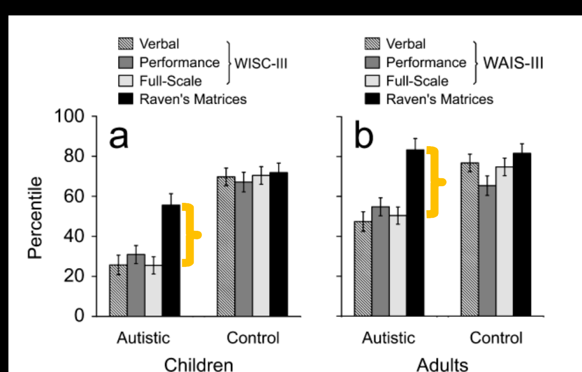


vs.

Wechsler Scales

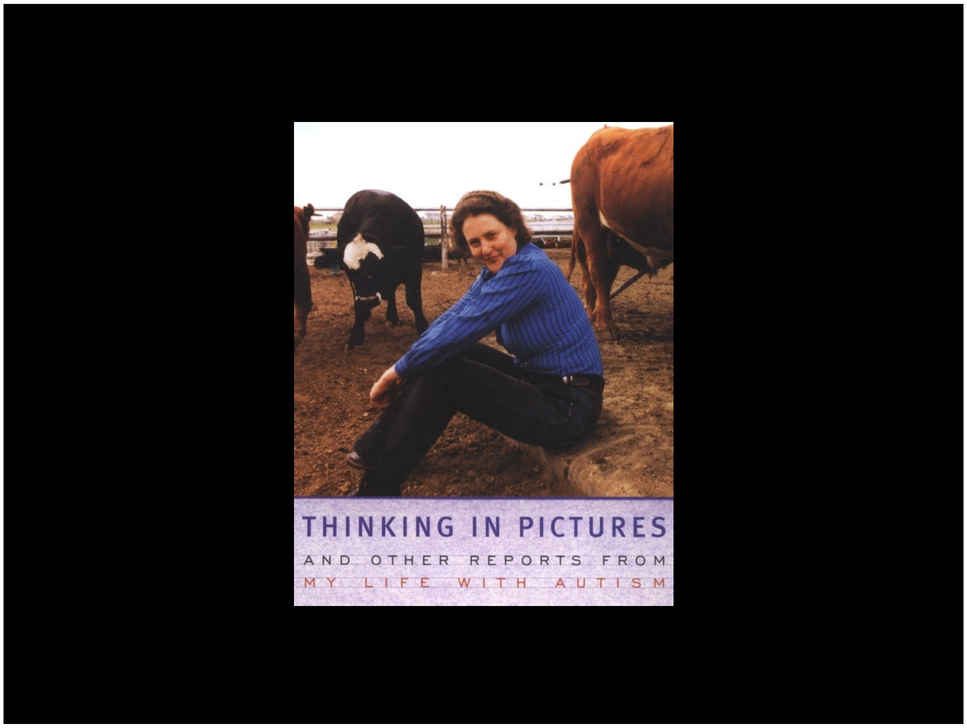
Information
Similarities
Vocabulary
Arithmetic
Digit Span
Letter-Number Sequencing
Block Design
Picture Completion
Digit Symbol-Coding
...

A puzzling discrepancy...



Dawson, M., Soulières, I., Gernsbacher, M., & Mottron, L. (2007). The level and nature of autistic intelligence. *Psychological Science*, *18*, 657-662.

Kunda, M., McGreggor, K., & Goel, A. (2010). Can the Raven's Progressive Matrices intelligence test be solved by thinking in pictures? Oral presentation given at 9th annual *International Meeting For Autism Research (IMFAR)*, Philadelphia, PA.



Our Central Question

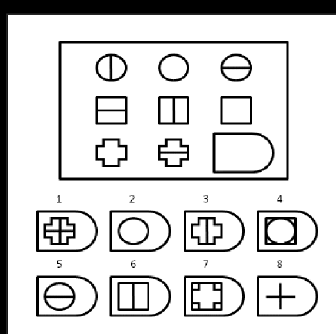
Do people with autism solve the Raven's test visually?

Kunda, M., McGreggor, K., & Goel, A. (2010). Can the Raven's Progressive Matrices intelligence test be solved by thinking in pictures? Oral presentation given at 9th annual *International Meeting For Autism Research (IMFAR)*, Philadelphia, PA.

But first...

Is using a visual strategy on the Raven's even possible?

What do we mean by a visual strategy anyway?



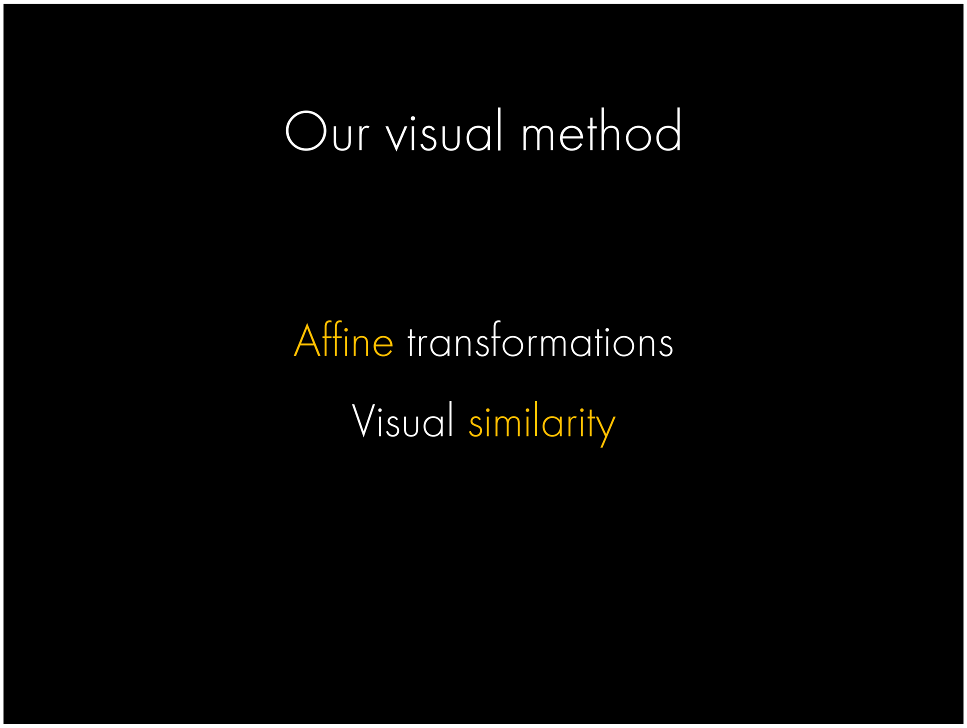
visual inputs

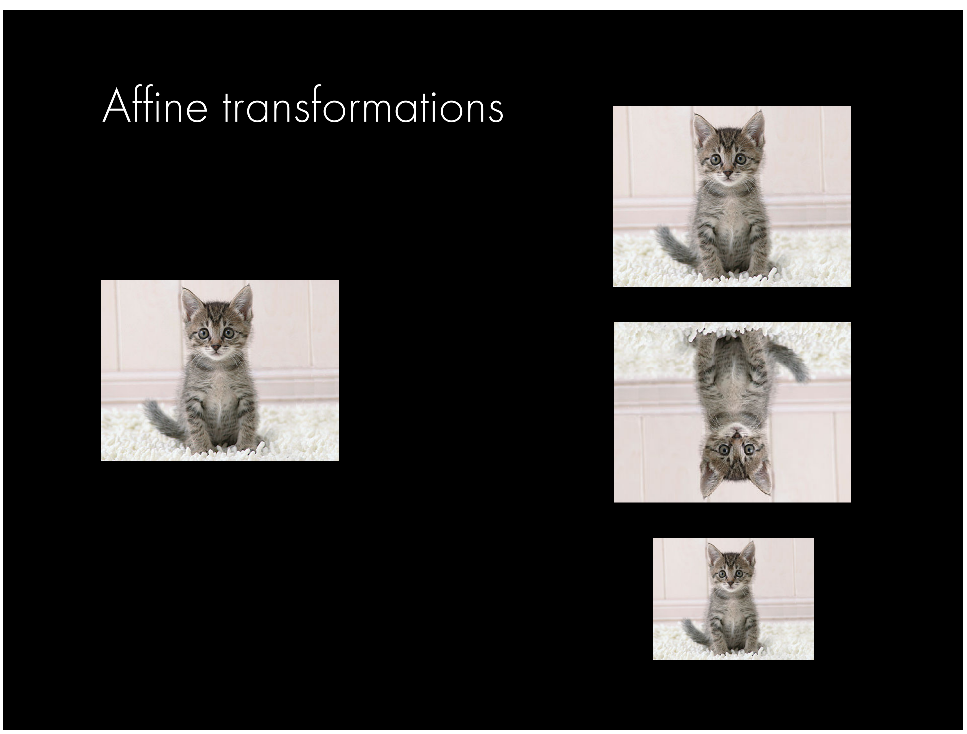
```
Figure1:
  Shape: Circle
  Texture: Line
  Orientation: Vertical
Figure2:
  Shape: Circle
  Texture: Empty
Figure3:
  Shape: Circle
  Texture: Line
  Orientation: Horizontal
          ...
```

verbal representations

Carpenter, P. A., Just, M. A., & Shell, P. (1990). What one intelligence test measures: a theoretical account of the processing in the Raven Progressive Matrices Test. *Psychological Review*, 97(3), 404-31.
Bringsjord, S., & Schimanski, B. (2003). What is artificial intelligence? Psychometric AI as an answer. *IJCAI*, 18, 887–893.
Lovett, A., Forbus, K., & Usher, J. (2007). Analogy with qualitative spatial representations can simulate solving Raven's Progressive Matrices. *29th Annual Cognitive Science Conference* (pp. 449-454).

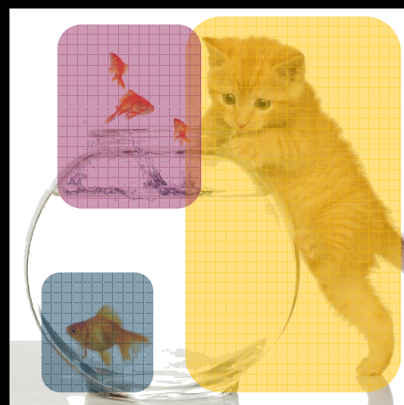
Kunda, M., McGreggor, K., & Goel, A. (2010). Can the Raven's Progressive Matrices intelligence test be solved by thinking in pictures? Oral presentation given at 9th annual *International Meeting For Autism Research (IMFAR)*, Philadelphia, PA.





Kunda, M., McGreggor, K., & Goel, A. (2010). Can the Raven's Progressive Matrices intelligence test be solved by thinking in pictures? Oral presentation given at 9th annual *International Meeting For Autism Research (IMFAR)*, Philadelphia, PA.

Visual similarity



Tversky, A. (1977). Features of similarity. *Psychological Review*, vol. 84, pp. 327-352.

Visual algorithm

For each base transform T:

Apply T to Image A.

Find translation (tx, ty) which yields best match between T(A) and B, according to:

$$similarity(A,B) = \frac{f(A \cap B)}{f(A \cup B)}$$

Find image composition operand X as follows:

Calculate similarity according to:

$$similarity(A,B) = \frac{f(A \cap B)}{f(A \cap B) + \alpha f(A - B) + \beta f(B - A)}$$

With: 1) α = 1, β = 1
2) α = 1, β = 0
3) α = 0, β = 1

Choose maximum similarity value.

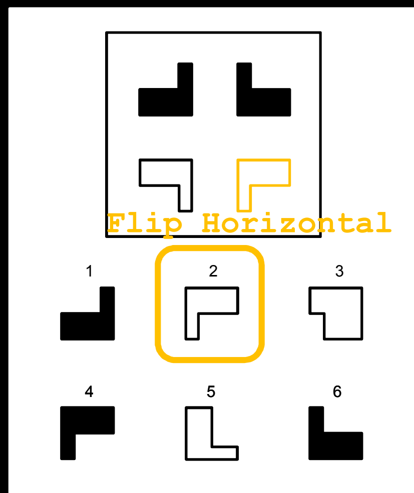
If maximum is (1), then X = 0.
If maximum is (2), then X = B – A, and ⊕ refers to image addition.
If maximum is (3), then X = A – B, and ⊕ refers to image subtraction.

The best-fit similitude transformation can then be specified as:

$$[T_{max}+(tx, ty)](A) \oplus X = B$$

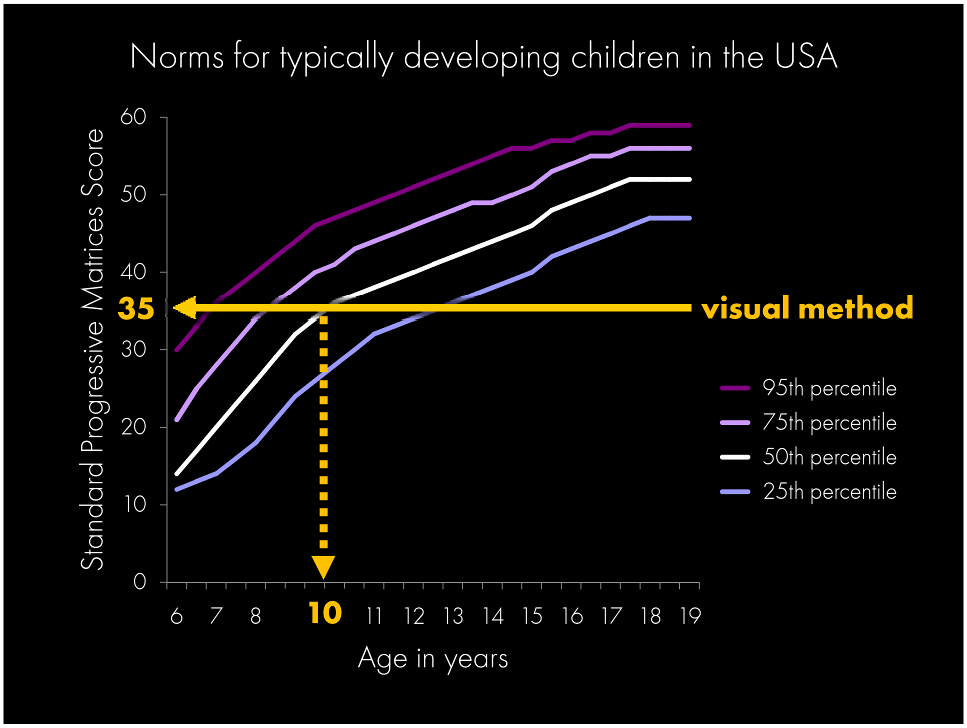
Kunda, M., McGreggor, K., & Goel, A. (2010). Can the Raven's Progressive Matrices intelligence test be solved by thinking in pictures? Oral presentation given at 9th annual *International Meeting For Autism Research (IMFAR)*, Philadelphia, PA.

Visual algorithm illustration



Results

Kunda, M., McGreggor, K., & Goel, A. (2010). Can the Raven's Progressive Matrices intelligence test be solved by thinking in pictures? Oral presentation given at 9th annual *International Meeting For Autism Research (IMFAR)*, Philadelphia, PA.



Kunda, M., McGreggor, K., & Goel, A. (2010). Can the Raven's Progressive Matrices intelligence test be solved by thinking in pictures? Oral presentation given at 9th annual *International Meeting For Autism Research (IMFAR)*, Philadelphia, PA.

Our work shows sufficiency of these particular visual representations, not necessity.

We have shown that one could use a purely visual strategy on parts of the Raven's test.

Whether one does is still an open question.