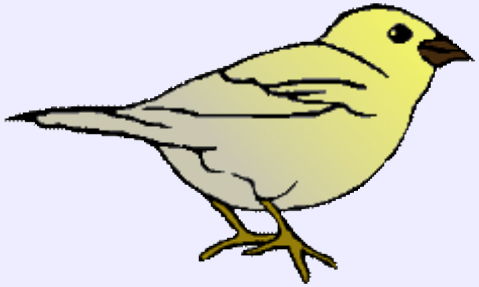
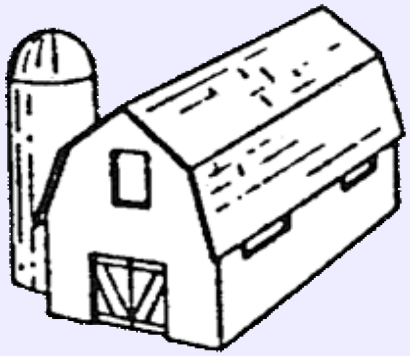
Revisiting Snodgrass and Vanderwart's object databank: color and texture improve object recognition

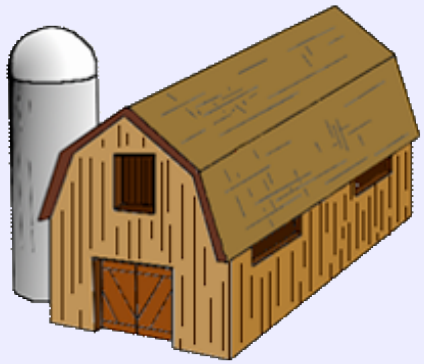


Bruno Rossion (Brown University)

Gilles Pourtois (Tilburg University, The Netherlands)

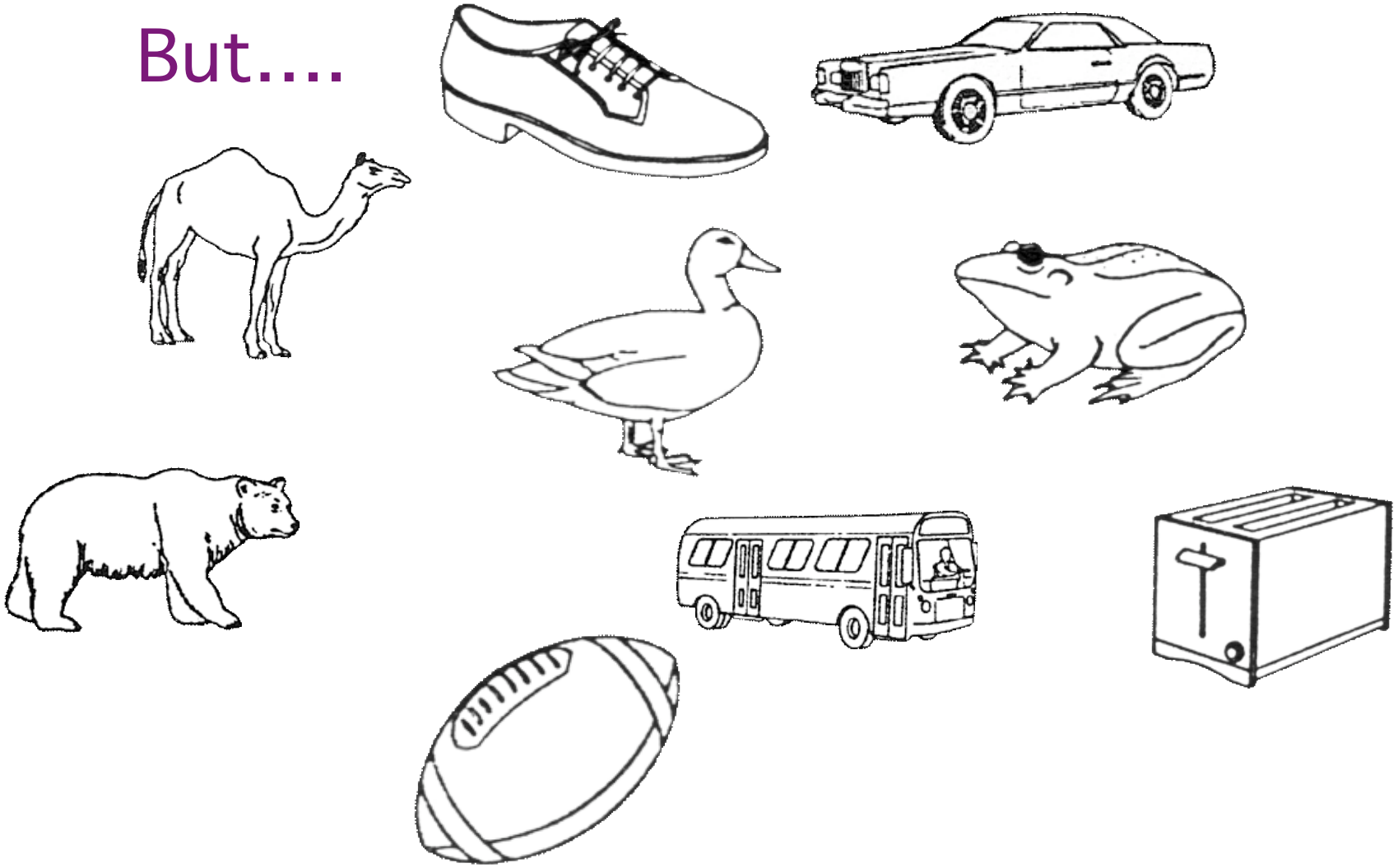
University of Louvain, Belgium





Snodgrass, J.G. & Vanderwart, M. (1980). A standardized set of 260 pictures: norms for name agreement, image agreement, familiarity, and visual complexity. *JEP:HPP*, 6, 174-215.

But....



Only line drawings available, without any texture and color information !

Why care?

- No advantage of color over black and white photographs in object classification and semantic tasks (Oostergaard & Davidoff, 1985; Davidoff & Oostergaard, 1988)

- No difference in correct naming latencies for simple line drawings and colorized photographs (Biederman & Ju, 1988)

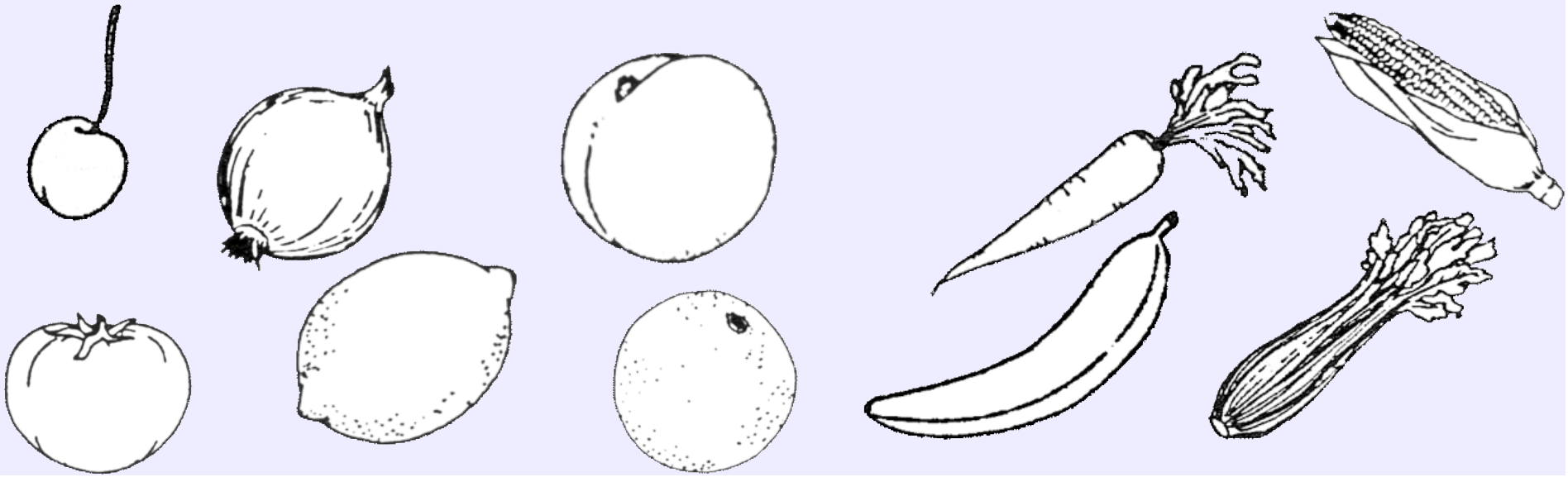
→ Only shape matters, color and other surface characteristics are not part of an object representation (e.g. Biederman, 1987)

However...

- Object naming is facilitated by congruent surface color and photographic detail as compared to line drawings (Price & Humphreys, 1989)

This holds particularly for...

- Structurally similar objects
- Objects with diagnostic color

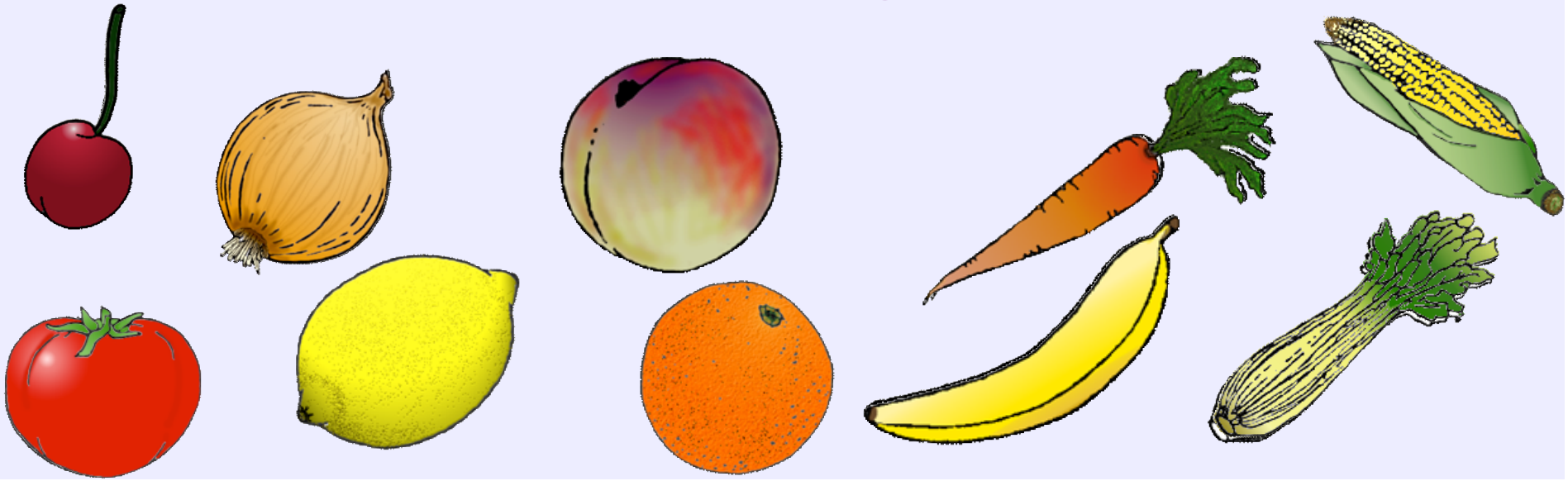


However...

- Object naming is facilitated by congruent surface color and photographic detail as compared to line drawings (Price & Humphreys, 1989)

This holds particularly for...

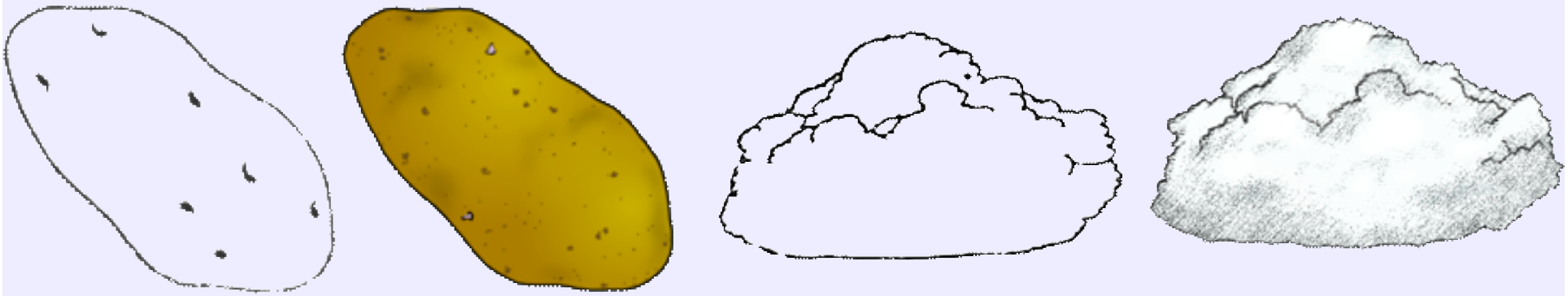
- Structurally similar objects
- Objects with diagnostic color



Object recognition is also facilitated by texture and color...

In normals, when objects have to be discriminated at the subordinate level or shapes are degraded through occlusion (Price & Humphreys, 1989; Wurm et al., 1993; Tanaka & Presnell, 1999)

In patients with low-level vision (Wurm et al., 1993) or visual agnosia (Mapelli & Behrmann, 1997; Chainay & Humphreys, 2001)



The present study:

- Testing the role of surface information in object recognition, on the largest set of common objects used in the literature

- Dissociating the role of texture and color in object recognition

- Providing new sets of stimuli for object recognition studies in normal and patients, with comparative normative data on these stimuli

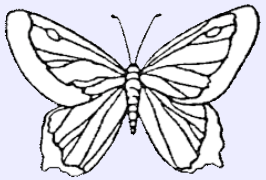
Stimuli

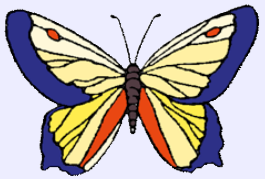
- Scanning of the 260 original drawings at high resolution (600 dpi) and "cleaning" of the images, all saved in 72 dpi on a white background (281 x 197 pixels).

- Careful colouring and texture addition by a professional graphist, using Adobe Photoshop 5.0 and color information from encyclopaedic books

- Two formats: 600 dpi for high resolution prints out and 72 dpi for screen presentations.

- All computerized images available in 3 types: line drawings, grey levels, color.





Subjects and tasks

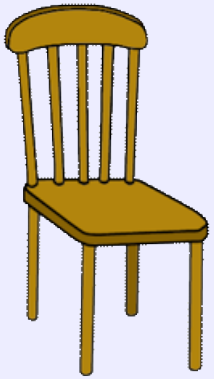
- 240 students (age range 18-22)

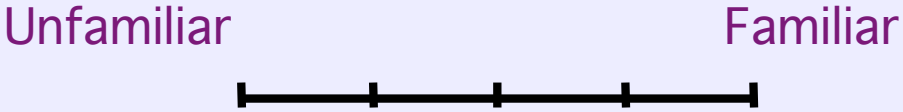
- 60 subjects for each of the 4 tasks: naming, familiarity and complexity judgements, image agreement.

- 20 subjects in each condition (line drawings, grey level, color)

- Each task tested similarly as Snodgrass & Vanderwart (1980)

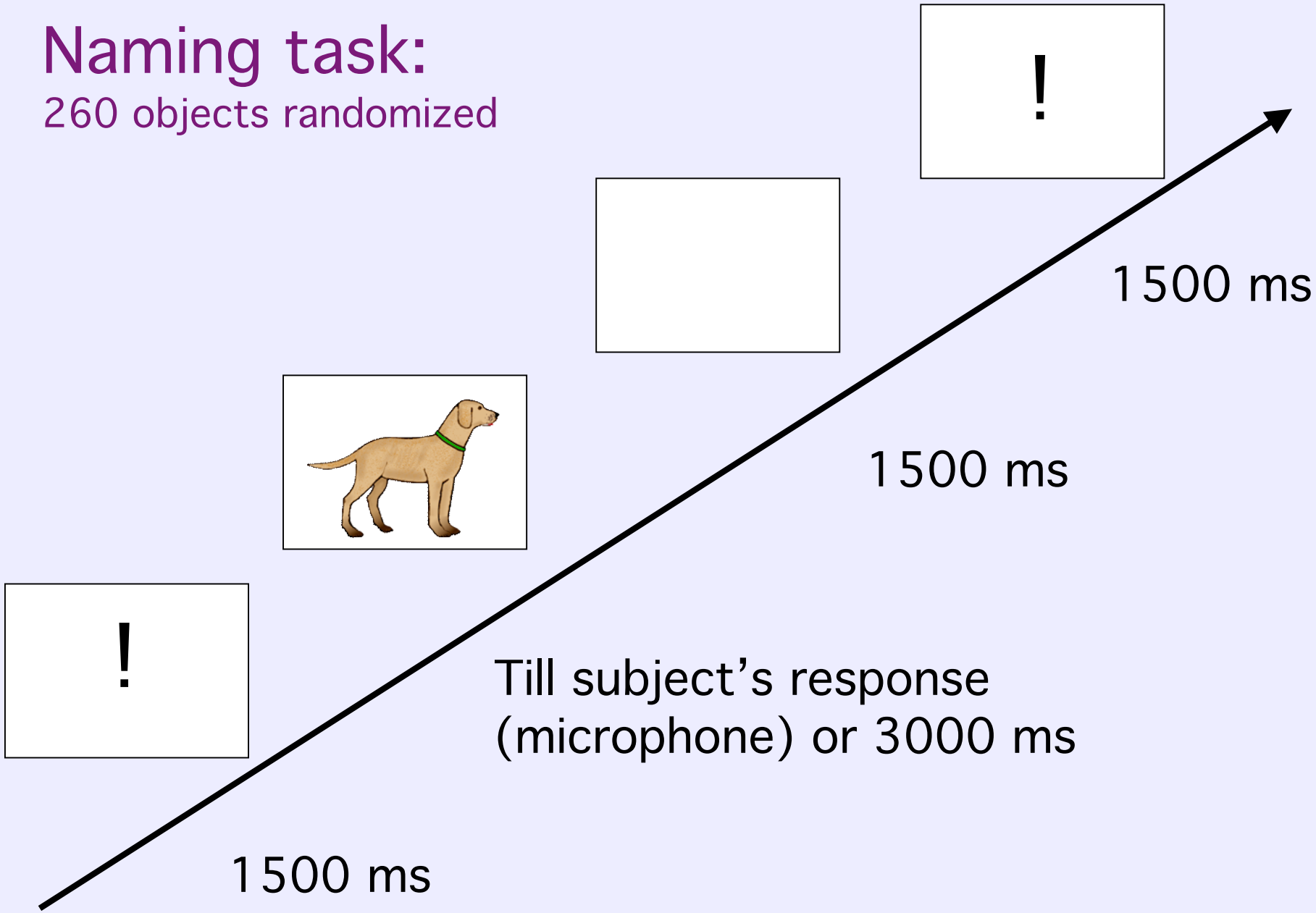
e.g.:





Naming task:

260 objects randomized



Results: naming task

1. Accuracy rates (based on the most common name given): 88% (LD), 89.3% (gray), 90.7% (color), p=0.001)

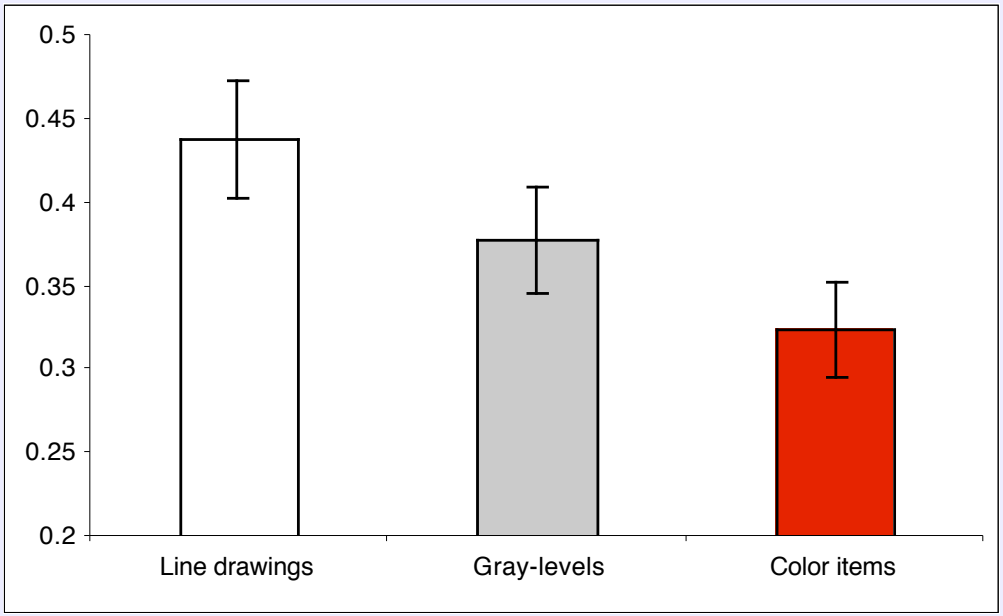
2. Overall agreement of subjects for the item names (H statistic, from Snodgrass and Vanderwart, 1980):

Lower values = higher agreement (H = 0, all subjects giving the same name)

Gray level vs. Line drawings: p=0.01

Colorized vs. Gray level: p=0.01

Colorized vs. Line drawings: p<0.0001

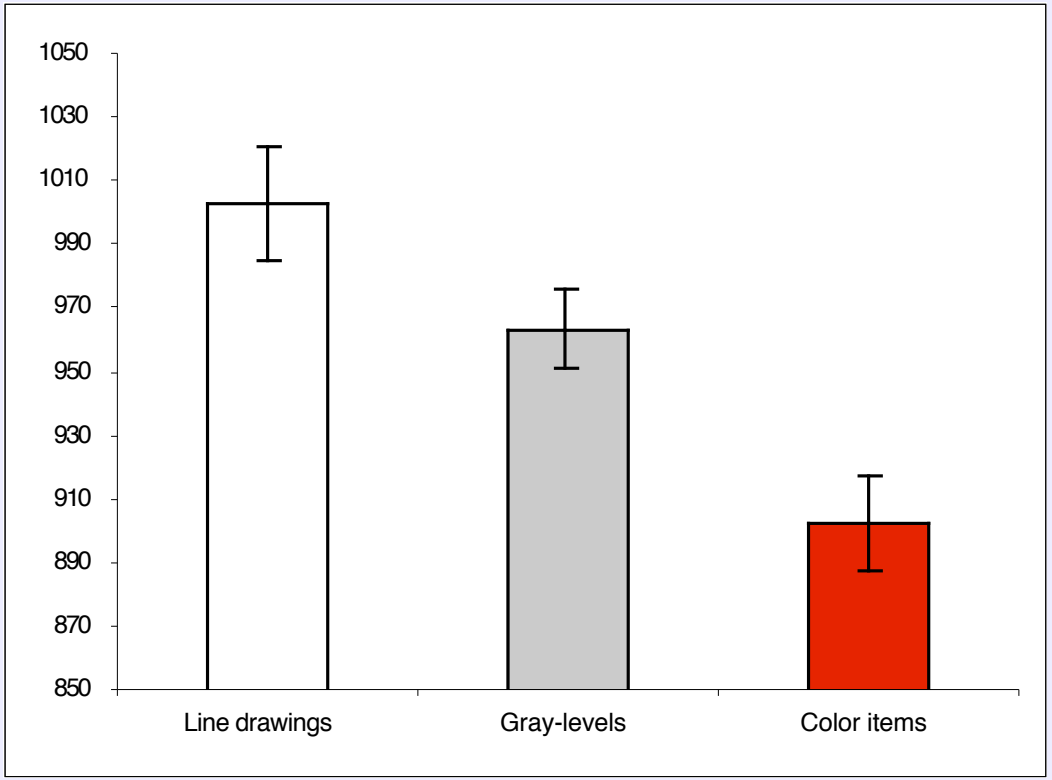


3. Correct response times: significantly different among the three conditions ($F_{2,259}$=46.5, p<0.0001)

Gray level vs. Line drawings: p<0.001

Colorized vs. Gray level: p<0.0001

Colorized vs. Line drawings: p<0.0001

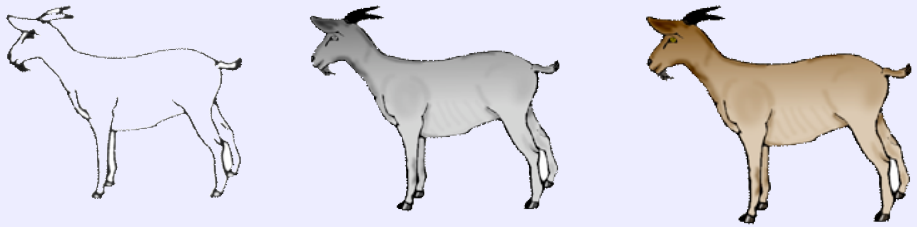


+ color, but not texture alone, further reduces naming RTs for the 40 items named fastest as line drawings only (color vs. line drawings: p<0.01).

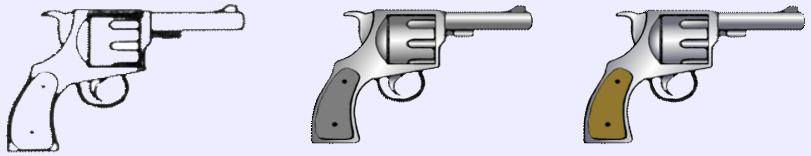
4. Naming task: Analyses by categories

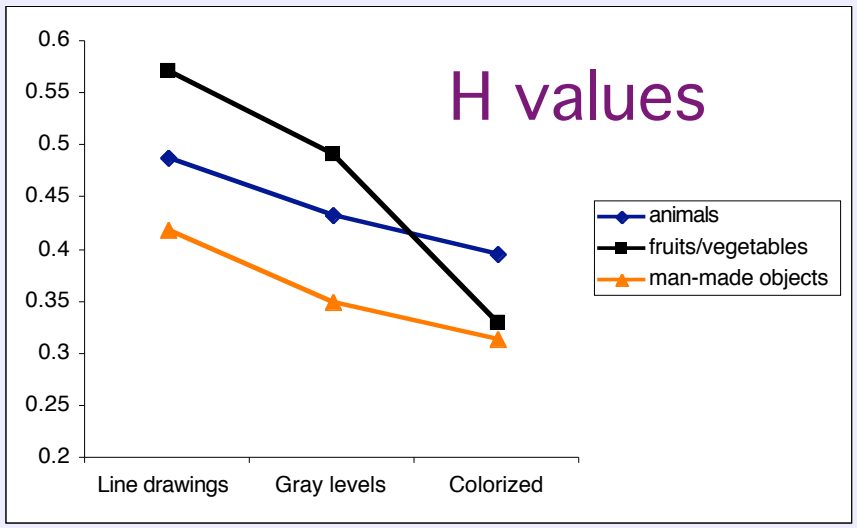
Fruits/vegetables (N=28)

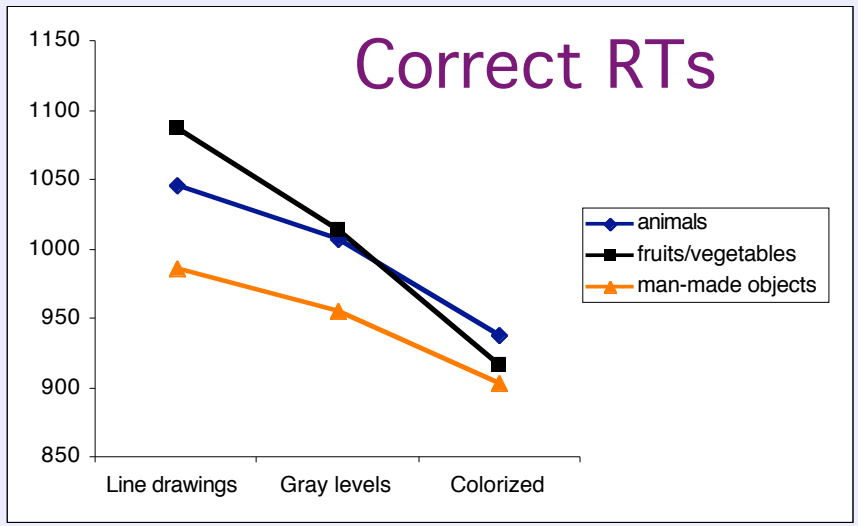
Animals (N=53)



Man-made objects (N=158)

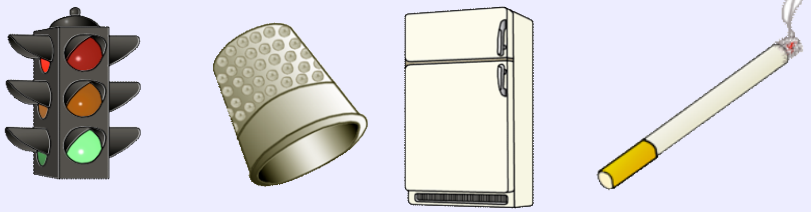




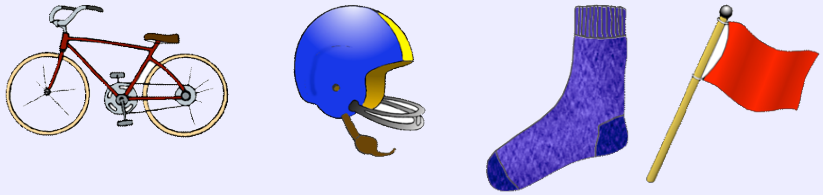


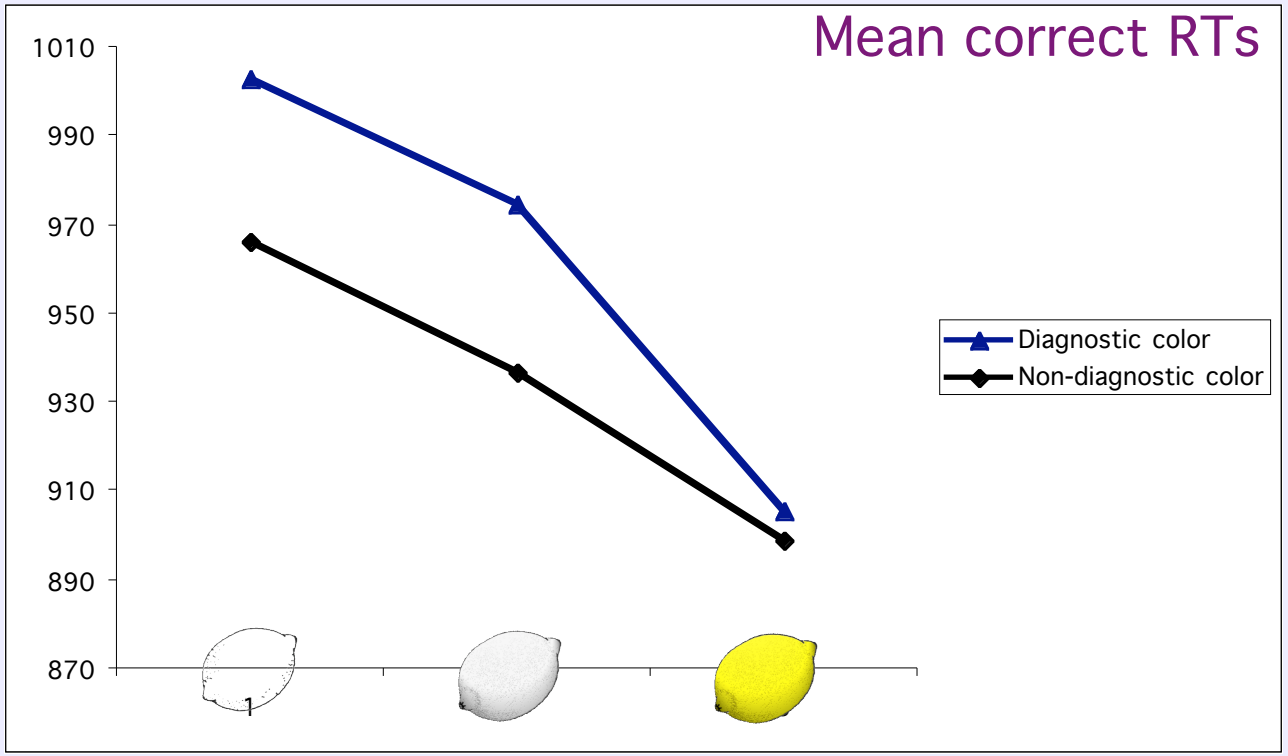
Color diagnosticity for man-made objects

Objects with a diagnostic color (N=62)

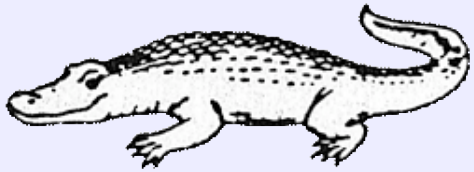


Object without diagnostic color at all (N=96)



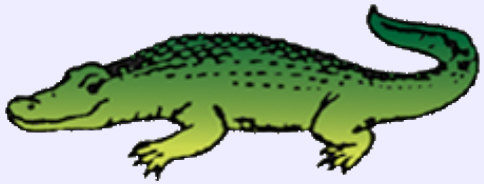


Familiarity norms (1-5 scale, "judge the object according to how usual or unusual the object is in your realm of experience")



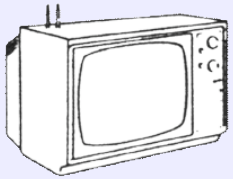
3.59 ± 1.11

3.53 ± 0.94

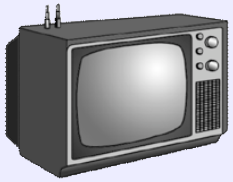


3.44 ± 0.71

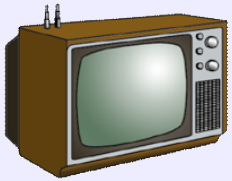
Visual complexity norms (1-5 scale, "judge the object according to the amount of detail or intricacy of line in the picture")



2.76 ± 0.69



2.88 ± 0.87

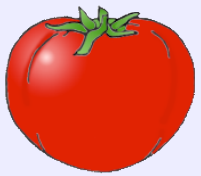


2.70 ± 0.83

Image agreement norms (1-5 scale, object label given...then "judge the object according to how close it is to the object you imaged")

3.73 ± 1.12

3.76 ± 0.98



3.74 ± 1.15

Conclusions

Texture and color contribute to object recognition for all categories of objects, including artefacts without any dagnostic color.

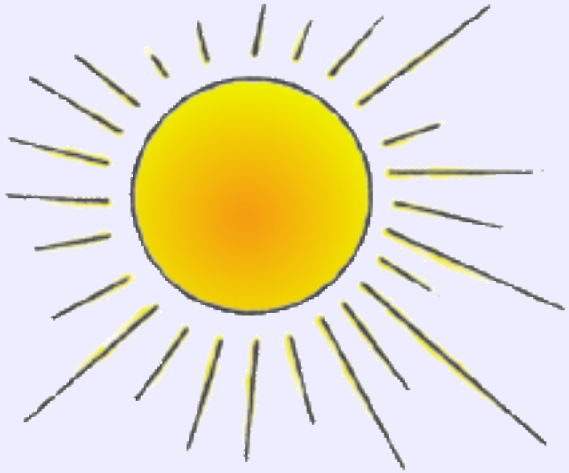
How?

→ Better segmentation ? (perceptual contribution)

→ Better recognition ? (“knowledge-based” contribution)

When all informations are available, objects are recognized at the same speed, suggesting that recognition of an object is based on multiple cues, with contour and surface information all part of an object representation and providing important information for recognition

There is a new set of 2D high quality pictures available for a large number of experiments involving object recognition, in both normals and patients



Special Acknowledgements to Olivier Clabots and Philippe Schynkus

Pictures available at **www.md.ucl.ac.be/nefy/Face_Categorisation_Lab** or **www.cog.brow.edu/~tarr**

Or e-mail: Bruno_Rossion@psp.ucl.ac.be