Integration of texture and color cues for visual shape recognition

Toni P. Saarela[1,2] & Michael S. Landy[1]

Contact: saarela@sas.upenn.edu

[1] Department of Psychology & Center for Neural Science, New York University
[2] Current address: Department of Psychology, University of Pennsylvania

http://www.cns.nyu.edu/~saarela

Background

Figures differ from their backgrounds in several ways (texture, color, luminance, motion...).

There are thus multiple cues available for segmenting figure from background.

How are the cues integrated in visual segmentation and shape recognition?

We tested the integration and interaction of texture and color in a simple shape-recognition task.

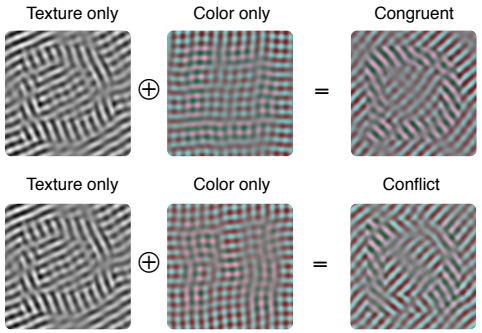
Task & Stimuli

Task: Letter identification.

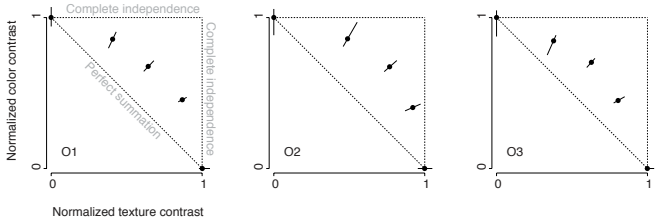
Letter templates: Five Sloan letters: D, N, R, S, Z
(http://psych.nyu.edu/pelli/software.html)

Stimuli:
- Filtered noise
- Carrier spatial frequency 1 cycle/deg

'Second-order' cues:
1. Texture (orientation contrast)
2. Color (red-green modulation)



Experiment 1: Summation



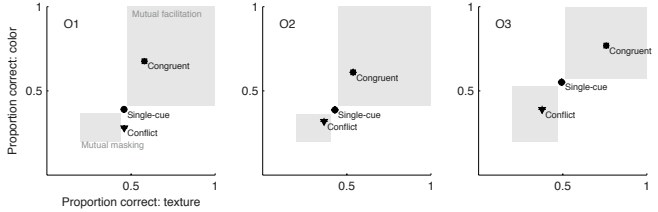
Question: Can observers integrate texture and color cues?

Experiment: Identification thresholds were measured at several relative texture and color contrasts. Texture and color letters were congruent.

- **Observers perform better with two cues, but cue summation is not perfect.**

Experiment 2: Masking

PERFORMANCE



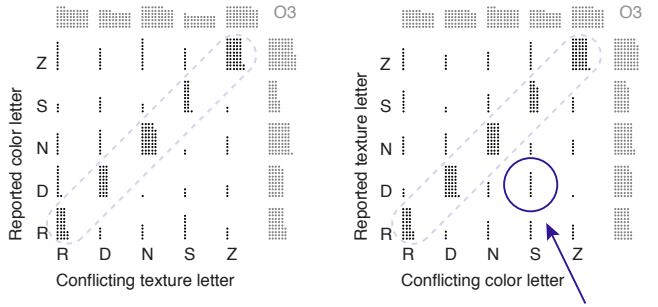
Question: Can observers ignore a task-irrelevant cue?

Experiment: Identification performance was measured at one texture contrast and one color contrast. Two tasks (blocked):
1. Report texture-defined letter
2. Report color-defined letter

Three types of trial (mixed):
1. Single-cue
2. Congruent
3. Conflict

Performance
- **Task-irrelevant cue facilitates identification when congruent and masks when in conflict with the target.**

ERROR RESPONSES



Error analysis:
Each dot represents an error on a conflict trial.
- **When making an error on a conflict trial, the observers were most likely to respond according to the task-irrelevant cue** (the dots are concentrated on the main diagonal).

Example: Conflicting letter was `S' and the observer responded `D'.

See all data online: www.cns.nyu.edu/~saarela/VSS2012/SaarelaLandy_VSS2012.php

Conclusions

Improved performance with two cues: Observers can integrate texture and color cues.

Facilitation and masking by task-irrelevant cue: Observers cannot ignore the other cue even when it is uninformative.

Texture and color are not completely independent.

VSS 2012 Naples, Florida

Support: NIH EY16165; Swiss National Science Foundation PBELP1-125415