Texture statistics predict human performance on a range of scene-perception tasks

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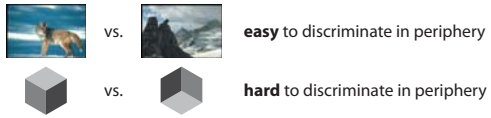
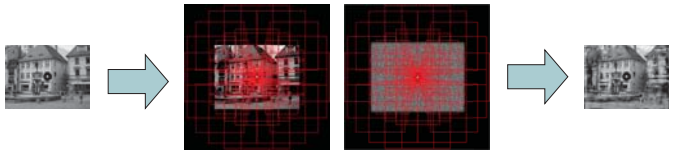
People are good at scene perception tasks (eg, "is there an animal?"), even when scenes are shown peripherally and attention is limited [1]
Why are scene tasks easy, when similar tasks with "simple" stimuli are hard?



A summary statistic representation of peripheral vision predicts performance on visual search and crowding tasks [2.3]. Does it also predict performance on scene tasks?

"Mongrel" images

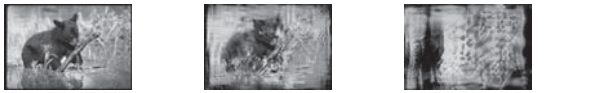
Feature statistics [4] are measured in pooling regions over the image, and a noise image is coerced to have the same statistics

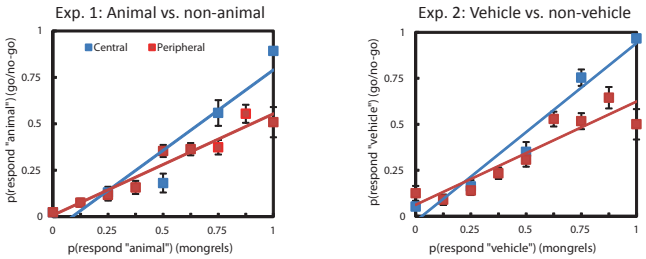


Rapid-perception task

Go/no-go task: images were flashed for 20 ms at fixation or 11° eccentricity; subjects responded if the image contained a target object (animals in Exp. 1, vehicles in Exp. 2).

Mongrel task: "mongrel" images were synthesized at fixation or 11° eccentricity; subjects classified mongrels as target or non-target (free viewing, no time limit).



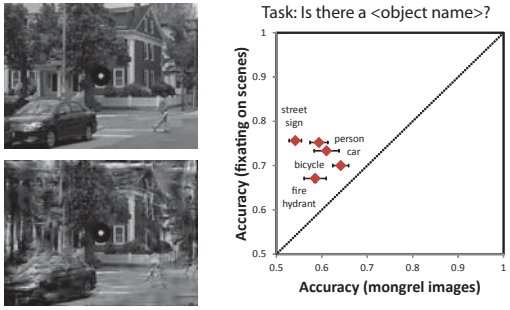


Gaze-contingent scene perception tasks

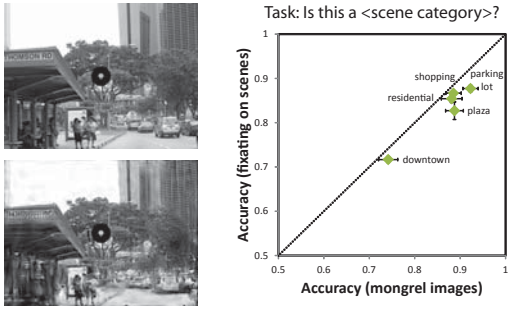
Scene task: subjects answered questions about scenes (eg, "Is this a parking lot?") while maintaining fixation in the center of the image (eye position tracked with an Eyelink 2000 eye tracker).

Mongrel task: "mongrel" images were synthesized with central fixation; subjects answered the same questions about mongrels while free viewing.

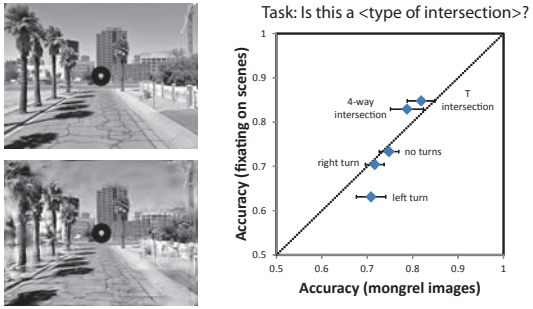
Object present / absent



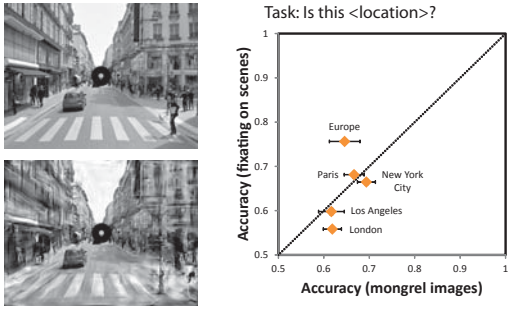
Scene category



Scene layout



Geographic location



Conclusions

"Mongrel" image classification predicts performance on various scene perception tasks

A statistical summary model of peripheral vision predicts that scene tasks should be easy, even though visual search for simple stimuli is difficult

References

[1] VanRullen, R., Reddy, L., & Koch, C. (2004).
[2] Balas, B. J., Nakano, L., & Rosenholtz, R. (2009).
[3] Rosenholtz, R., Huang, J., Raj, A., Balas, B. J., & Ilie, L. (2012).
[4] Portilla, J. & Simoncelli, E. P. (2000).