Saliency-based guidance of gaze in monkeys with unilateral lesion of primary visual cortex

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1. Introduction

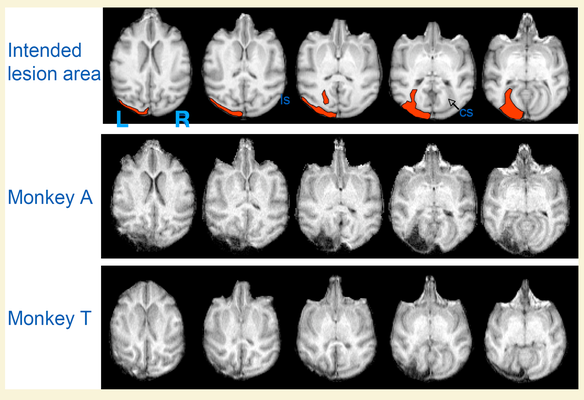
Bottom-up saliency is believed to be a strong attractor of gaze during free viewing (Parkhurst et al., 2002; Tatler et al., 2005; Itti; 2005; Carmi & Itti, 2006).

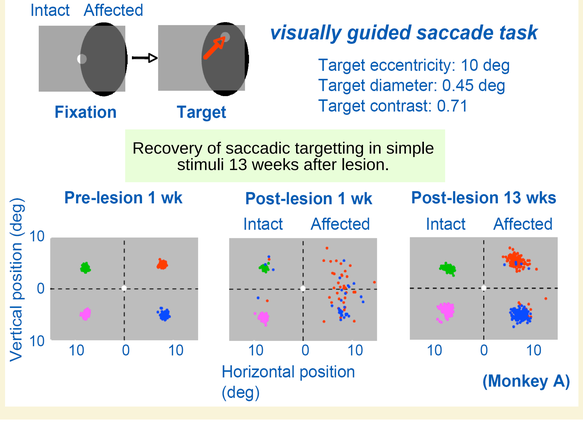
In many models, saliency computations rely principally on primary visual cortex (V1) features (Treisman & Gelade, 1980; Koch & Ullman, 1985; Wolfe et al., 1994; Itti et al., 1998; Li, 2002).

Here we tested the possible role of other pathways (e.g., retino-tectal, subcortical or extrastriate feedback) in guiding monkey gaze towards salient locations while free-viewing natural video clips.

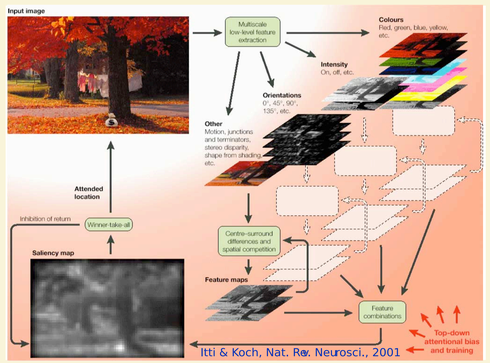
To this end, we used a computational model to measure salience of saccadic gaze targets, in normal monkeys vs. in monkeys with complete unilateral V1 ablation.

2. Basic observations

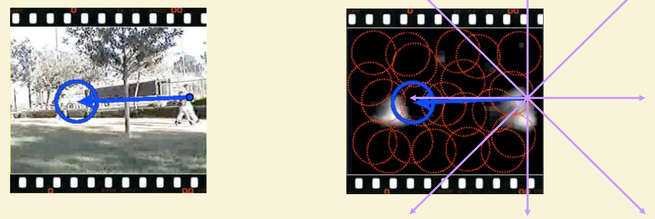




3. Modeling and eye movement analysis



Measure saliency values at target of each monkey saccade.
Compare to chance saliency values at target of random saccades.
Compute saliency score, for each of 8 principal directions.

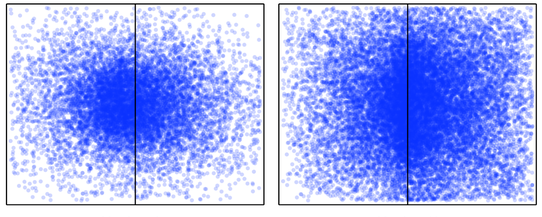


50 video clips (set 1) and 115 video clips (set 2). 5s to 90s per clip.
2 presentations: normal and flipped horizontally
1kHz scleral coil eye-tracker

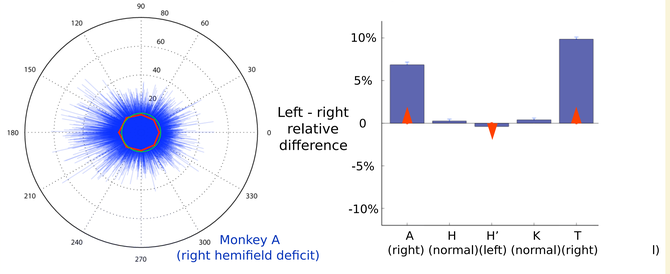
Itti, Vis Cogn 2005
Carmi & Itti, JoV 2006

4. Main observations

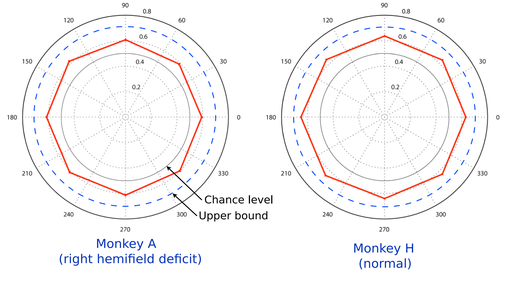
4.a. Spatial distribution of saccade targets



4.b. Saccade amplitudes

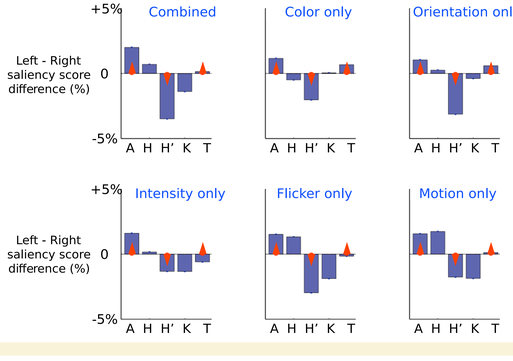


4.c. Saccade scores

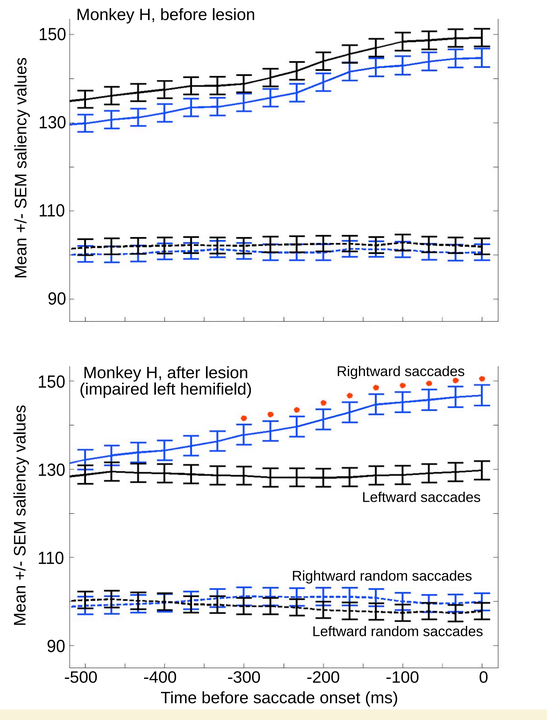


Saliency significantly attracts gaze
($p<10^{-50}$ in all directions / all monkeys)

4.d. Saliency scores, for different V1 features

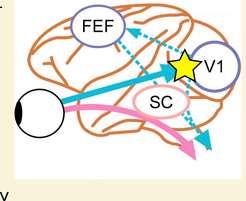


5. History of salience values



6. Discussion and conclusion

- Significant differences exist in low-level saccadic behavior in lesioned vs. intact hemifield:
  - saccadic accuracy
  - saccadic latency
  - saccadic amplitude
  - etc
- Monkeys are significantly attracted towards salient visual locations.
- While significant, differences in saliency values for saccades into intact vs. lesioned hemifield are small.
- Bottom-up salience deficits due to V1 lesion are small under natural viewing conditions (left-right saliency score differences <5%).



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