Microsaccade dynamics mediate perceptual alternation in Monet's "Impression, Sunrise"

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INTRODUCTION

Troxler fading is described as the perceptual disappearance of stationary images, often in the visual periphery, during sustained fixation. Microsaccades have been shown to counteract and reverse the perceptual fading of contrived stimuli such as Gabor patches (Costela, McCamy, Macknik, Otero-Millan, & Martinez-Conde, 2013; McCamy, Macknik, & Martinez-Conde, 2014; McCamy et al., 2012). Here we demonstrate that microsaccadic dynamics similarly drive equivalent perceptual alternations in representational art. This approach can help deepen our understanding of masterpieces such as Claude Monet's "Impression, Sunrise" ("Impression, soleil levant"), in which a red sun rises over two small fishing boats in a port.

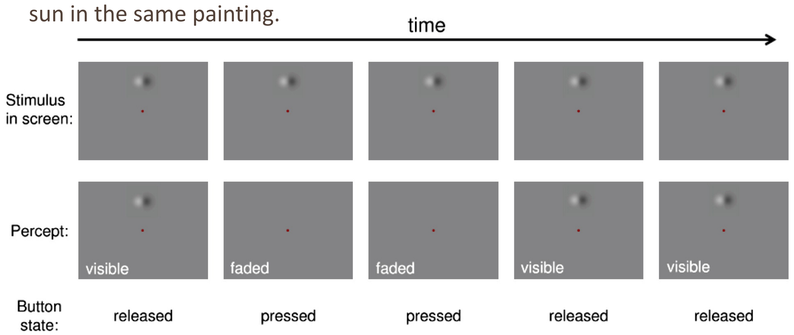
Though the red sun appears perceptually brighter than the surrounding sky, Livingstone (2002) showed that the sun and the surrounding sky have the same approximate luminance. Equiluminance between an object and its background is known to facilitate Troxler fading. Accordingly, Safran & Landis (1998) noticed that staring at the sailor in Monet's painting results in perceptual fading of the sun.

We set out to assess whether the perceptual fading of the sun in "Impression, Sunrise" depends on microsaccade production. If so, it would indicate that the vanishing of the sun in Monet's masterpiece represents an instantiation of Troxler fading in art.

METHODS

Procedure:

We tracked the eye movements of 23 human participants with normal vision while they: a) fixated a central target and simultaneously reported (by button press) on the visibility of a peripheral Gabor patch, as in Martinez-Conde et al (2006), or b) fixated their gaze on the sailor in "Impression, Sunrise" and simultaneously reported on the visibility of the sun in the same painting.



- Trials were 30 seconds long.
- To control for contrast adaptation effects across trials, Gabor patches were presented at eight different compass orientations.
- "Impression, Sunrise" was presented in its original orientation, as well as horizontally flipped, such that the sun appeared on either the left or the right side of the screen.
- Gabor patches and the sun were both presented at an eccentricity of 9°.

EXPERIMENT 1 RESULTS

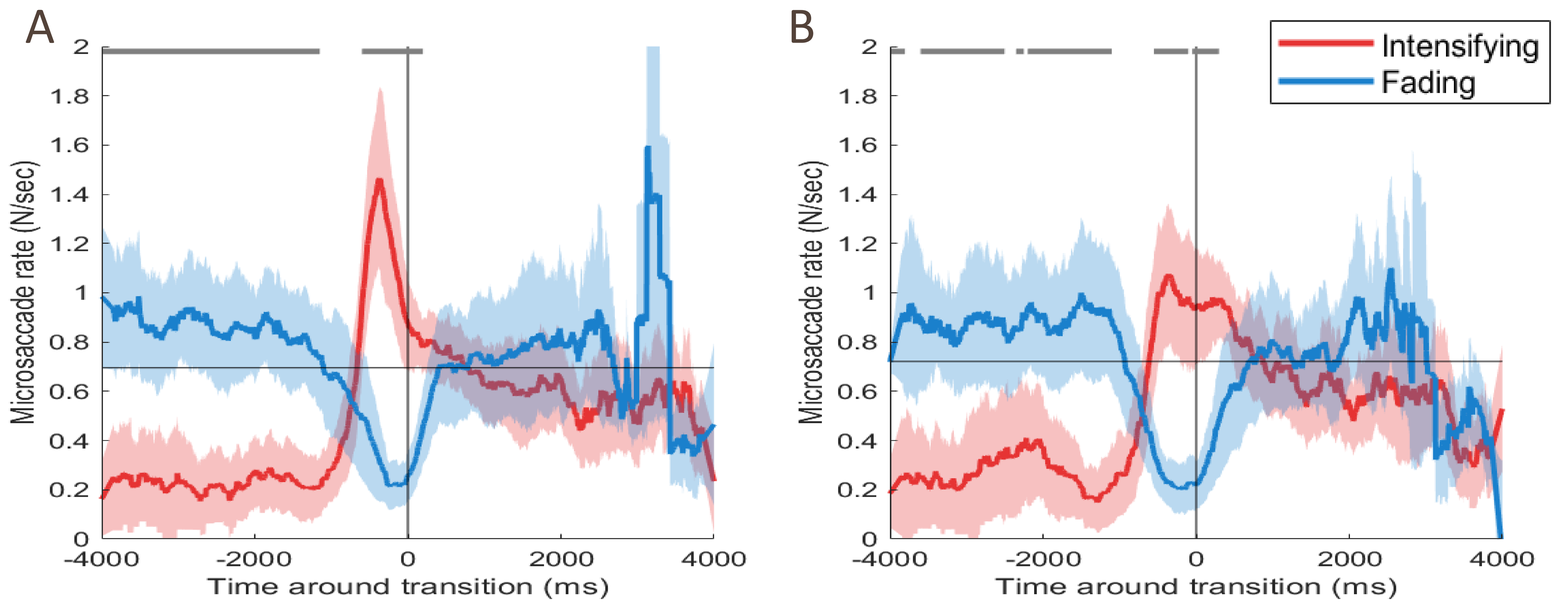


Figure 1. Average rate of microsaccades before perceptual transitions. Transitions to fading and intensification are preceded by corresponding decreases and increases in microsaccade rates, following a similar pattern both for **(A)** the Gabor and **(B)** the Monet trials, and suggesting that microsaccades have a strong effect on the visibility of the sun in "Impression, Sunrise".

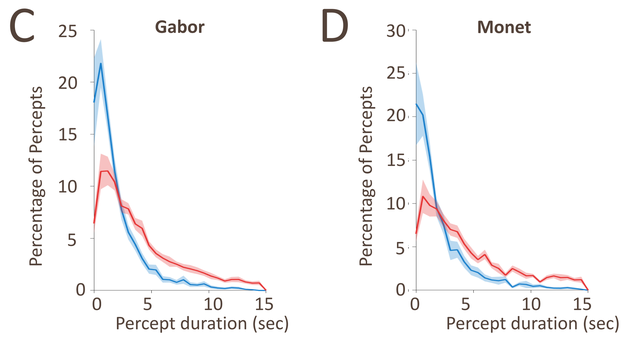


Figure 2. The distribution of fading (blue) and intensifying (red) periods for **(C)** Gabor trials and **(D)** Monet trials.

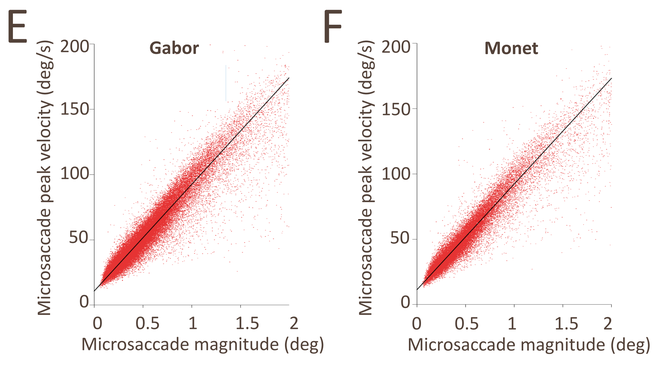


Figure 3. Microsaccades followed the main sequence, for **(E)** Gabor trials (0.86 microsaccades / sec) and **(F)** Monet trials (0.95 microsaccades/sec).

CONCLUSIONS

Central gaze fixation during the observation of peripheral Gabor patches and the sun in Monet's "Impression, Sunrise", resulted in the following findings:

- **Microsaccades rates decreased before perceptual fading reports.**
- **Microsaccades rates increased before perceptual intensification reports.**
- **Microsaccadic timing and dynamics were equivalent in both kinds of trials (Gabor patches and Monet's painting).**

This indicates that:

- **Microsaccade dynamics drive the sun's perceptual alternations in Monet's "Impression, Sunrise."**
- **The vanishing of the sun in Monet's "Impression, Sunrise" is due to Troxler fading.**

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