Color-blindness of direction-selective units in the zebrafish optic tectum

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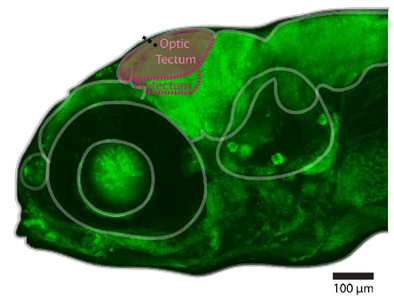
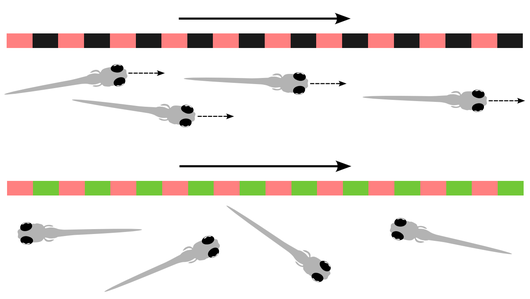


Introduction

Orger and Baier (2004) demonstrated that chromaticity has a big influence on a zebrafishs ability to perceive motion. The optomotor response to gratings showed that combinations of different green and red contrasts can be used to null motion perception.



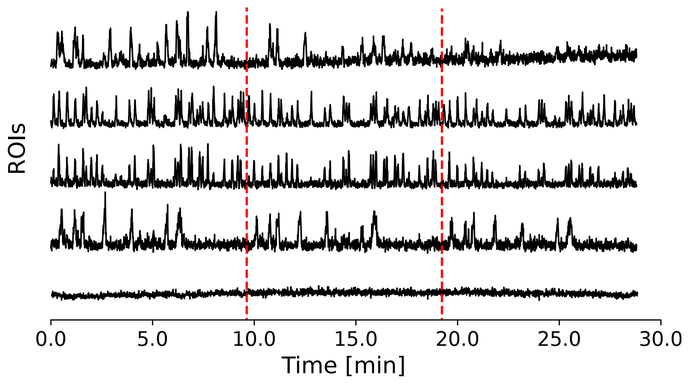
Little is known about the sensitivity of direction selective (ds) units in the midbrain to chromatic contrast. We investigated the activity of ds units in the optic tectum of zebrafish in response to gratings of various color contrasts using a combination of two-photon microscopy and calcium imaging.

Preprocessing:

1. Registration and Segmentation

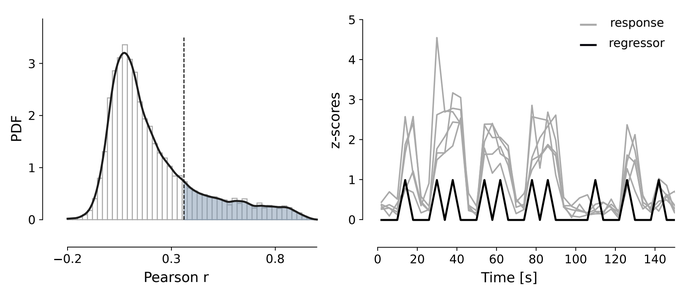
- Alignment of images across time.
- Detection and segmentations to regions of interests (ROIs).

2. Region of Interests (ROI): corresponds to cells with genetically encoded calcium indicators. Fluorescence increases with the release of calcium in a cell if excited by a IR-laser.

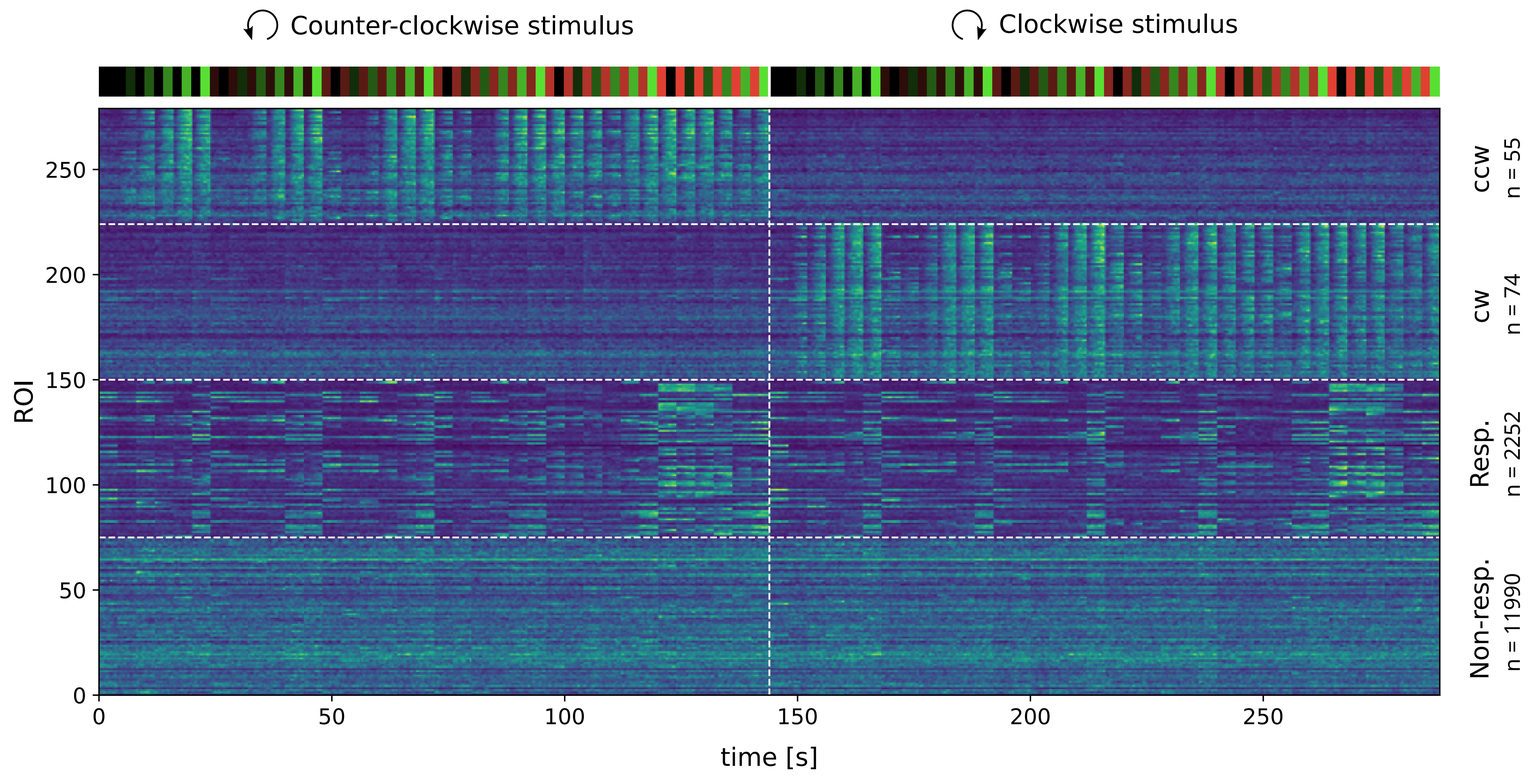


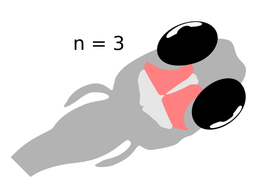
3. Active and direction-selective ROIs:

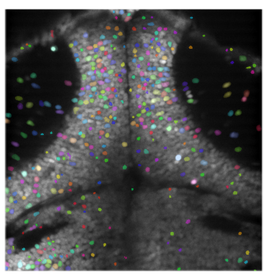
- Strongly autocorrelated ROIs across stimulus repeats are „responding“.
- ROIs that correlated with a direction regressor (clockwise cw or counterclockwise ccw) are ds.



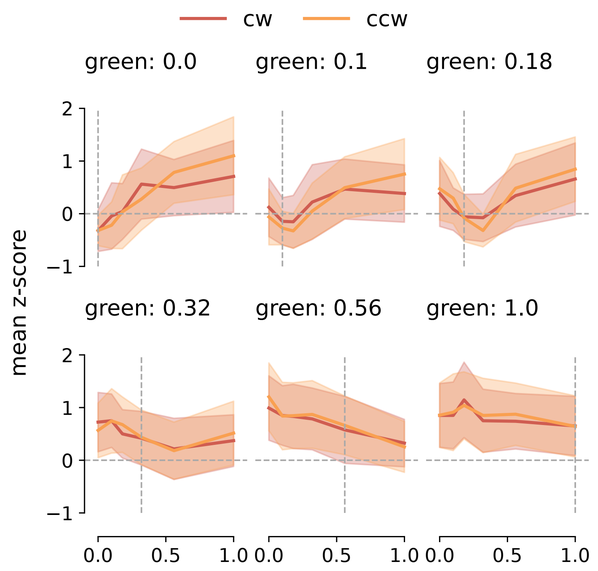
Results: 2-photon calcium imaging

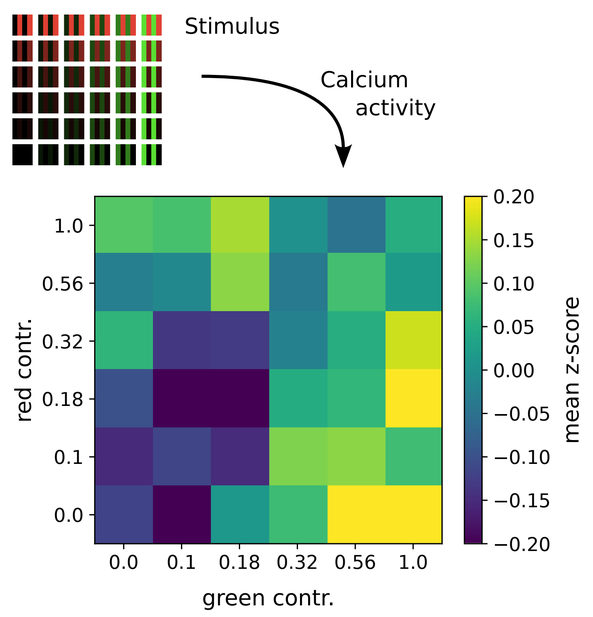






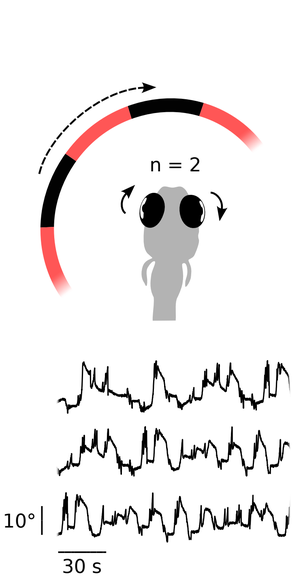
ROIs on optic tectum

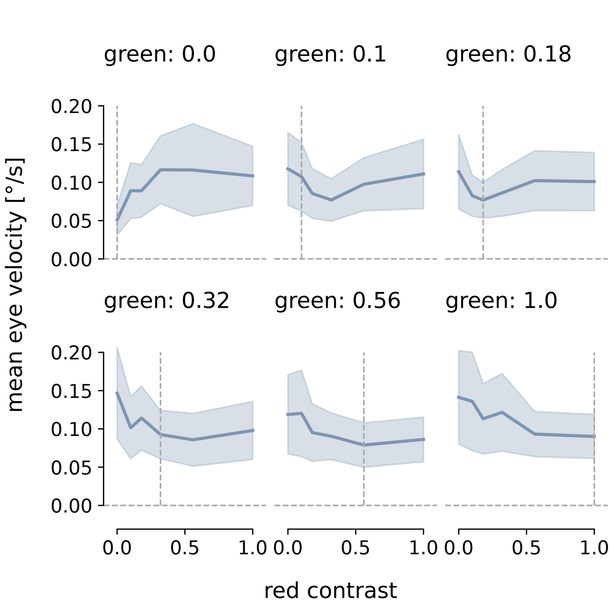


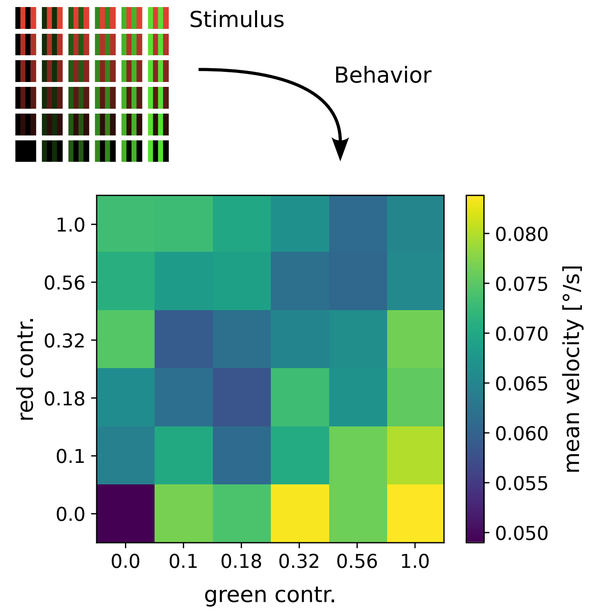


- ROIs responded to moving gratings of red and green and both populations (cw, ccw) responded similarly.
- If both red and green had the same contrast the response was supressed indicating color blindness of direction selective units.
- A slight shift in the troughs of activity could be due to by a higher intensity of the green stimulus compared to red.

Results: Behavior







- The behavioral response (OKR) reflects the pattern shown in calcium activity.

Conclusion

The ds neurons in the optic tectum show the lowest response to exclusively chromatic red-green contrast and might therefore be color blind to these contrasts.

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