Persistent hemispheric differences in the perceptual selection of spatial frequencies
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Background + Motivation

Previous work has shown hemispheric asymmetry in spatial frequency processing. Low SFs are preferentially processed by the RH (in the LVF) and high SFs by the LH (in the RVF).

Most studies have measured SFs using individual, briefly flashed stimuli, asking subjects to judge a single SF at a time. Are there hemispheric differences in perceptual selection from multiple spatial frequencies simultaneously present in the environment? What is the time course of this asymmetry?

We used binocular rivalry to measure continuous perceptual selection from multiple frequencies competing for conscious awareness.

Methods

2 orthogonal gratings of differing spatial frequency at 3.5° eccentricity viewed through a mirror stereoscope. Subjects fixated the alignment cross. Tilt (45°, 135°) and spatial frequency (1 cpd, 3 cpd) of each eye’s grating counterbalanced. Each 30-second trial was divided into 60 non-overlapping time bins (500-ms each).

Participants perceived alternation between the gratings over time and responded by continuously reporting the tilt they observe at any moment (45°, 135°) and spatial frequency (1 cpd, 3 cpd) of each eye’s grating counterbalanced.

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Results

Initial Response Analysis: Are there hemispheric differences in initial perceptual selection of spatial frequency information?

Significant SF x Hemisphere interaction for proportion of initial responses:

- Lower SF was first seen in the RH more often than in the LH.
- Higher SF was first seen in the LH more often than in the RH.

Significant main effect of SF, consistent with known properties of spatial frequency channels:

- Lower SF channels have shorter latencies (Breitmeyer, 1975) and low SF stimuli evoke larger neural responses (Peyrin et al., 2004).

Conclusions + Future Directions

Spatial frequency selection differs between the two hemispheres both during the initial response and throughout the remainder of stimulus presentation.

Relative, not absolute, frequency information drives hemispheric differences in SF perception (Hellige, 1993). Is the asymmetry we found in binocular rivalry due to relative processing as well?

Initial response duration analysis:

- Significant SF x Hemisphere interaction for duration of initial responses:
  - Initial responses corresponding to the higher SF were longer in the RH than the LH.
  - Initial responses in the RH were longer for the lower SF than the higher SF.

- Again, significant main effect of SF:
  - Lower SF responses were longer than higher SF responses overall.

Conclusions:

- Spatial frequency selection differs between the two hemispheres both during the initial response and throughout the remainder of stimulus presentation.

- Relative, not absolute, frequency information drives hemispheric differences in SF perception (Hellige, 1993). Is the asymmetry we found in binocular rivalry due to relative processing as well?

Acknowledgments

This work was supported by NIH Training Grant T32 EY007043 and by the Department of Defense (DoD) through the National Defense Science and Engineering Graduate (NDSEG) Fellowship, D209T166, awarded to E.A.P. We would like to thank Dr. Lynn Robertson for helpful correspondence.

References


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