Physically blurred images moving in stereoscopic depth in 3D displays are neurally sharpened more than laterally moving equally blurred images with the same retinal image velocities. We attributed this to higher contrast gain and saturation properties in stereoscopic motion neurons which symmetrically sharpen both target edges.

Our purposes in this study were threefold: (Expt. 1) – to verify and quantify asymmetric motion sharpening in our blurred bar motion stimuli. This hypothetical pre-binaric process sharpens the trailing edges of moving ocular images (not leading edges) and could explain stronger stereoscopic motion sharpening. (Expt. 2) – to compare stereoscopic to lateral motion sharpening when asymmetric sharpening has been removed from images. (Expt. 3) – to replicate our previous study of stereoscopic and lateral motion sharpening on this new study population.

**Methods**

**Subjects:**
- 10 normally binocular subjects, ages 18 to 35 years old
- 20/20 corrected visual acuity
- Local stereopsis threshold < 30 sec of arc
- Phoria, vergence, and health within normal limits

**Apparatus:**
- A LabView® program running on a Mac G4 sent stimulus parameters via a TCP/IP connection to MATLAB running on an Asus/Windows 7 PC. A PEST adaptive staircase procedure running in LabView established blur matches.
- MATLAB®/Psychtoolbox software on the PC presented stimuli on a 3D monitor comprising a shutter glasses system.
- The 3D monitor, 60Hz binocular frame rate, was viewed at 106.9cm.
- Subject’s head position was supported by a chinrest.

**Procedures:**
- **EXPERIMENT 1:** Monocular Sharpening Asymmetry (Fig. 1A, 1B)
  - Blur stimulus appears above or below fixation at random times.
  - A static sharp bar discourages fixation/attention loss
  - Leading edge blur matched to trailing edge blur
  - Conditions:
    - Left vs Right directionality
    - Left vs Right eye presentation
    - Fast (0.5°/sec) vs Slow (0.5°/sec) velocity

- **EXPERIMENT 2:** Edge-Matched Stereo Sharpening (Fig. 1C)
  - Subjects compared the blur of a moving bar whose monocular edges were perceptually matched, to the blur of a static comparison bar.
  - Conditions:
    - Near (approaching) vs. Far (receding) stereoscopic motion
    - Conjugate Lateral binocular motion (leftward vs rightward)
    - Fast (0.5°/sec) vs Slow (0.5°/sec) velocity

- **EXPERIMENT 3:** Edge-Unmatched Stereo Sharpening (Fig. 1D)
  - Parameters like Expt. 2 except that the edges of the monocular images comprising the moving blur stimulus were physically matched, not perceptually matched.

**Methods (continued)**

**Sharpening was quantified by the reduction of leading edge blur that matched the 42° trailing edge blur in Expt.1, or by the overall reduction of comparison target blur that matched the overall blur of the moving target in Expts. 2 & 3.**

**A Data Dsk© Repeated Measures algorithm did mixed ANOVAs:**

- **EXPERIMENT 1:**
  - Between-subject independent factors: Subject, Motion Direction, Eye
  - Within-subject dependent variables: Sharpening at target velocities of 0.5°/sec and 2.0°/sec

- **EXPERIMENT 2:**
  - Between-subject independent factors: Subject, Motion Direction
  - Within-subject dependent variables: Sharpening at target velocities of 0.5°/sec and 2.0°/sec

- **Results:**

**Conclusions:**

- **Experiment 1 – Monocular Sharpening Asymmetry**
  - Overall, the effect of target velocity on sharpening was highly significant (F=92.5, p≤0.0001), showing that asymmetric sharpening occurred in this experiment.
  - The direction and factors were not significant.
  - Asymmetric motion sharpening magnitude differed between subject conditions (F=3.13, p=0.028).

- **Experiment 2 – Edge-Matched Stereo Sharpening**
  - Motion sharpening was greater for stereo motion than lateral motion (F=6.69, p=0.036).
  - There was no significant effect of direction of motion (near vs. far) on sharpening.
  - The effect of motion was less significant for the subsequent analysis of stereo vs. lateral motion.

- **Experiment 3 – Edge-Unmatched Stereo Sharpening**
  - Stereoscopic motion sharpening was greater for conjugate lateral motion (F=7.11, p=0.032) and significantly different between subjects.
  - The relative strength of stereoscopic motion sharpening over lateral motion sharpening was not significantly different between experiments 2 & 3 (F=1.2, p=0.31).

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