OPTIC FLOW AND SELF MOTION PERCEPTION

The contribution of different parts of the field.

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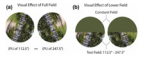
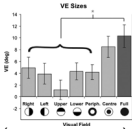
BACKGROUND

Moving generates optic flow which contains important information about heading direction and distance moved

For static cues, retinal regions' contributions to self orientation are additive.





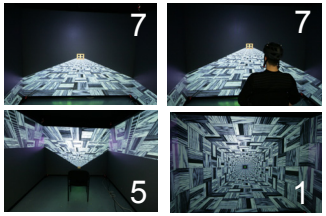
(*Dearing & Harris 2011*).

QUESTION

Does optic flow in different retinal regions contribute differently to the perception of distance traveled?

METHOD

Twelve subjects sat on a stationary bicycle in a "CUBE" display which provided a virtual reality presentation of moving in a corridor (8' wide) from which various sections could be removed.



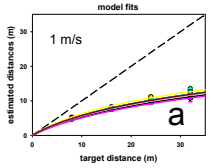
- BINOC dichoptic viewing.
- MONOC one eye patched.
- Targets simulated at 8, 16, 24, & 32m.
- Display yoked to head tracker.
- Optic flow compatible 1 or 2 m/s (forwards).
- Different parts of the field blanked.

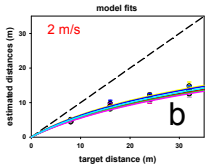
conditions

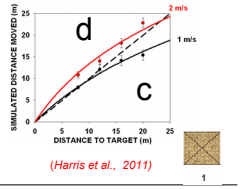
- Subjects indicated when they "moved" through the target distance.
- Data fitted by Lappe et al (2007) **leaky spatial integrator model** to assess spatial integration constants and sensory gains.

RESULTS

MONOC

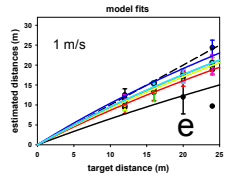


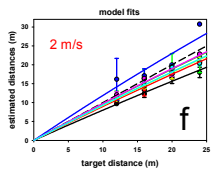


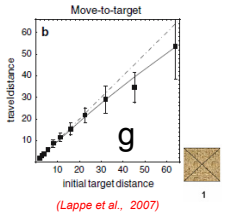


(*Harris et al., 2011*)

BINOC

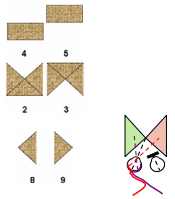






(*Lappe et al., 2007*)

- Monocular optic flow was more effective at evoking self motion than binocular.
- Monocular viewing resulted in substantial errors in which subjects felt they had moved much further than the simulated motion (mean gain 1.3).
- Monocularly optic flow in the upper field (condition 4) was significantly more effective than in the lower field (at 1m/s) (condition 5).
- However, for movement in a closed corridor at high velocity, motion in the upper field (condition 3) was only marginally more effective than motion in the lower field (condition 2).
- Optic flow on the nasal retina (condition 9) was no more effective than on the temporal retina (condition 8).



CONCLUSIONS

- Unlike for determining orientation, different parts of the field and different areas of stimulation differ only marginally in their effectiveness at evoking self motion.
- Curiously viewing optic flow through one eye seems to evoke a larger over-estimation of travel distance than when viewing binocularly.
- The large spatial decay associated with monocular viewing contributes to the over-estimations for long simulated distances.

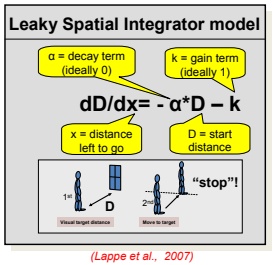
REFERENCES

Dearing RR, Harris LR (2011) "The contribution of different parts of the visual field to the perception of upright" Vision Research 51: 2207-2215

Harris LR, Herpers R, Jenkin M, Allison R, Jenkin H, Kapralos B, Scherfgen D, Felsner S. (2012) "The relative contributions of radial and laminar optic flow to the perception of linear self-motion" Journal of Vision, 12(10):7, 1–1

Lappe M, Jenkin M, Harris LR (2007) "Travel distance estimation from visual motion by leaky path integration" Experimental Brain Research 180: 35-48

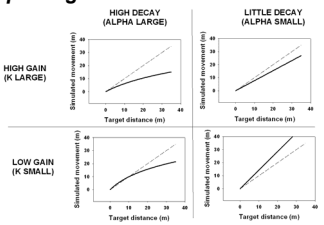
MODEL



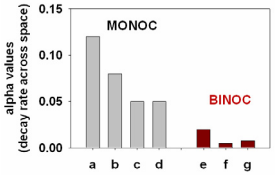
(*Lappe et al., 2007*)

Interpreting the model

How k (gain) and alpha (decay rate) affect the perceived distance traveled



Alpha (decay rate) is much larger for the MONOC condition



K (gain) shows only small variation with which part of the visual field is stimulated.