

The Roles of Optic Flow and Body Senses in Human Path Integration

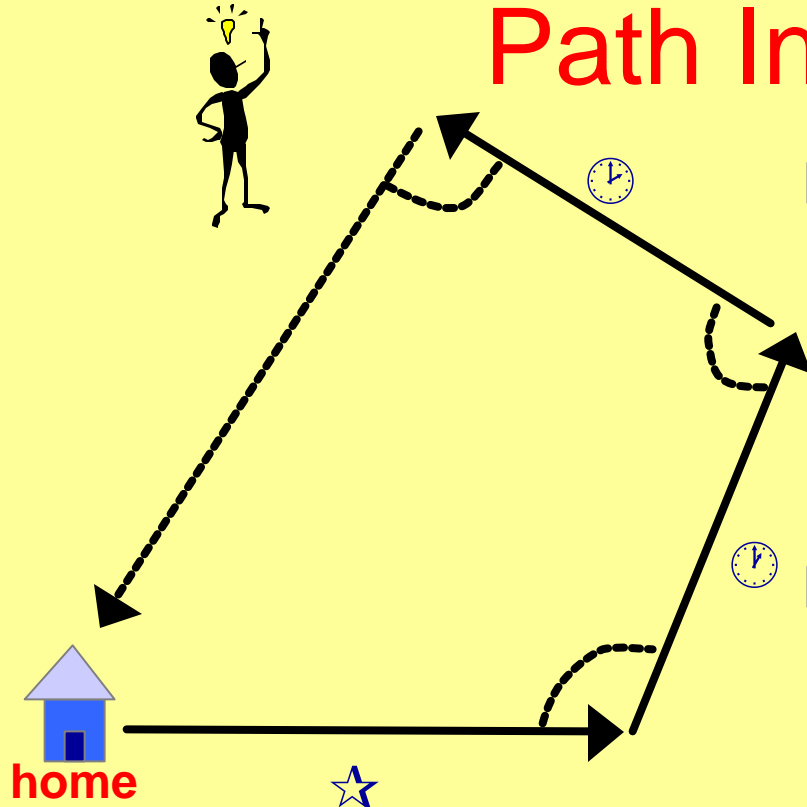
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Acknowledgement

Amanda Forte

Path Integration



↙ What are the relative contributions of optic flow and body senses for path integration?

↙ Are these contributions different for estimating translations and rotations?

Information from:

↙ Optic flow

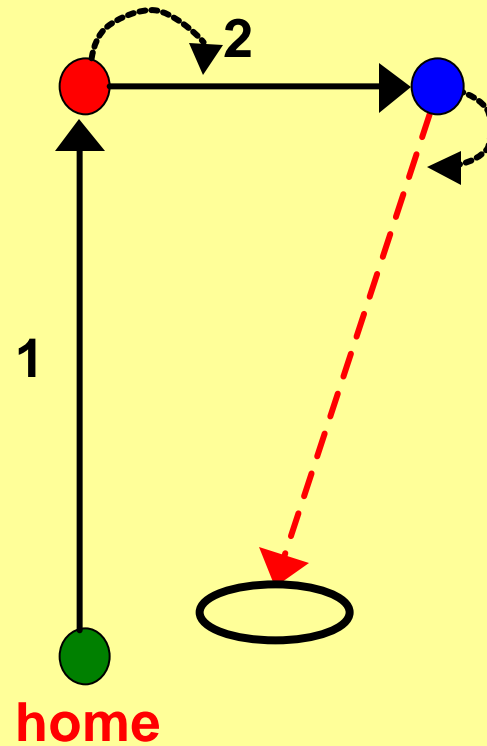
↙ Body Senses:

(proprioceptive, vestibular and efferent information)

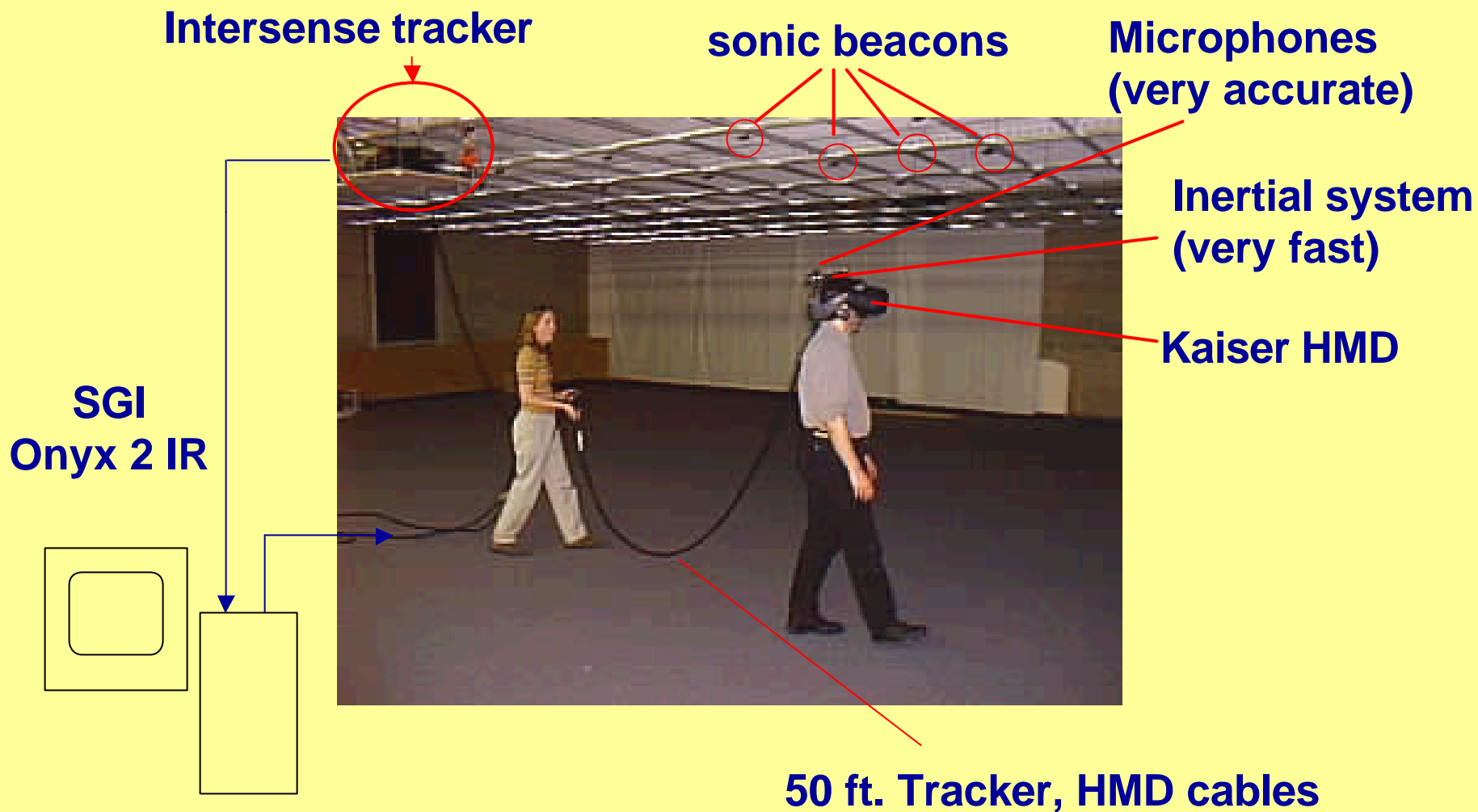
Path Integration Background

- ↙ **Bees and ants use optic flow (Esch, 1996; Srinivasan, 1997; Schatz, 1999; Ronacher, 1995)**
- ↙ **Humans can use body senses (Loomis, 1993)**
- ↙ **With only vision, (less successful?) use of optic flow by humans (Peruch, 1997; Riecke, 2000; Bud, 2000)**
- ↙ **However: when body senses and vision are available, body senses dominate (Bud, 2000)**

The Task: Triangle Completion



VENLab Hardware



How can we separate optic flow and body senses?

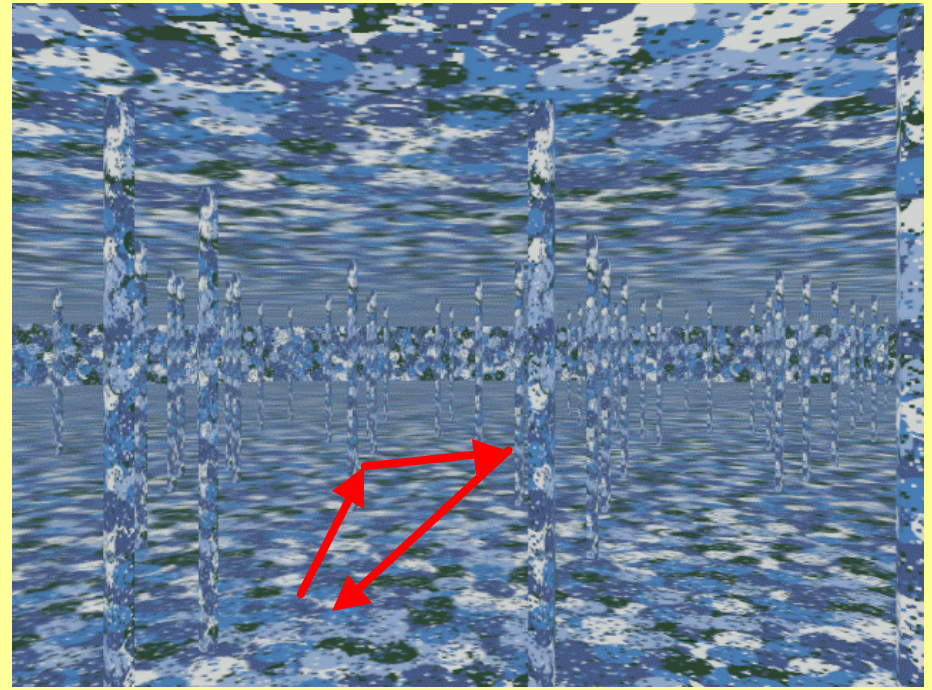
In virtual reality, anything is possible!

- ↙ Visually rich environment**
- ↙ Varied visual gain relative to physical motion**
- ↙ Trials blocked by gain: 100% (normal), 67% (low), and 150% (high)**
- ↙ 4 triangles, 4 trials each per condition**
- ↙ Separate sessions for translational and rotational gain changes**

Two reference frames

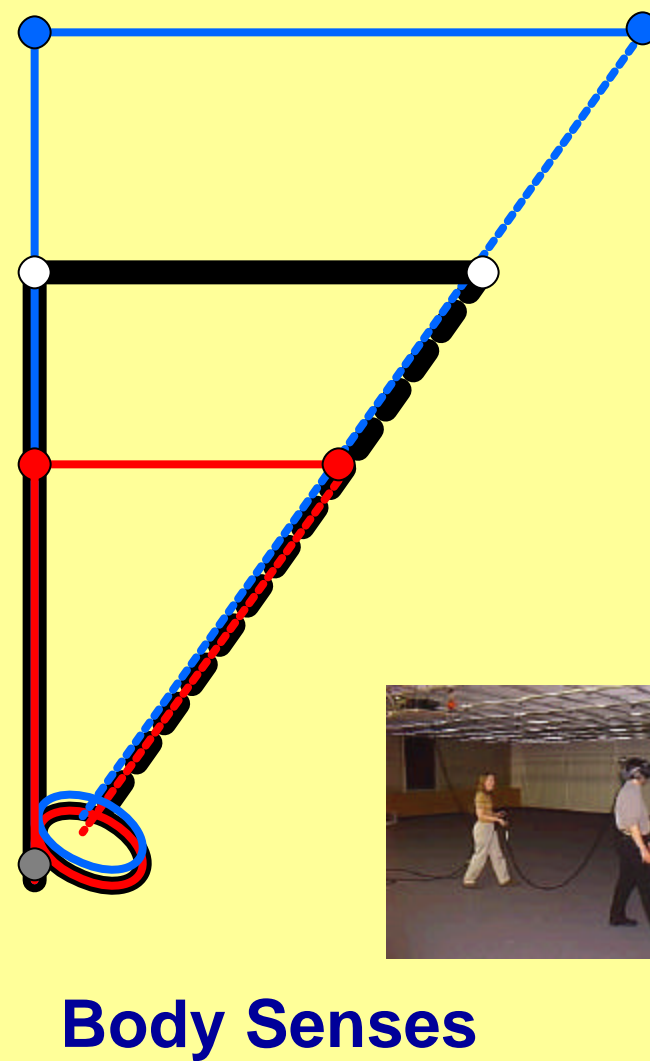
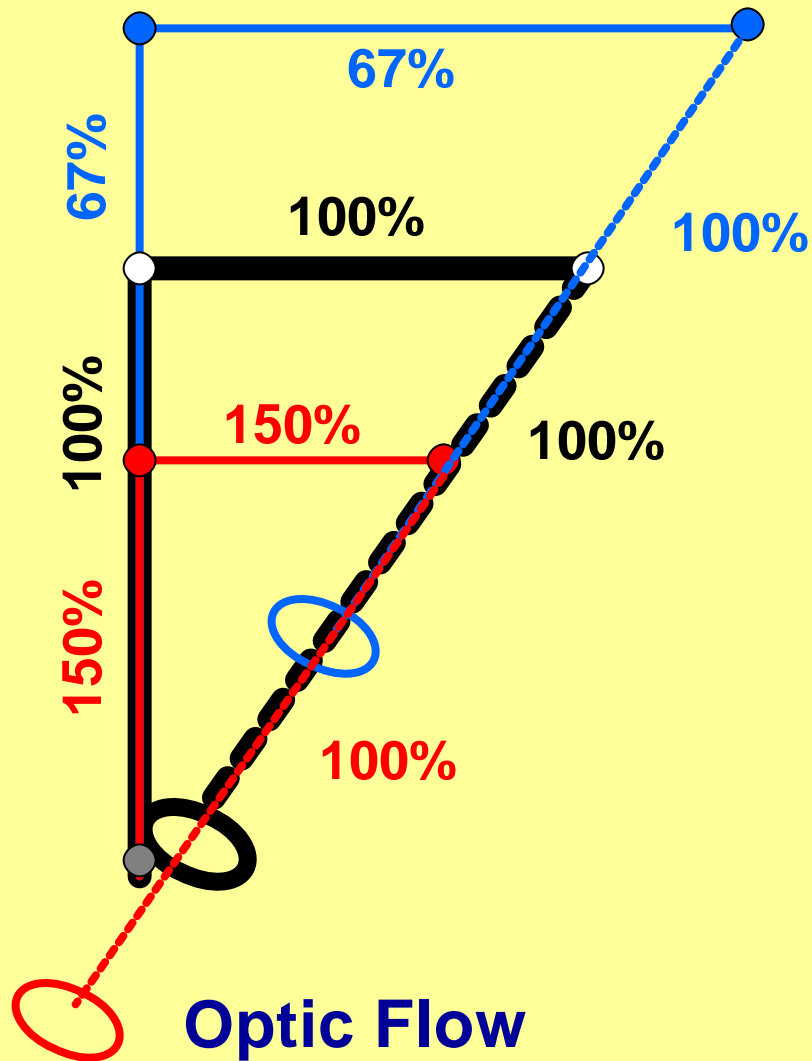


Physical Space

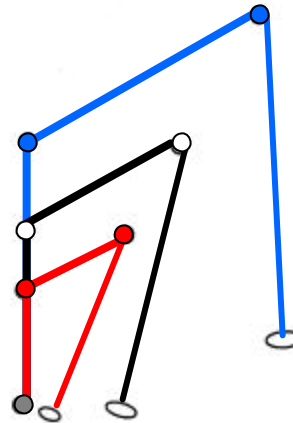
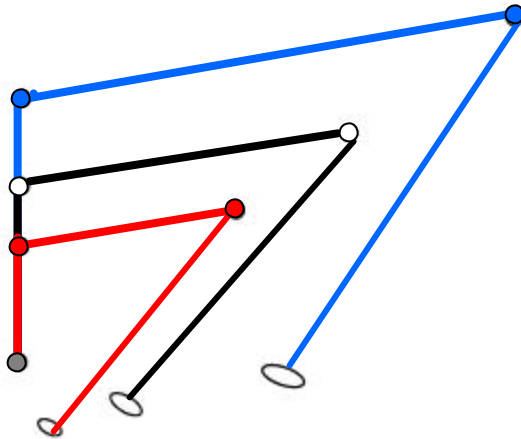
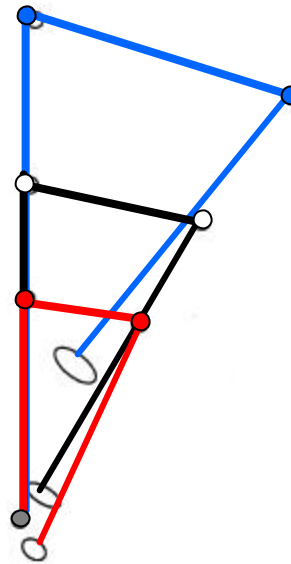
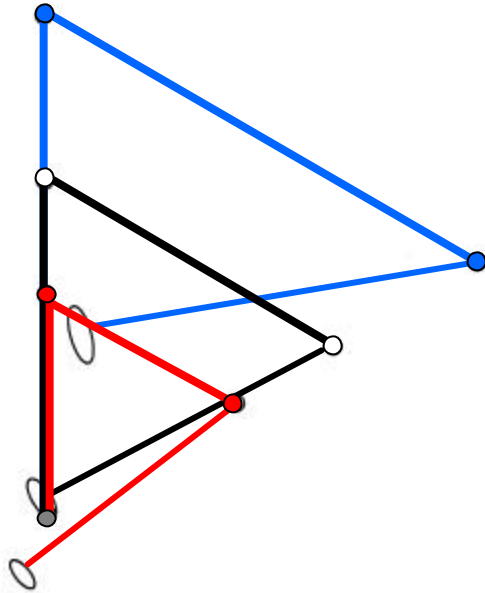


Virtual Space

Translation: Predictions in Physical Space



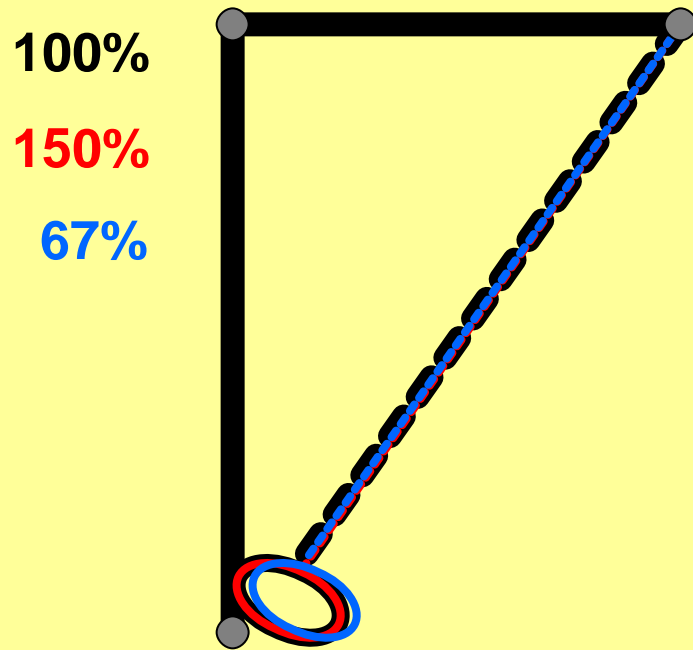
Results: Physical Space



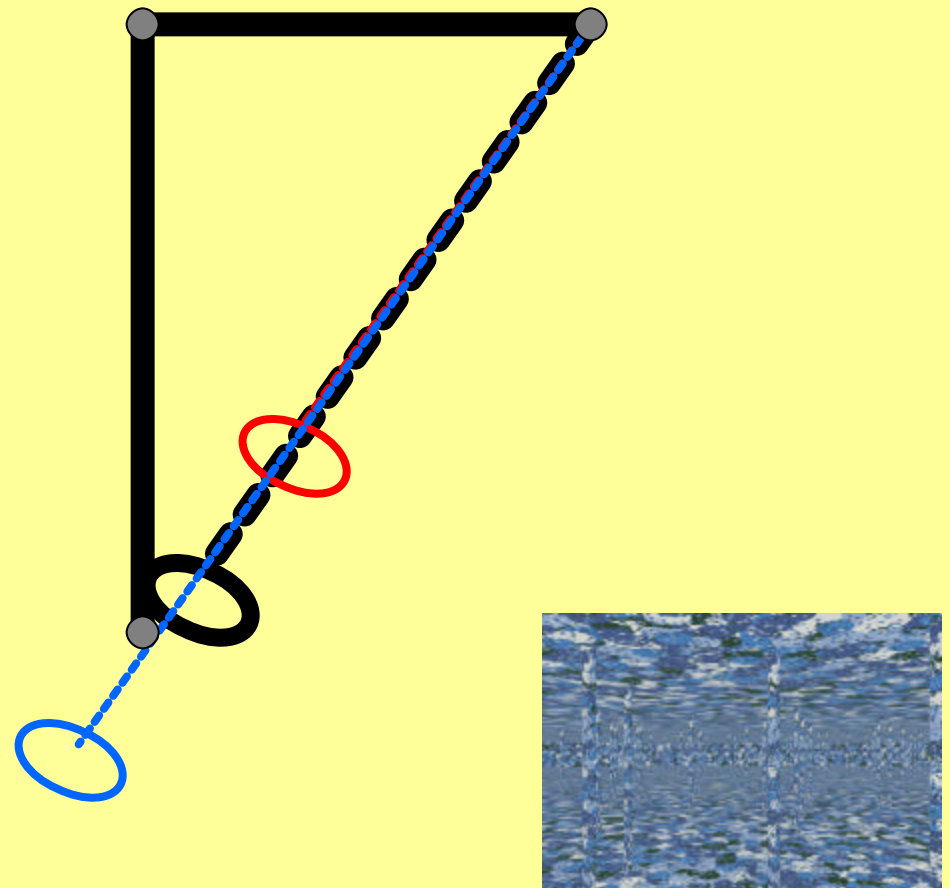
**Looks similar
to Optic Flow
predictions...**



Translation: Predictions in Virtual Space

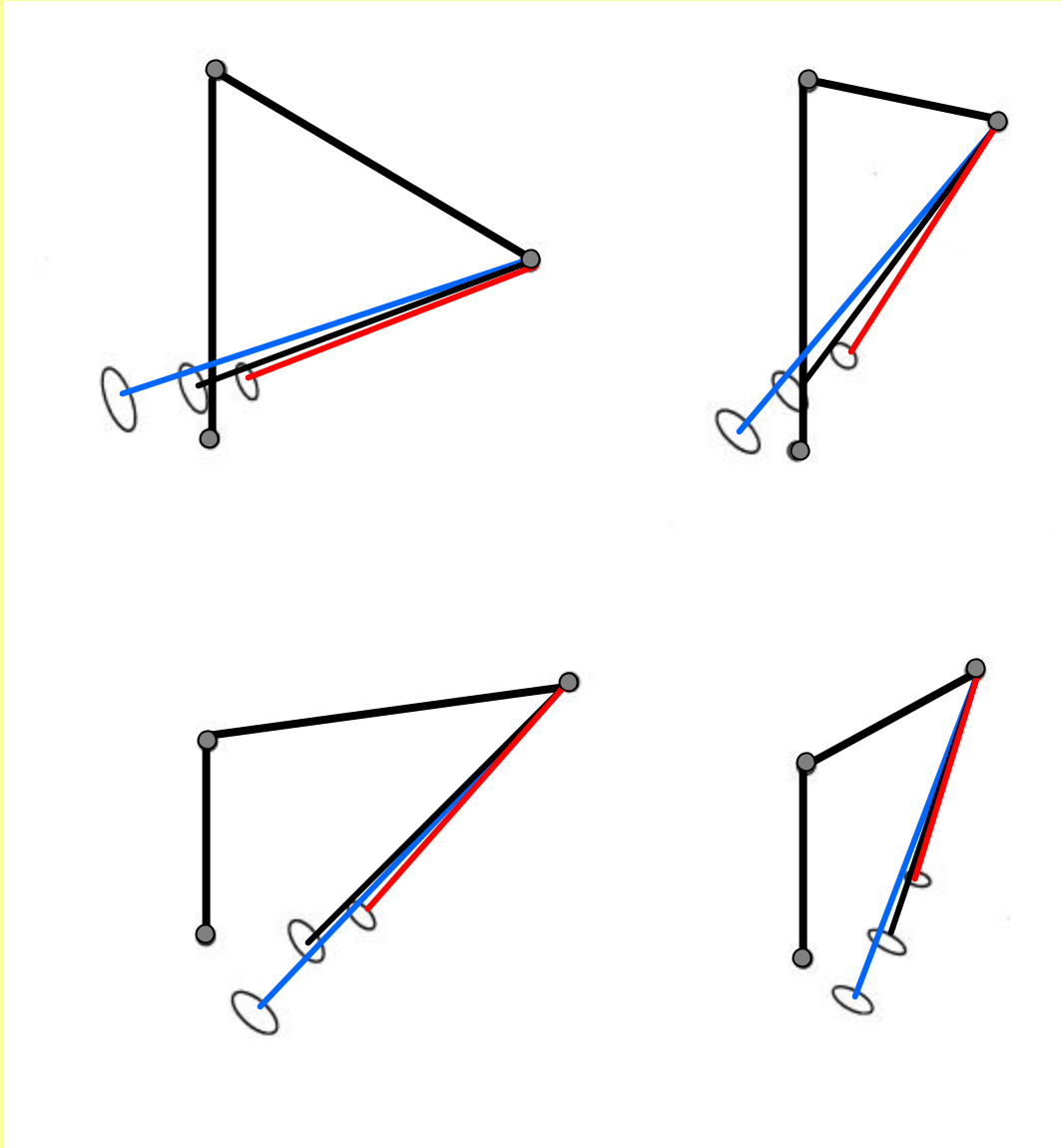


Optic Flow

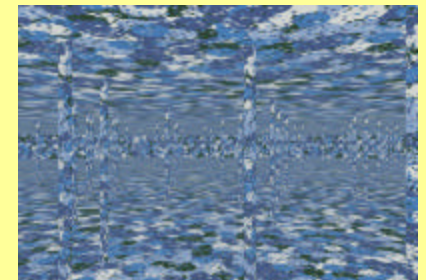


Body Senses

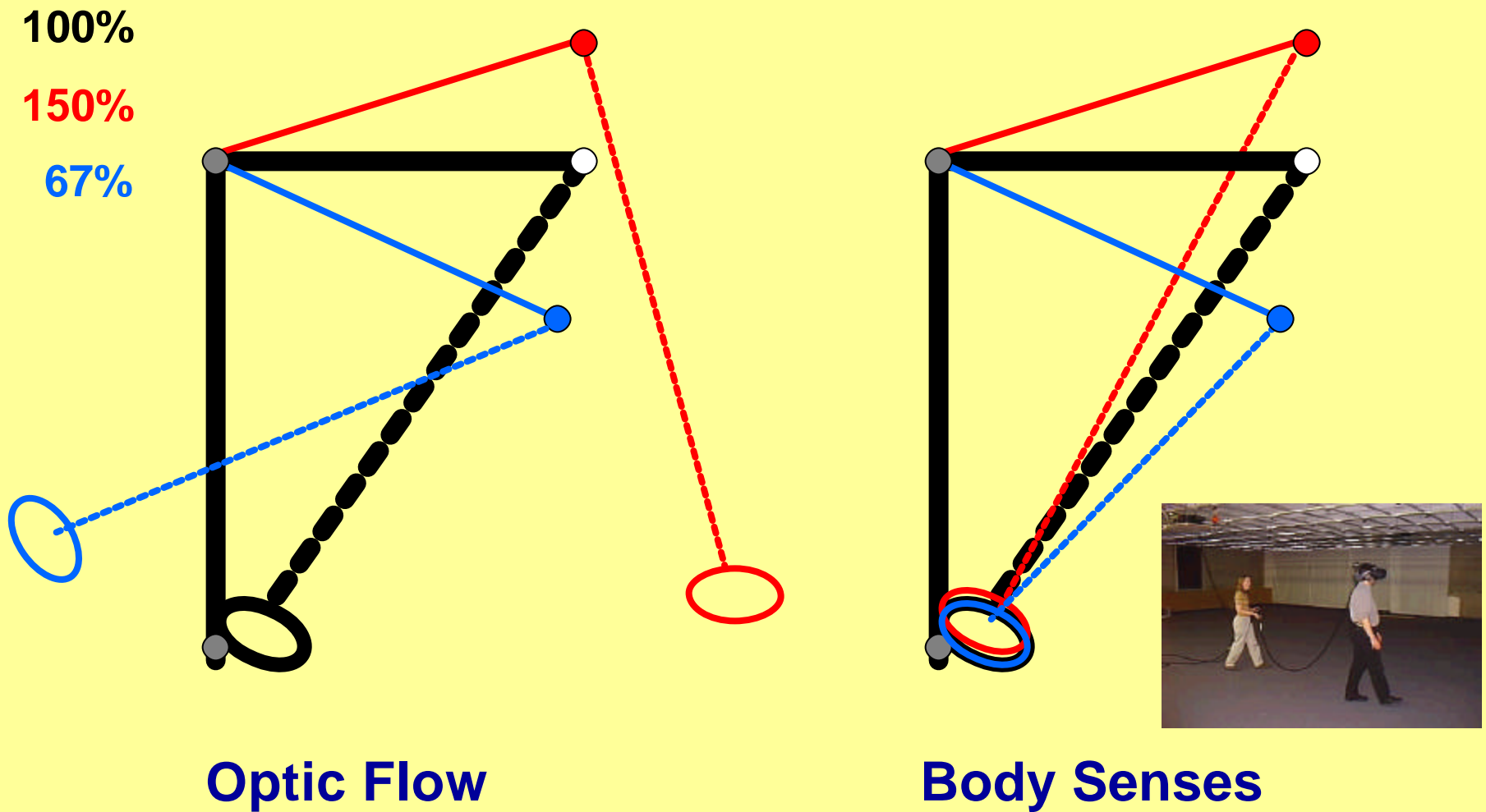
Results: Virtual Space



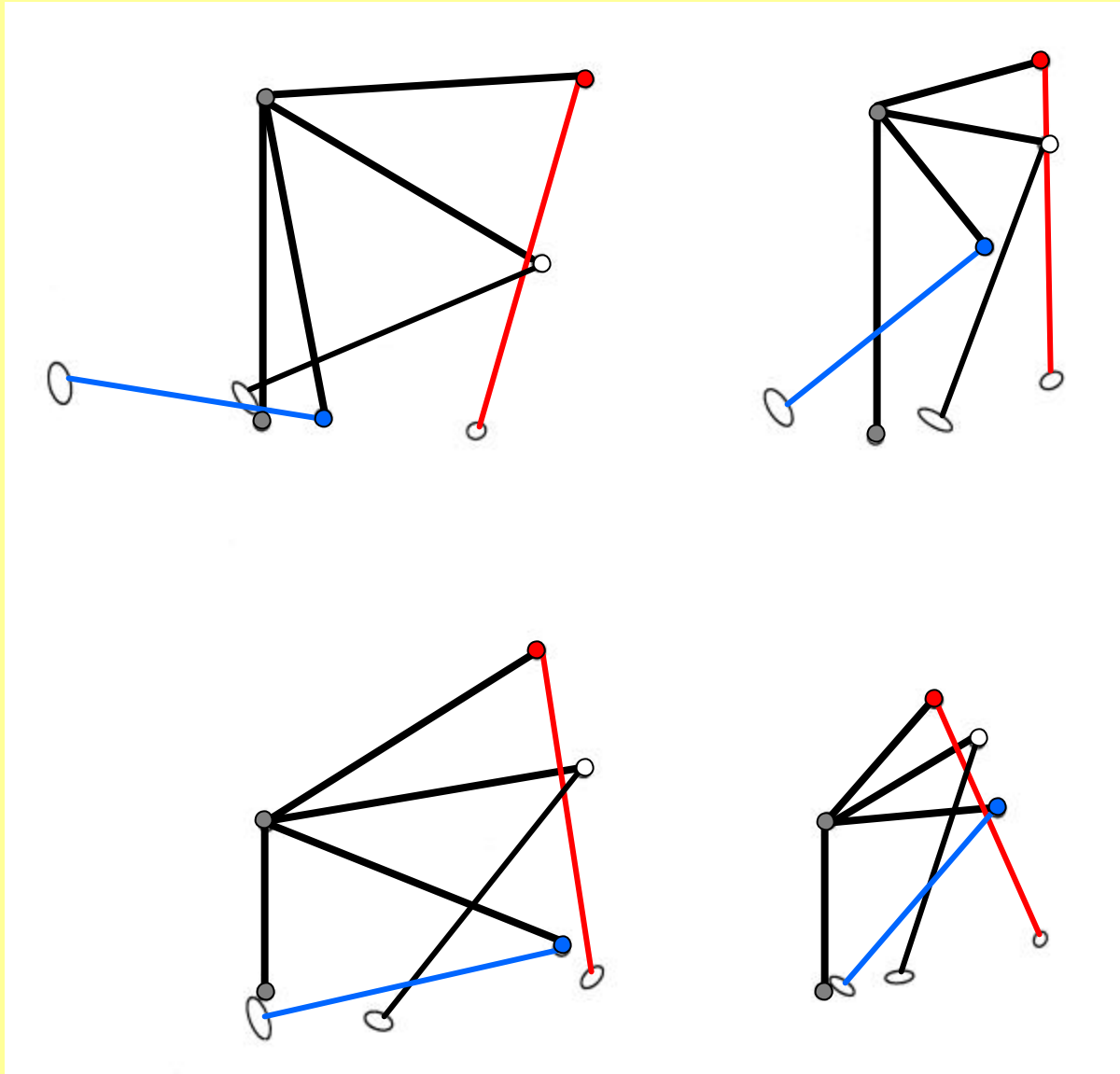
**Looks similar to
Body Senses
predictions...**



Rotation: Predictions in Physical Space



Results: Physical Space



**Looks similar
to Optic Flow
predictions...**

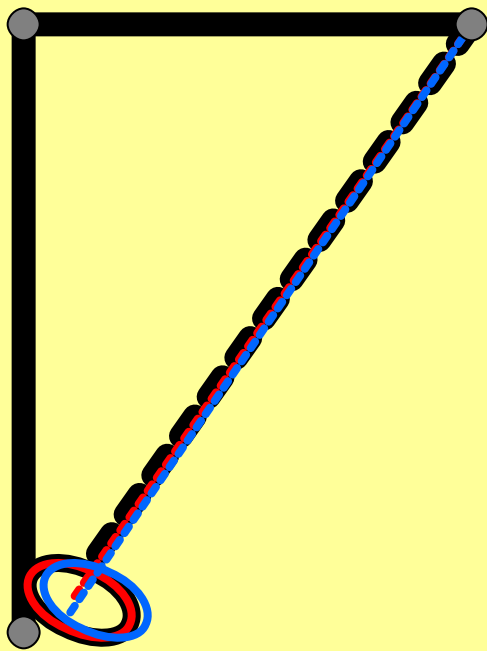


Rotation: Predictions in Virtual Space

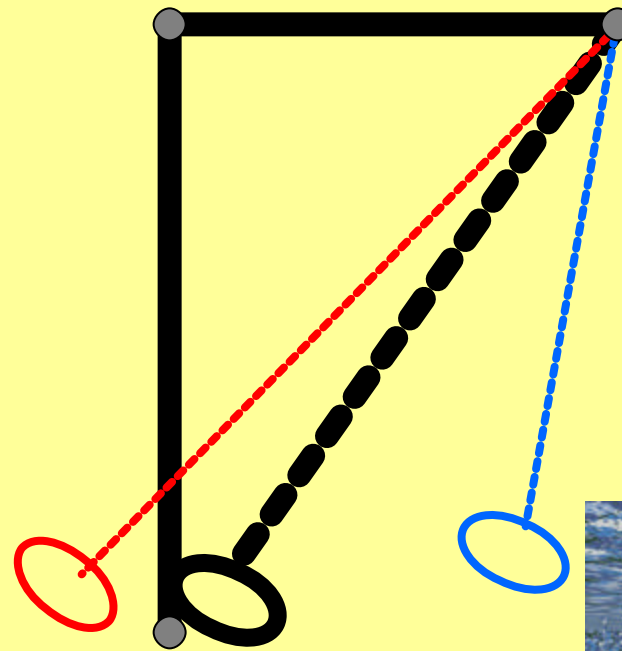
100%

150%

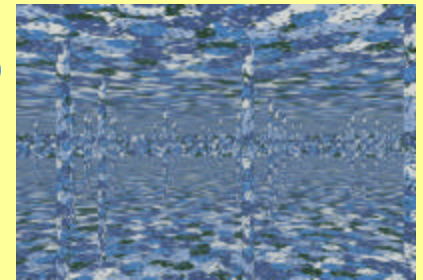
67%



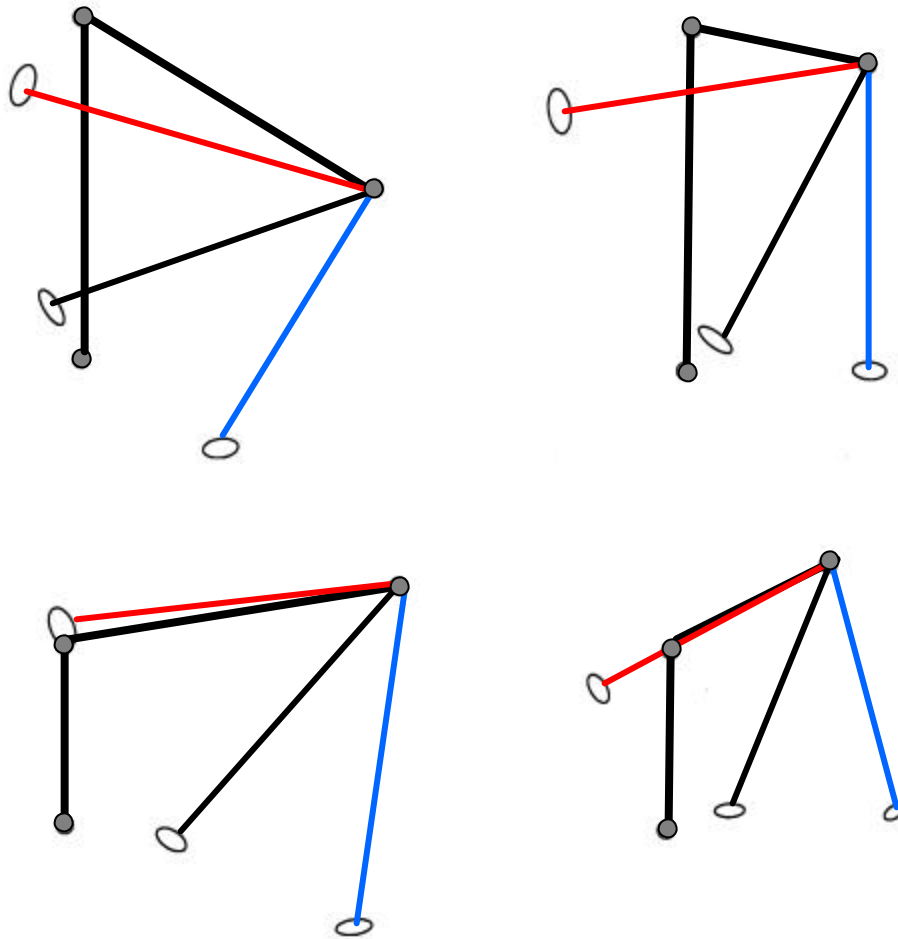
Optic Flow



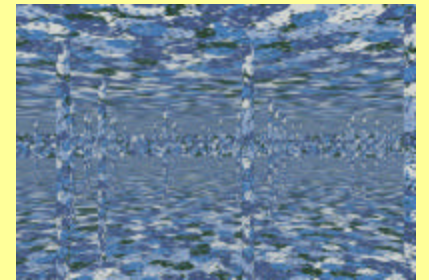
Body Senses



Results: Virtual Space



**Looks similar to
Body Senses
predictions...**

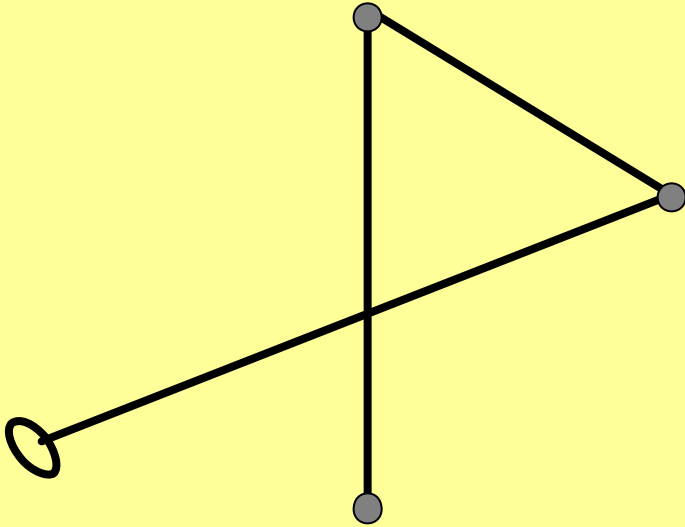


Results

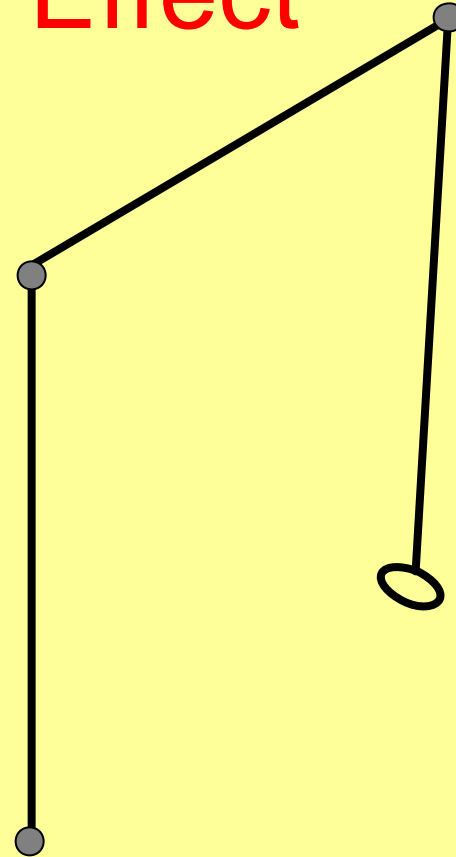
- ↙ **Body senses clearly contribute to path integration**
- ↙ **This is true for both translation and rotation**
- ↙ **It appears that optic flow also contributes to path integration**

But the physical size of triangles covaried with gain

Triangle Size Effect



**Small triangles:
Overshoot**



**Large triangles:
Undershoot**

Results (con't) and Conclusions

- ↙ **Optic flow predictions or triangle size effect could explain results in physical space**
- ↙ **However: body senses, not the triangle size effect explains the data in virtual space**
- ↙ **Information from body senses has a strong role in path integration**
- ↙ **Contribution of optic flow still undetermined**

Current directions...

- ↙ **Rerunning the experiment with the same physical triangles instead of the same virtual triangles to further examine the contribution of optic flow in path integration**