Illusions on Hills: Treading a Slippery Slope

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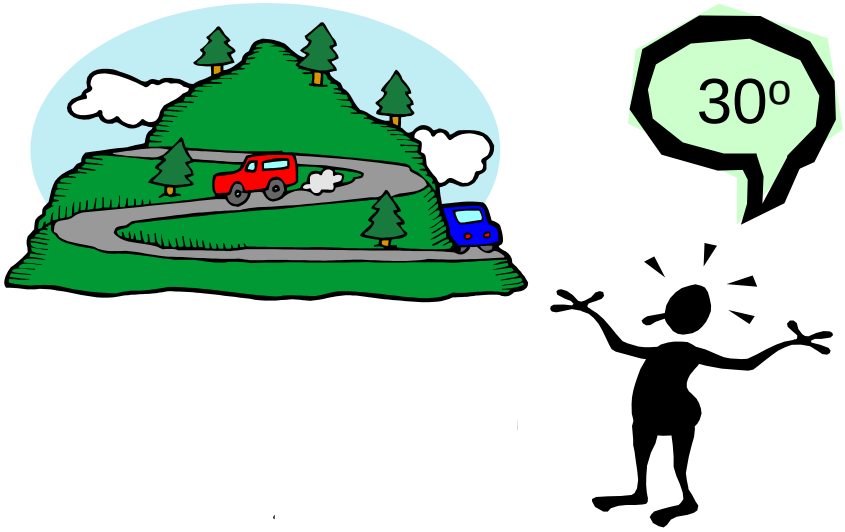
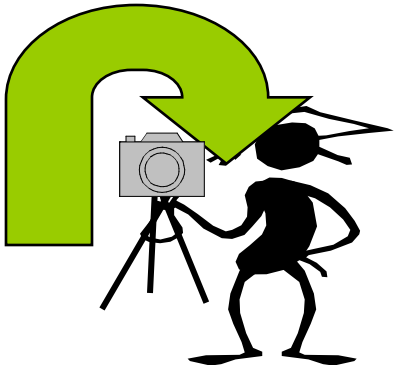
Background

Subjects overestimate slopes with a verbal measure:



But they are more accurate With a motor measure:



(arm matches slope of hill)

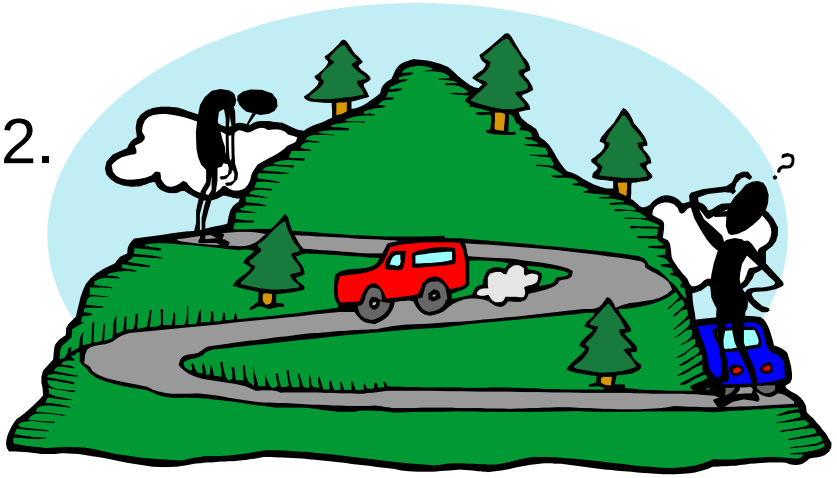
Reference:
Proffitt, D., R., Bhalla, M., Gossweiler, R., & Midgett, J. (1995) Perceiving geographical slant. *Psychonomic Bulletin & Review, 2,* 409-428.

Two Hypotheses

1.

The brain handles near space (within arm's reach) differently than far space. Do motor/perceptual mismatches occur in near space?

2.



Long climbs require more effort than short ones. Does perception warn us about this?

Methods

Tired, old-fashioned method

VR

[Virtual Reality]

The next big thing

GR

Genuine Reality

Method - Experiment 1

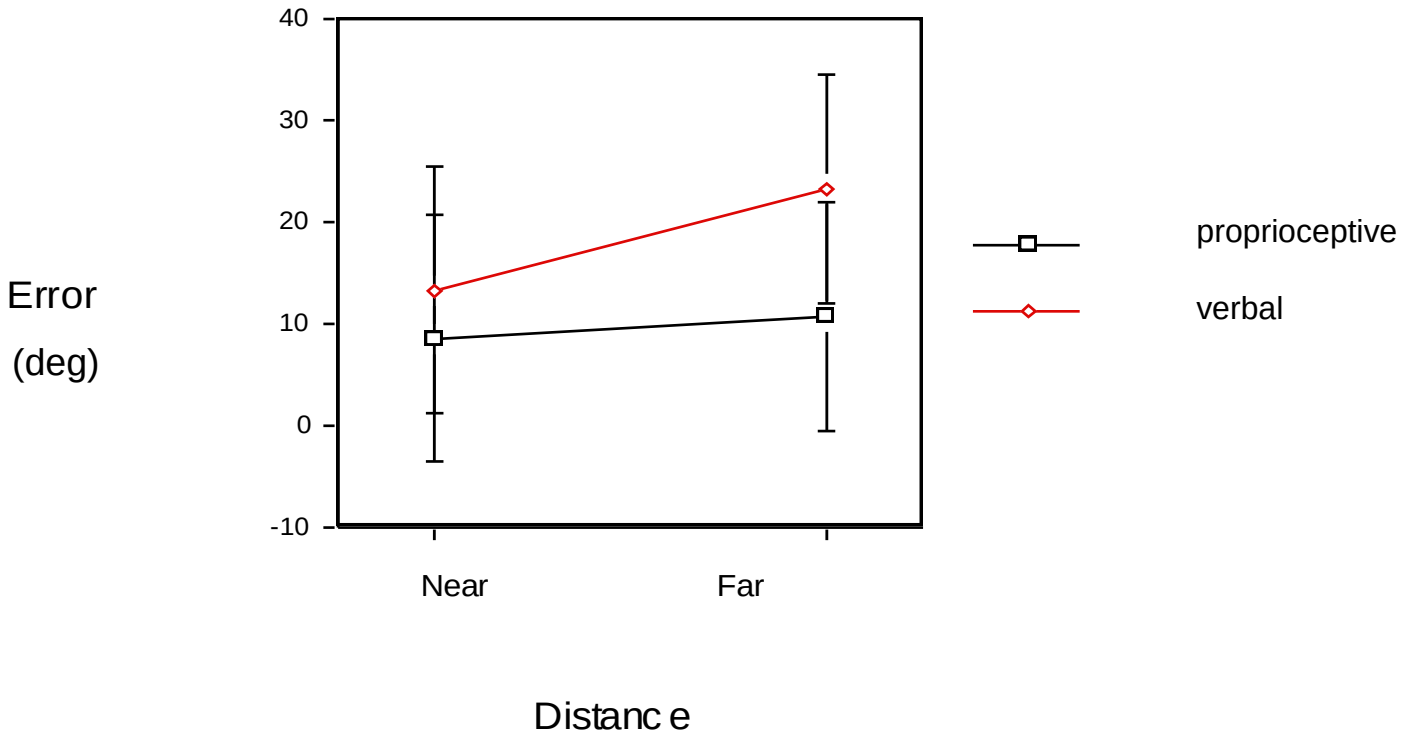
- Observers estimate the slopes of 4 campus hills.
  - Verbal estimate in degrees: 0º = flat, 90 º = vertical
  - Motor (proprioceptive) estimate: match slope with forearm

Method - Experiment 1

real slopes 6º, 9º, 10º, and 12º
2 paved, 2 unpaved

Results - Experiment 1

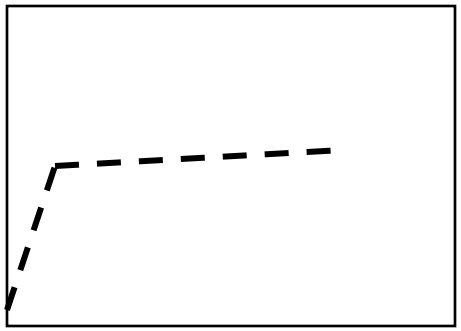
Slope Estimate Errors



Two Theories

1. Near space is handled by distinct neurological machinery.

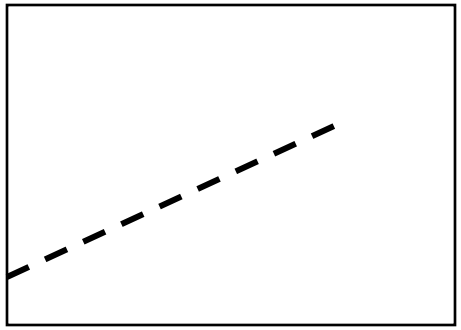
   Prediction: perceived slope vs. distance function should have a nonlinearity at the edge of personal space.



distance

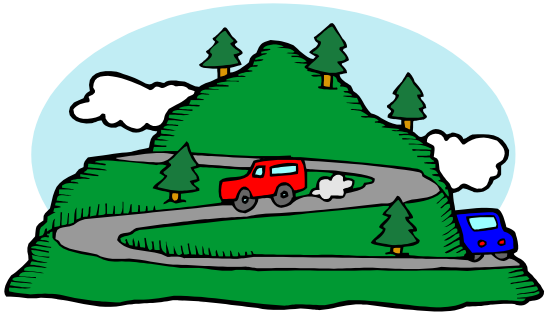
2. Perceived slope may depend partly on predicted effort required to reach the far point.

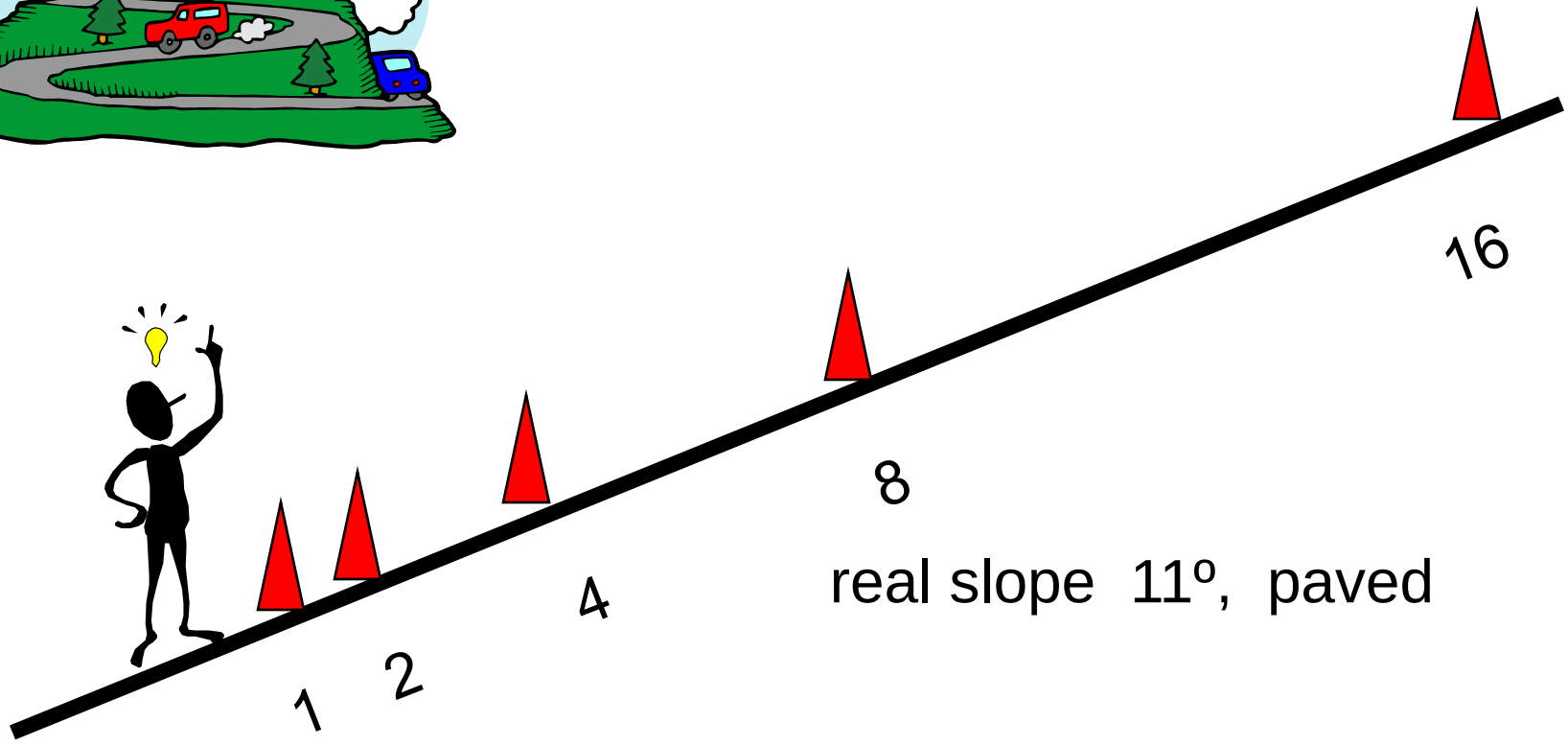
   Prediction: perceived slope should increase linearly.



distance

Method - Experiment 2

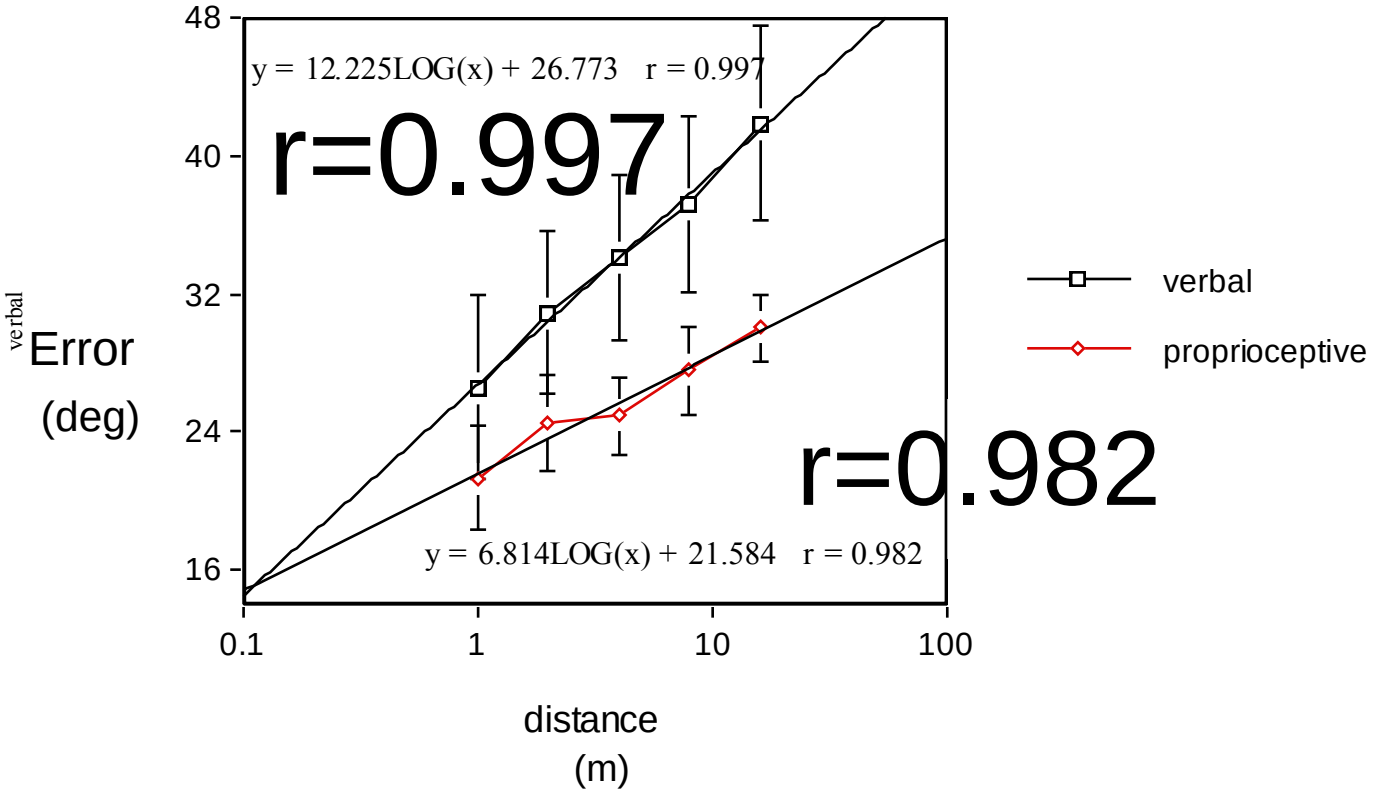




real slope 11º, paved

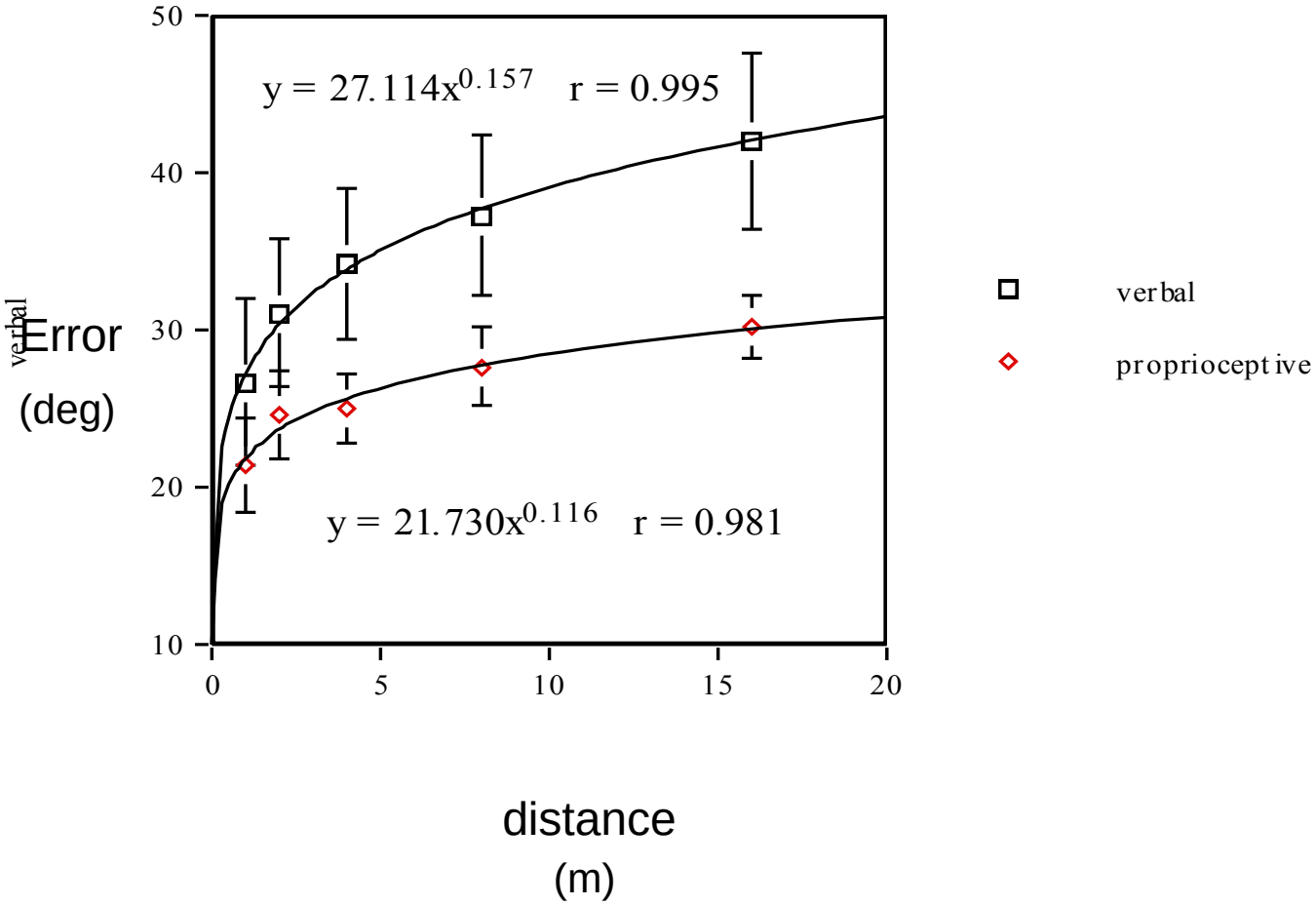
Results - Experiment 2

Logarithmic fits



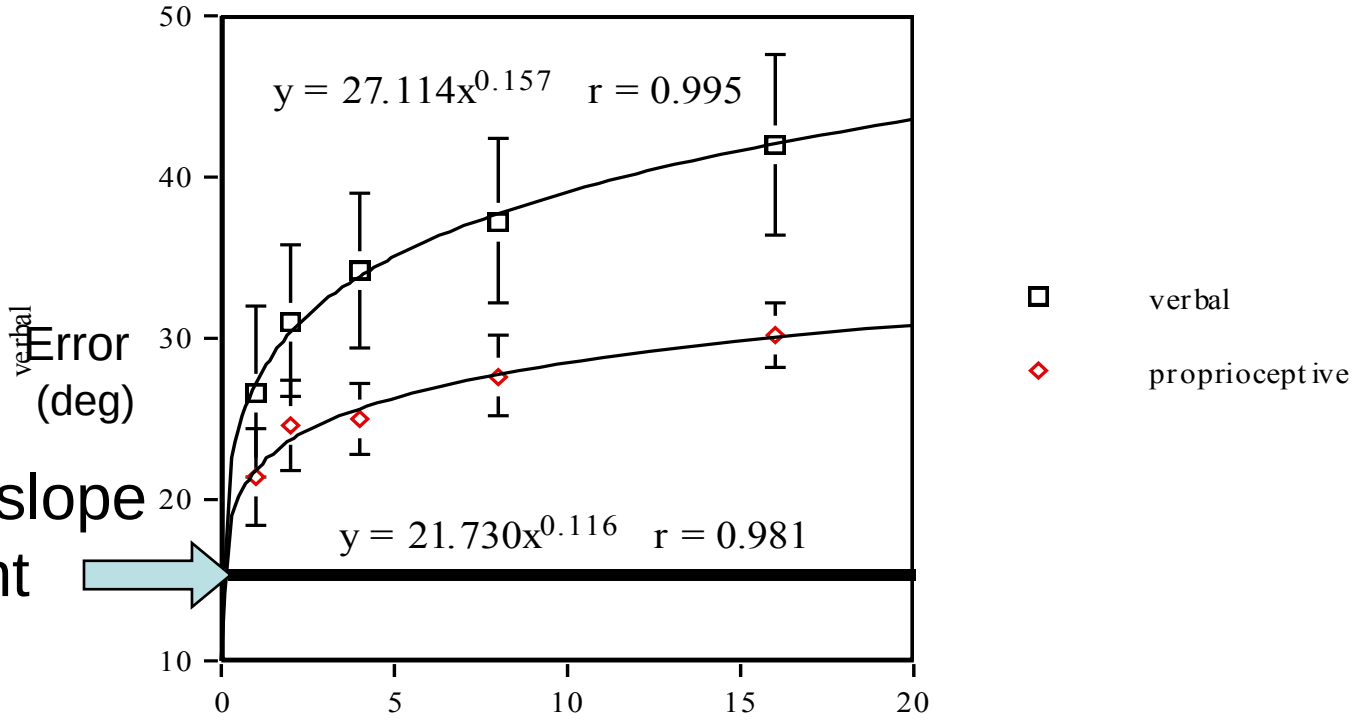
Results - Experiment 2

Power Function Fits



Method - Experiment 3

Power Function Fits

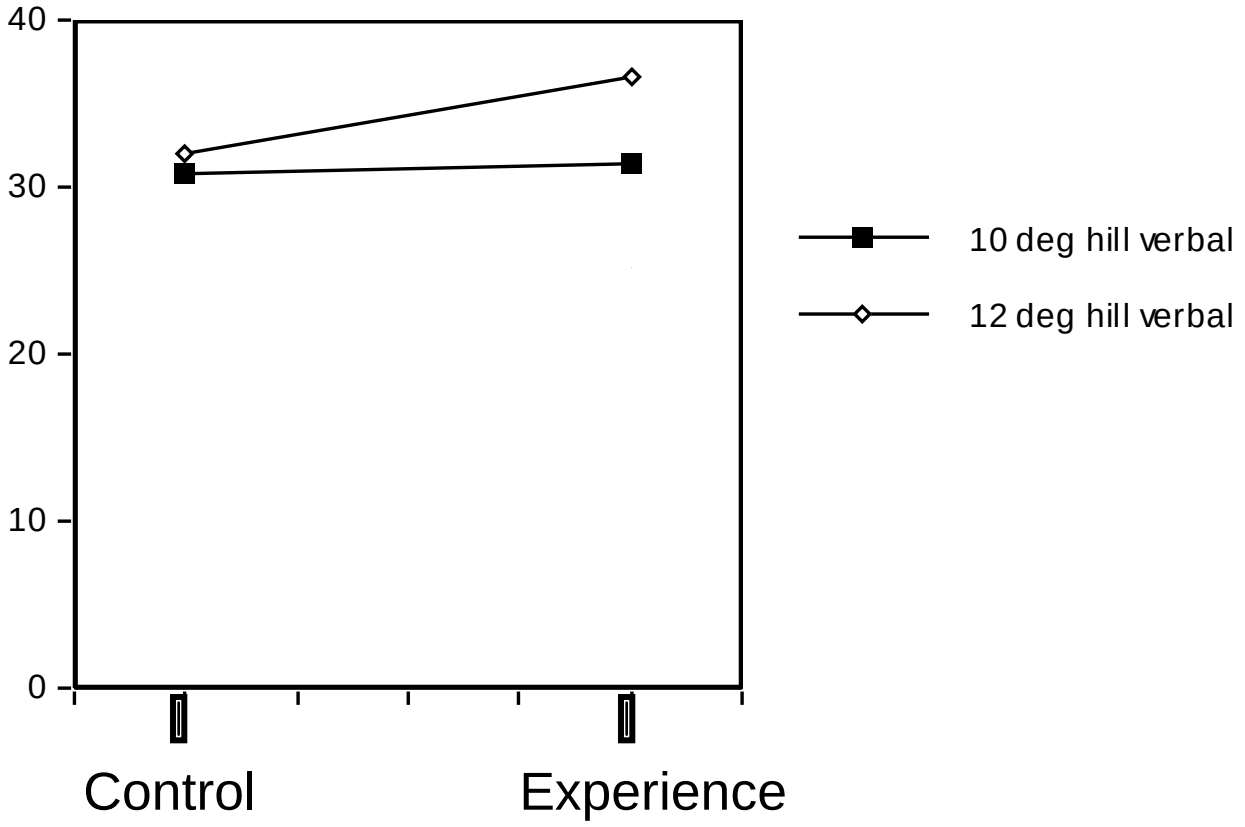


Put entire slope at this point by walking the hill

Method - Experiment 3

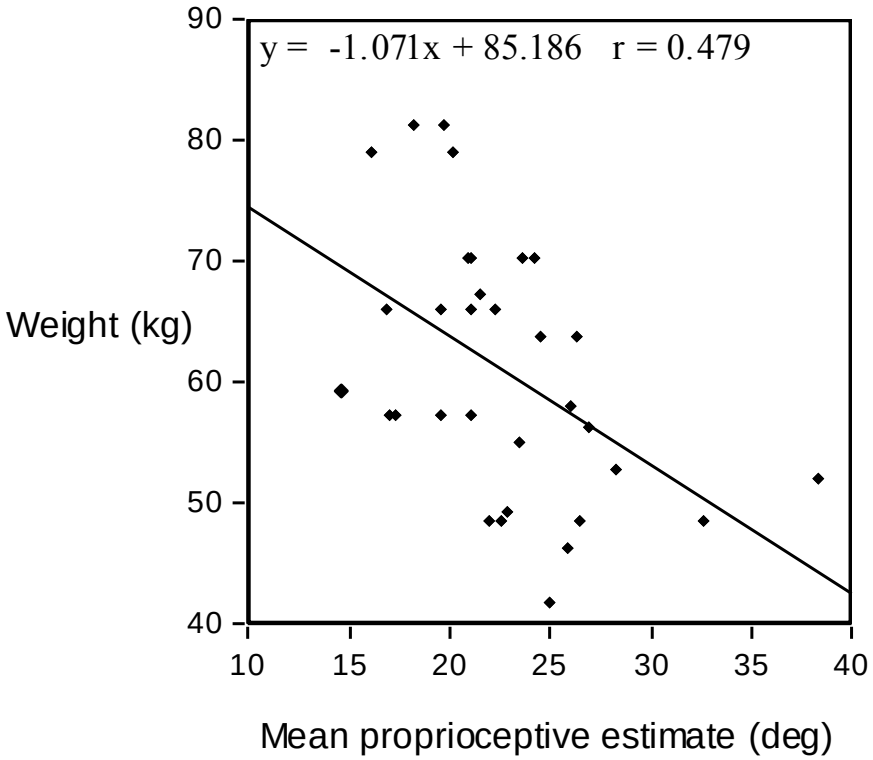
Results - Experiment 3

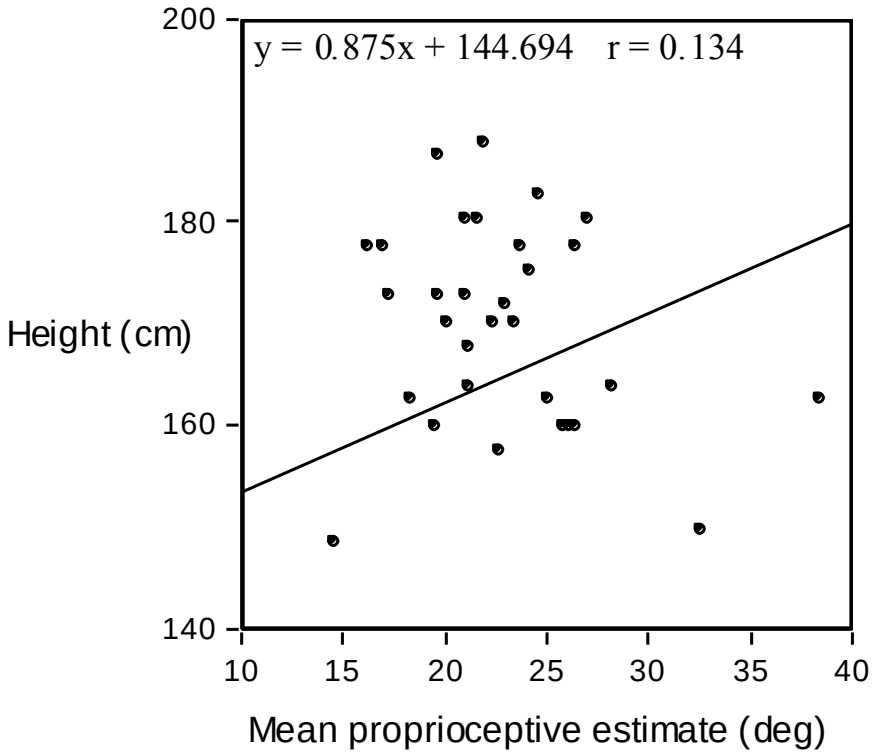
slope estimate (deg)



ers

Results - Experiment 3

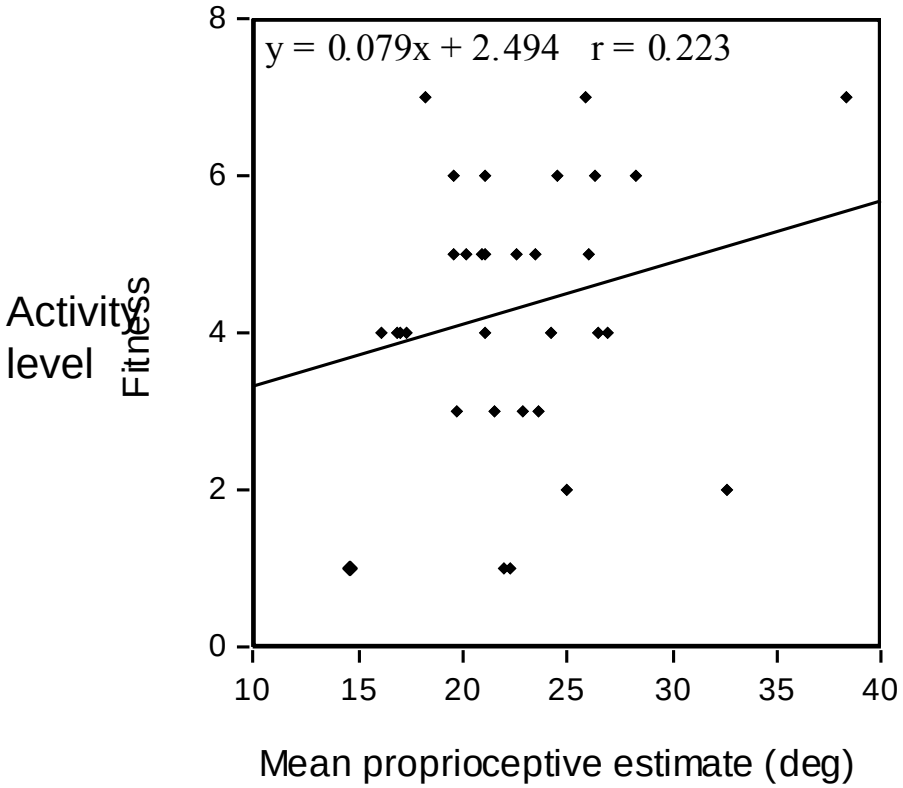




$r^2 = 0.23$

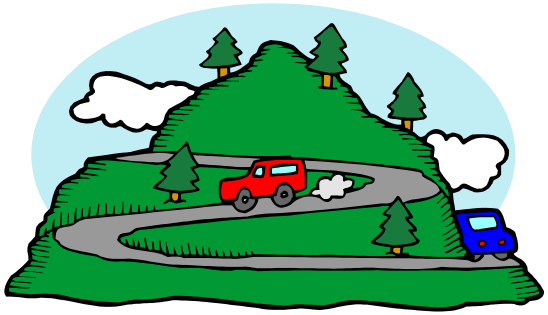
$r^2 = 0.02$

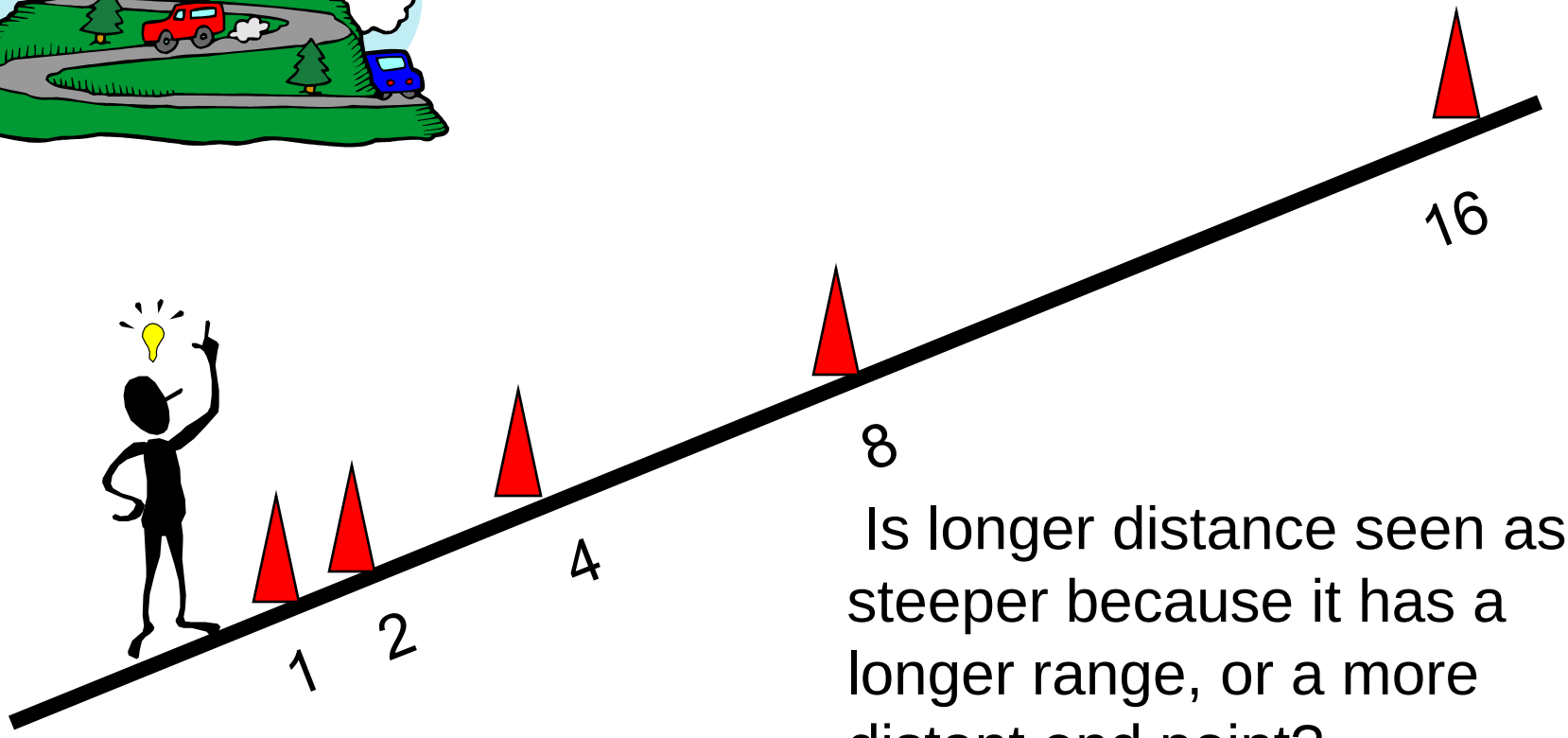
Results - Experiment 3



$r^2 = 0.05$

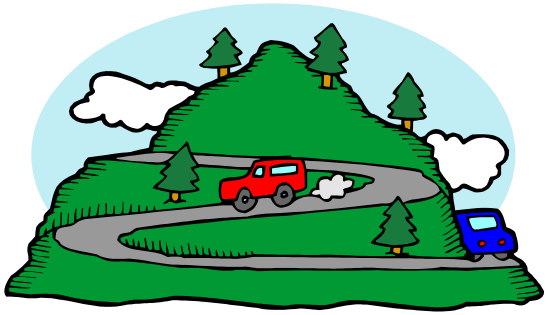
A Complication

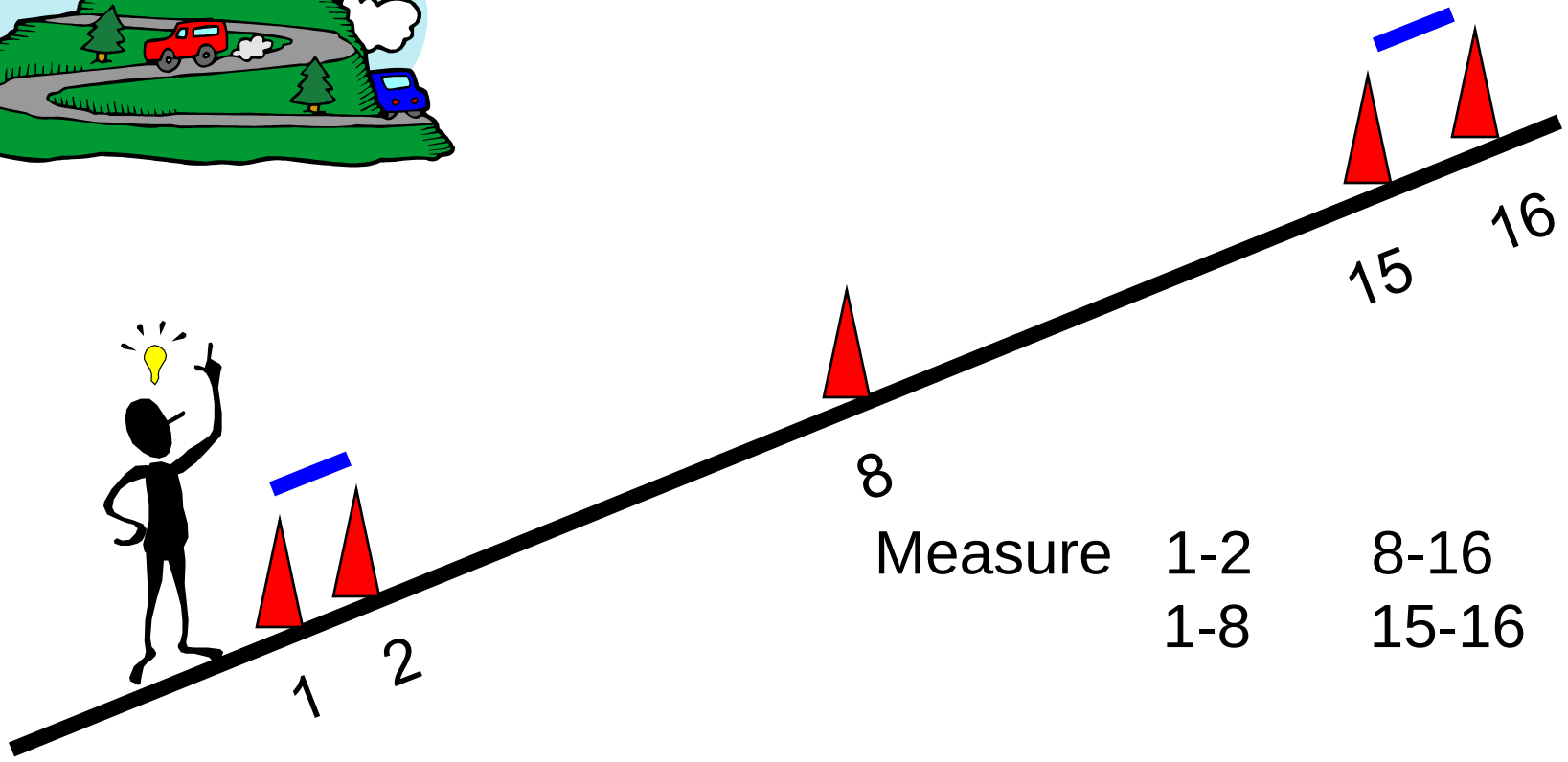




Is longer distance seen as steeper because it has a longer range, or a more distant end point?

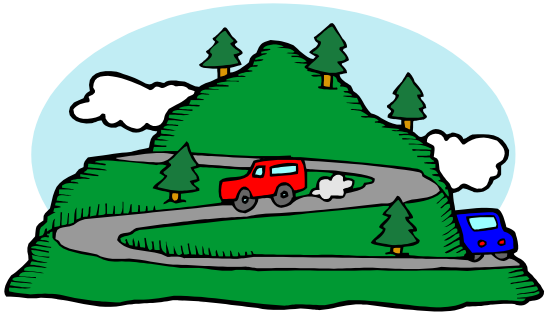
Experiment 4 - Range vs Endpoint

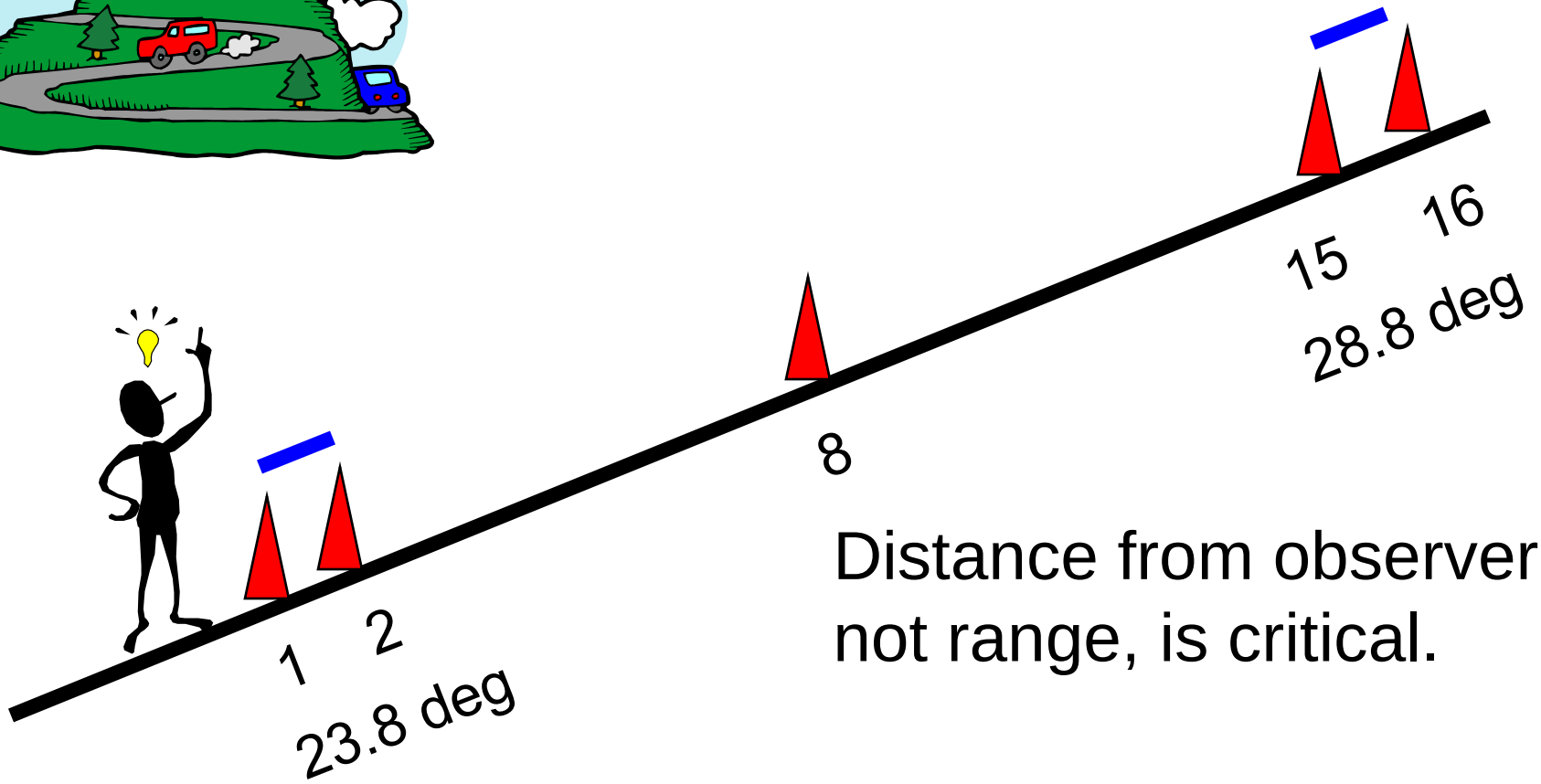




Measure	1-2	8-16
	1-8	15-16

Experiment 4 - Results





Distance from observer, not range, is critical.

Discussion

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

From

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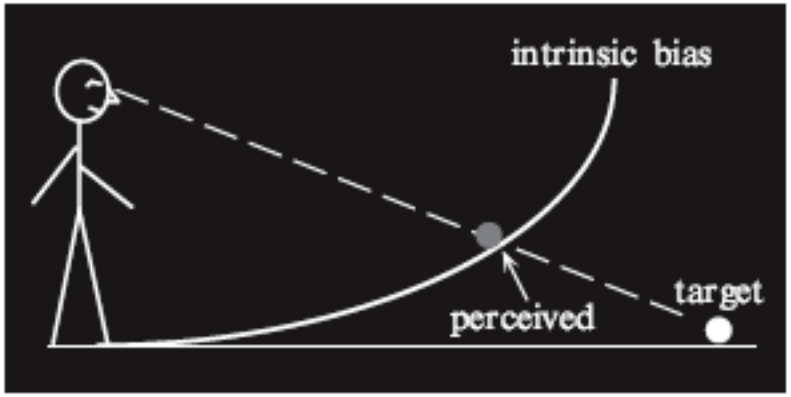
Discussion

Ooi, Wu & He (2006) find an ‘intrinsic bias’ in darkness, measured as misperceived distance; angle is veridical. Error increases with distance.



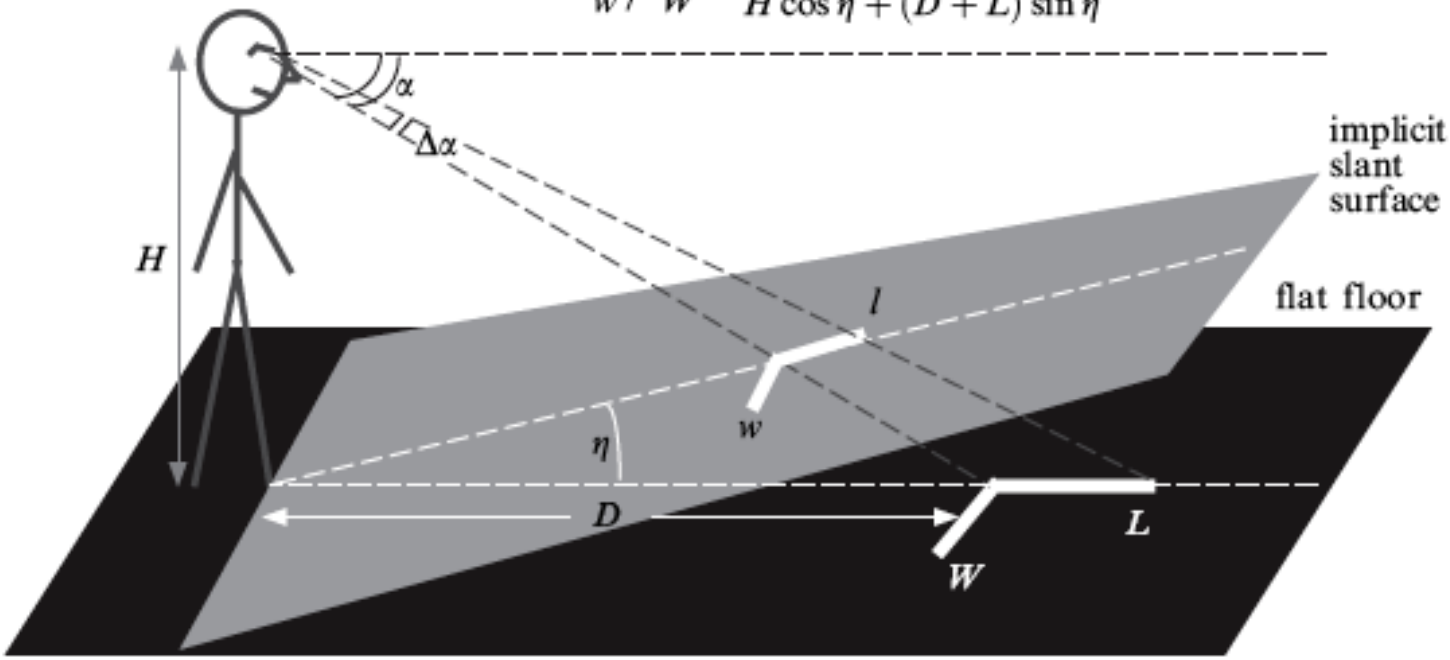
Perception, 2006, volume 35, pages 605 – 624

Discussion

See L-shaped figure in darkness; *l* adjusted to match *w*. Shows that surface is really perceived as sloped.

Judged Aspect Ratio/Physical Aspect Ratio

$$\mathrm{RAR} = \frac{l}{w} \Big/ \frac{L}{W} = \frac{H}{H\cos\eta + (D+L)\sin\eta}$$



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Conclusions

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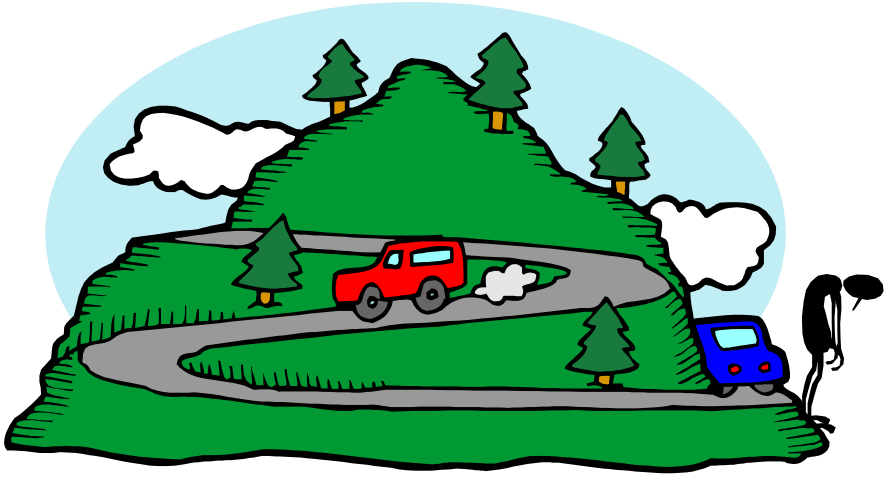
3. Both measures follow log/power functions of distance.
4. Compression of perceived space cannot account for the result.
5. Loss of horizontal calibration on a slope might allow influence of intrinsic bias at longer ranges.
6. Experience does not change the result.



The End