Prospective uncertainty: The range of possible futures in physical predictions

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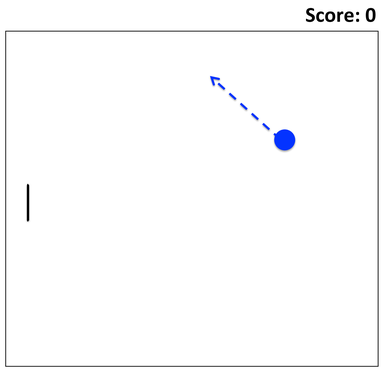
Introduction

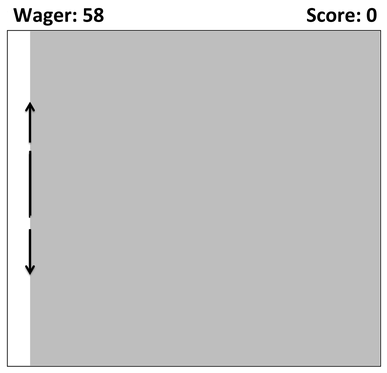
- Physical prediction is well explained as accurate extrapolation of an uncertain, probabilistic world (Battaglia et al 2013, Smith & Vul 2013)
- Implies that people form a probability distribution over possible future states
- Can people reason about the uncertainty captured in these probability distributions?

Task

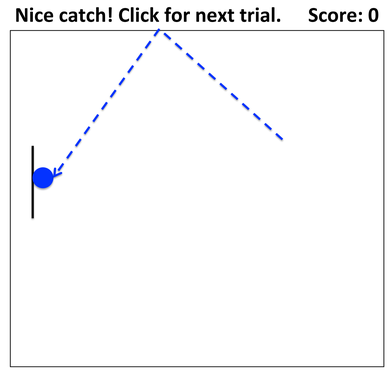
Observe initial motion



Predict motion & set paddle length



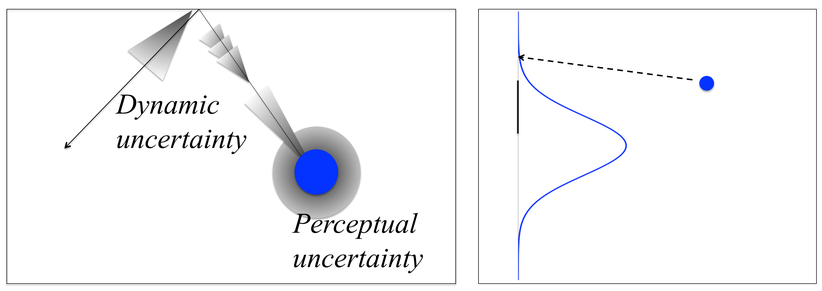
Observe actual path



- N = 43
- 450 trials / participant
- Measures:
  1. Predictions (paddle position)
  2. Uncertainty (paddle length)

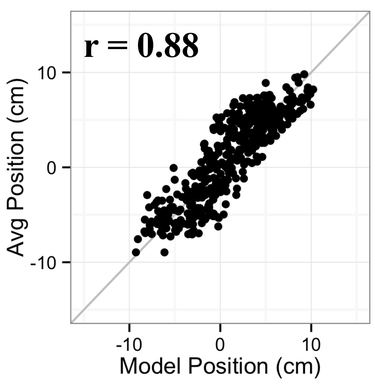
Prediction model

Physical forward model + Center expectation

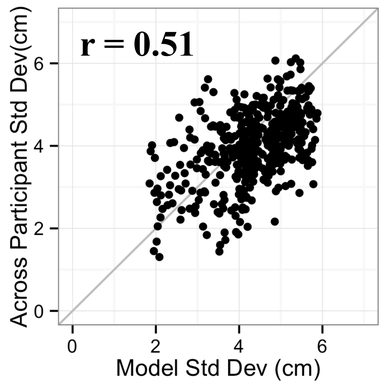


Smith & Vul (2013)

Explains predictions

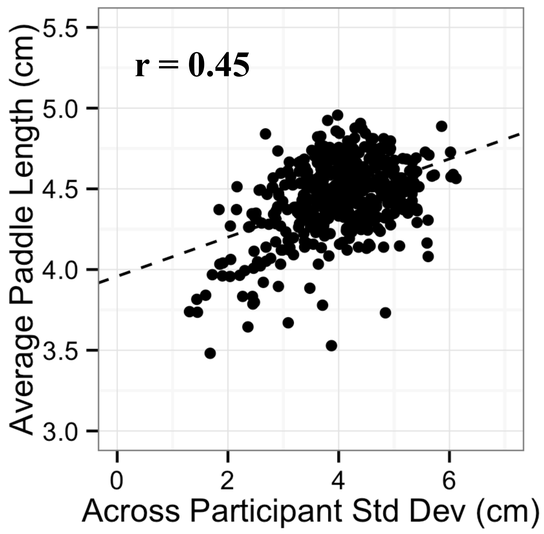


Explains variability

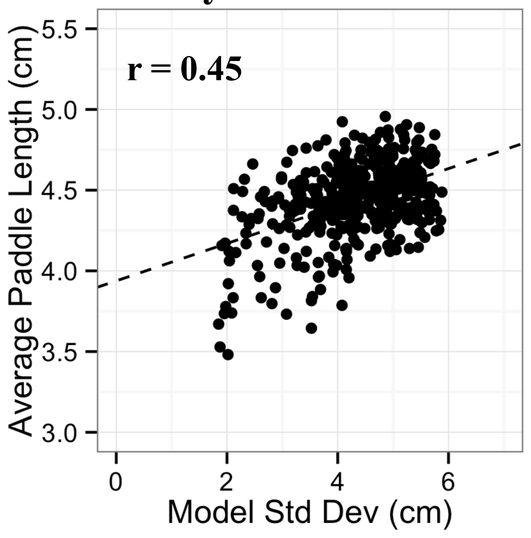


Results

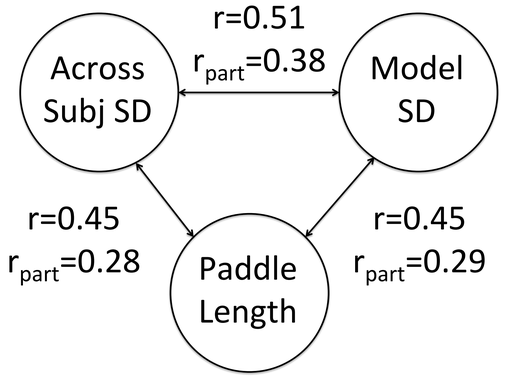
1) By-trial uncertainty relates to variability in predictions



2) Model explains by-trial uncertainty well



3) Uncertainty explained in part by both measures



All ps << 0.001

Discussion

- Explicit measures of uncertainty track estimates of how much uncertainty people should have
- Suggests that people have and use probabilistic distributions over where objects might go
- Both estimates of uncertainty capture different facets of peoples' uncertainty