Modeling Part
Summer School on Modeling

Philosophy of the School

- We expect homogeneous learning outcomes for the conceptual s
  - irrespective of part knowledge
- We accept heteroge for the technical str
  - some people will m
  - this is difficult to av heterogeneous bac

We encourage peer-assisted learning

If we are here, we are available (even if we appear to be busy)

Interaction with mentors: Start at 3pm today

Computational Modeling							
				Track 1	Track 2		
12	Tue.	3	AM	Overview and Principles of Modeling		Ch. 1, 2 F&L	SL, JJ
			PM	From Verbal Theories to Computational Models		Ch. 1, 2 F&L	KO, MN
			3 PM	Project Time: Meet with Supervisors			All
13	Wed.	4	AM	Parameter Estimation, From Basics to Maximum Likelihood		Ch. 3, 4 F&L	GB, CL, LF
			PM	Parameter Estimation & Maximum Likelihood Exercises: Memory and Judgment/Decision-Making Models			GB, CL, LF
			4 PM	Project time			All
14	Thurs.	5	AM	Model Selection and Drawing Inferences from Models		Chapter 10 F&L	CD & SL

Overview for Today (Tuesday)

Time	Instructor	Topic
9:00 – 10:45	Stephan Lewandowsky	why models? inside a simulation
10:45 – 12:00	Jana Jarecki	scope, falsifiability, explanations, some terms
12:00 – 1:00	Klaus Oberauer	from models to instantiations
1:00 – 2:00		lunch
2:00 – 3:30	Michael Nunez	from models to instantiations
3:30 – dinner	All	meet mentors and discuss projects
6:30		dinner

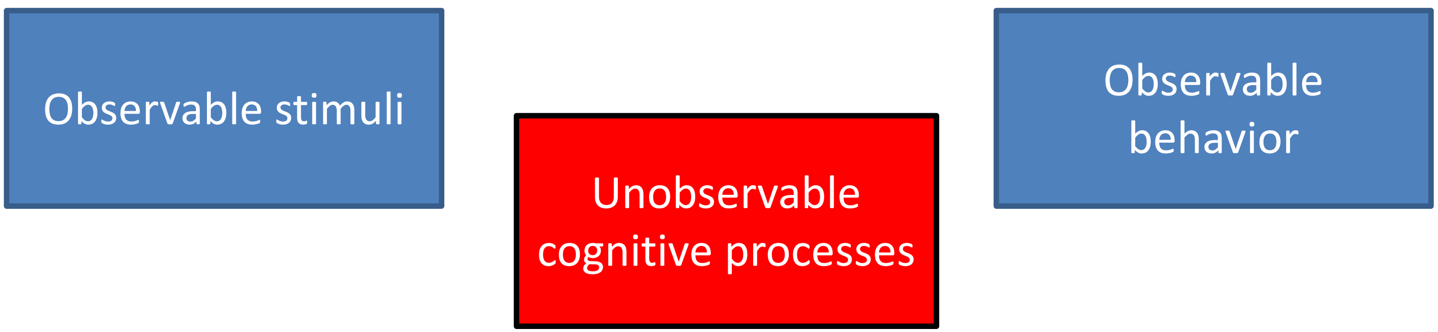
Yes, there will be breaks

Why Models?

Why *Computational* Models?

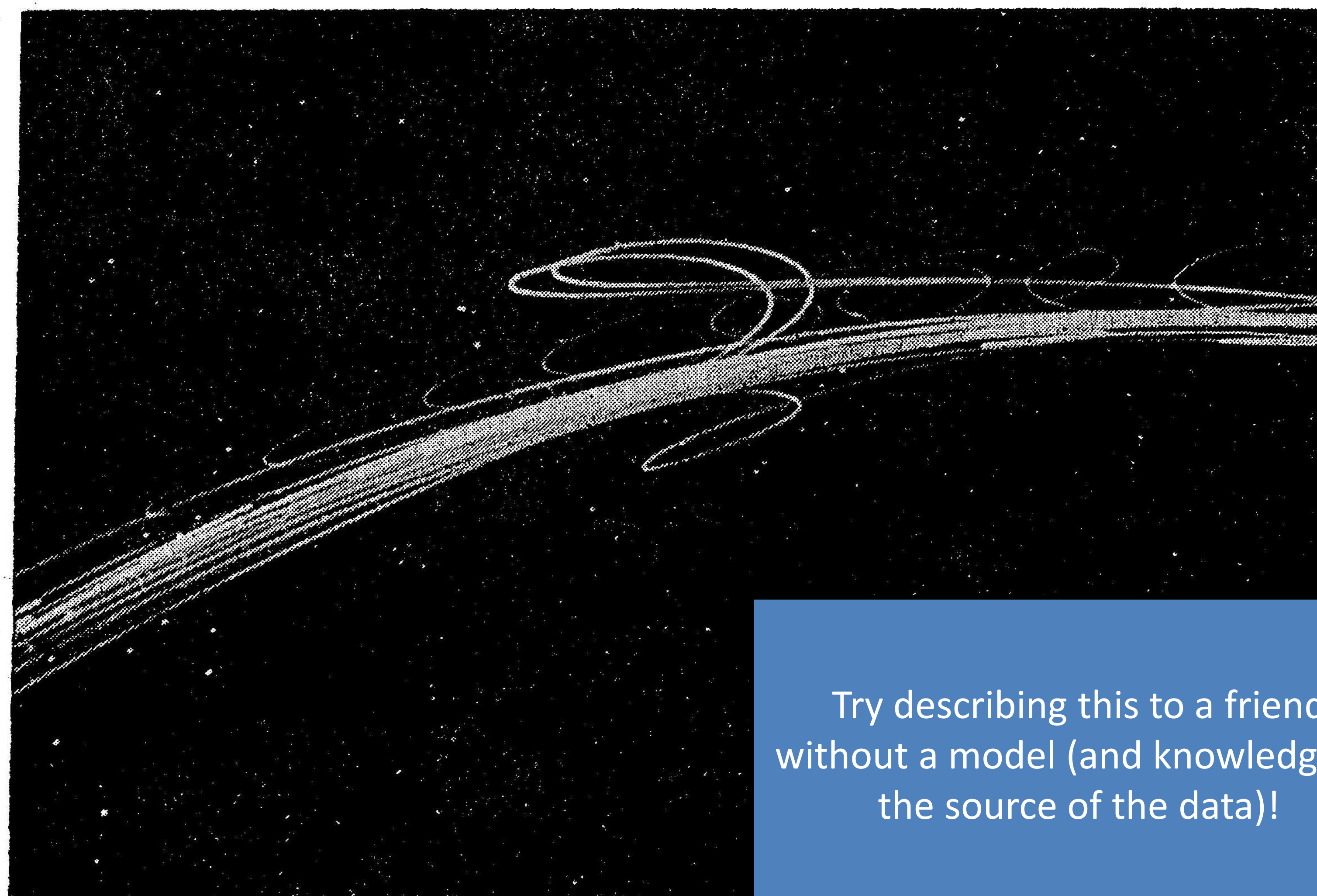
Why Cognitive Science?

- We seek to understand how the mind works



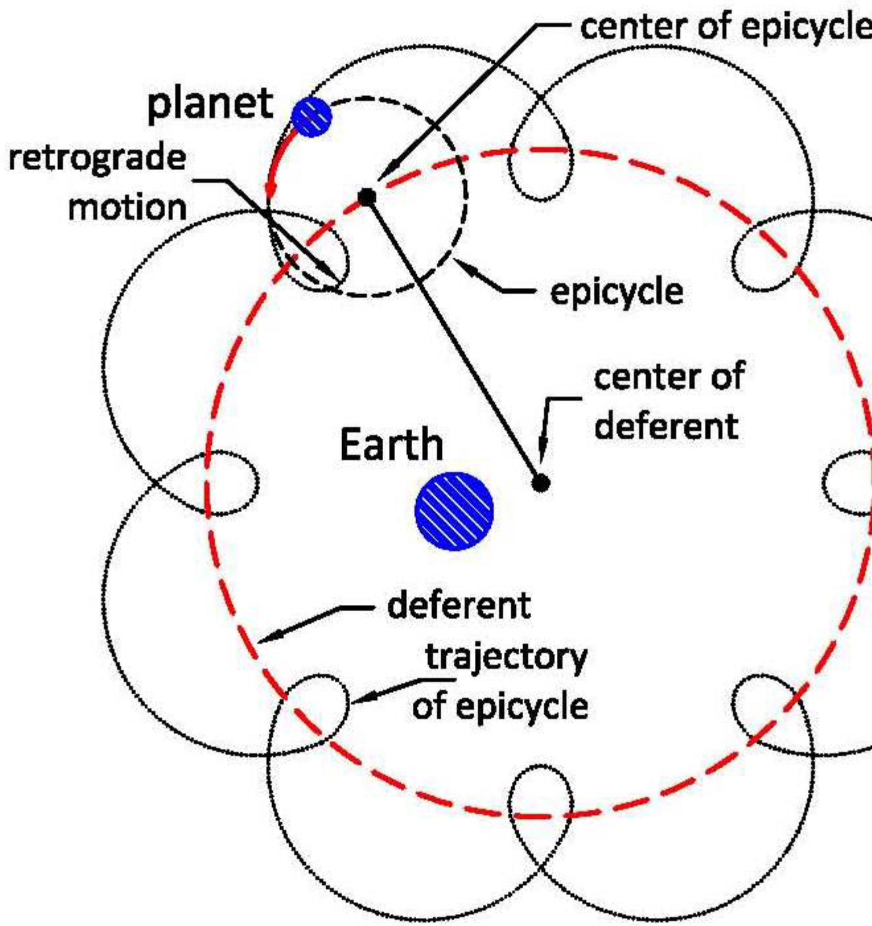
- Models are indispensable
- Nothing can be understood without a model

A Stellar Example

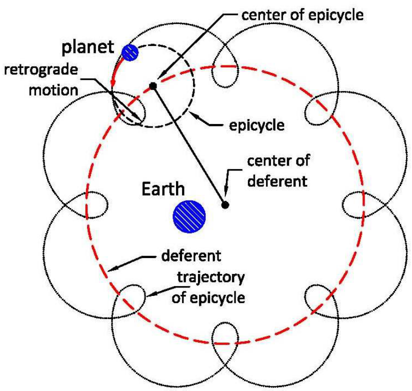


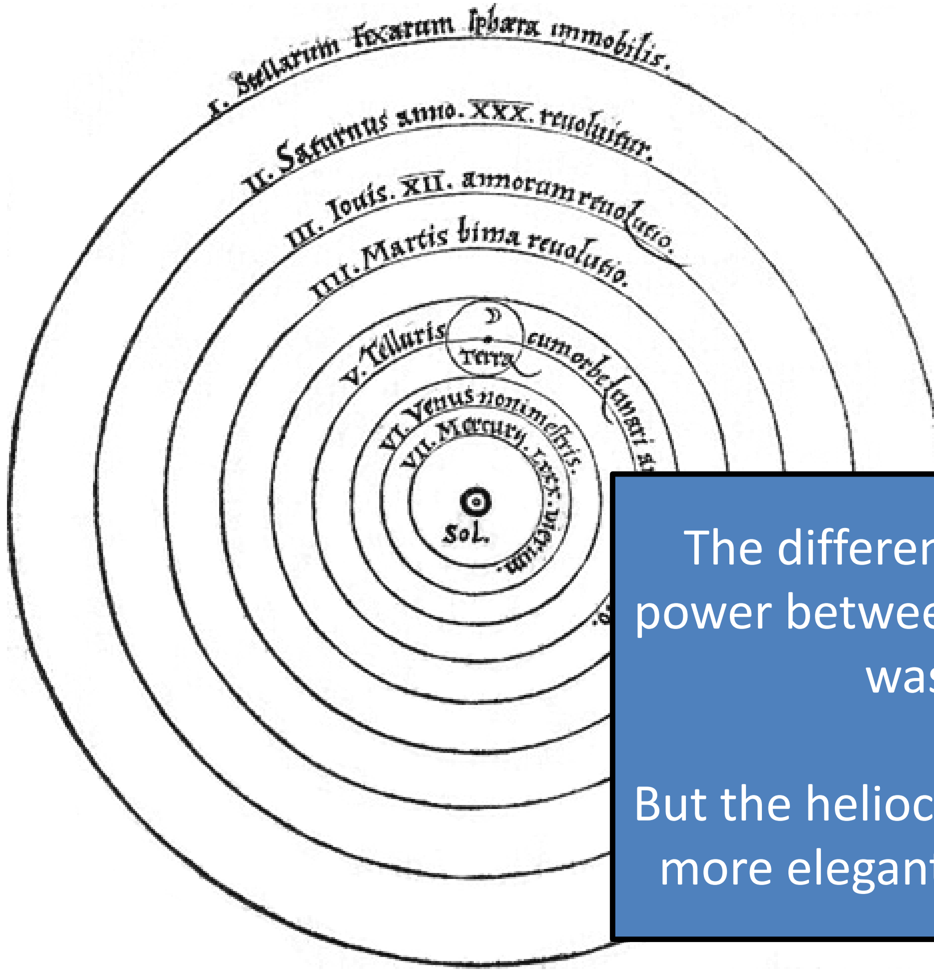
Try describing this to a friend without a model (and knowledge of the source of the data)!

1,300 Years of Modeling ...



… and Modernity





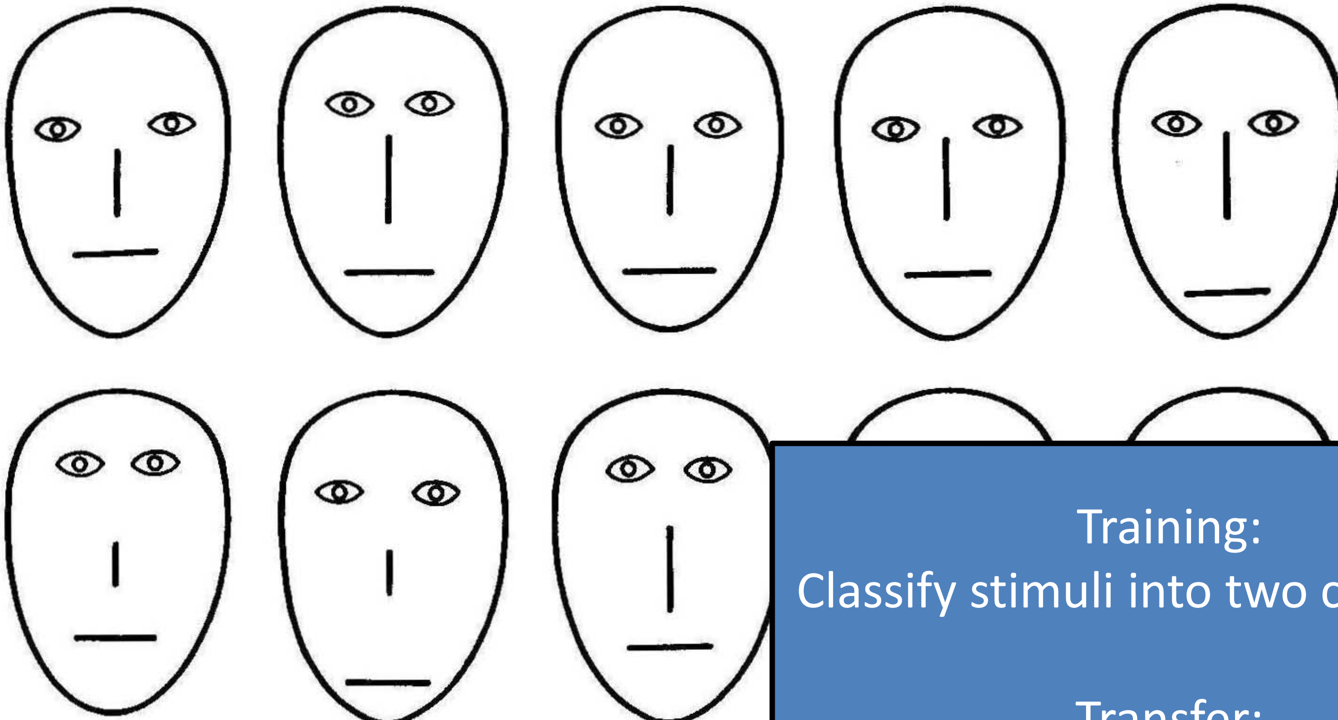
The difference in predictive power between the two models was *slight*!

But the heliocentric model is far more elegant and satisfactory

Conclusions (I.)

- Data never speak for themselves
- Nothing can be understood without a model
- There are always ***multiple possible models***
- Choice between models based on
  - quantitative comparison
  - *and* intellectual judgment

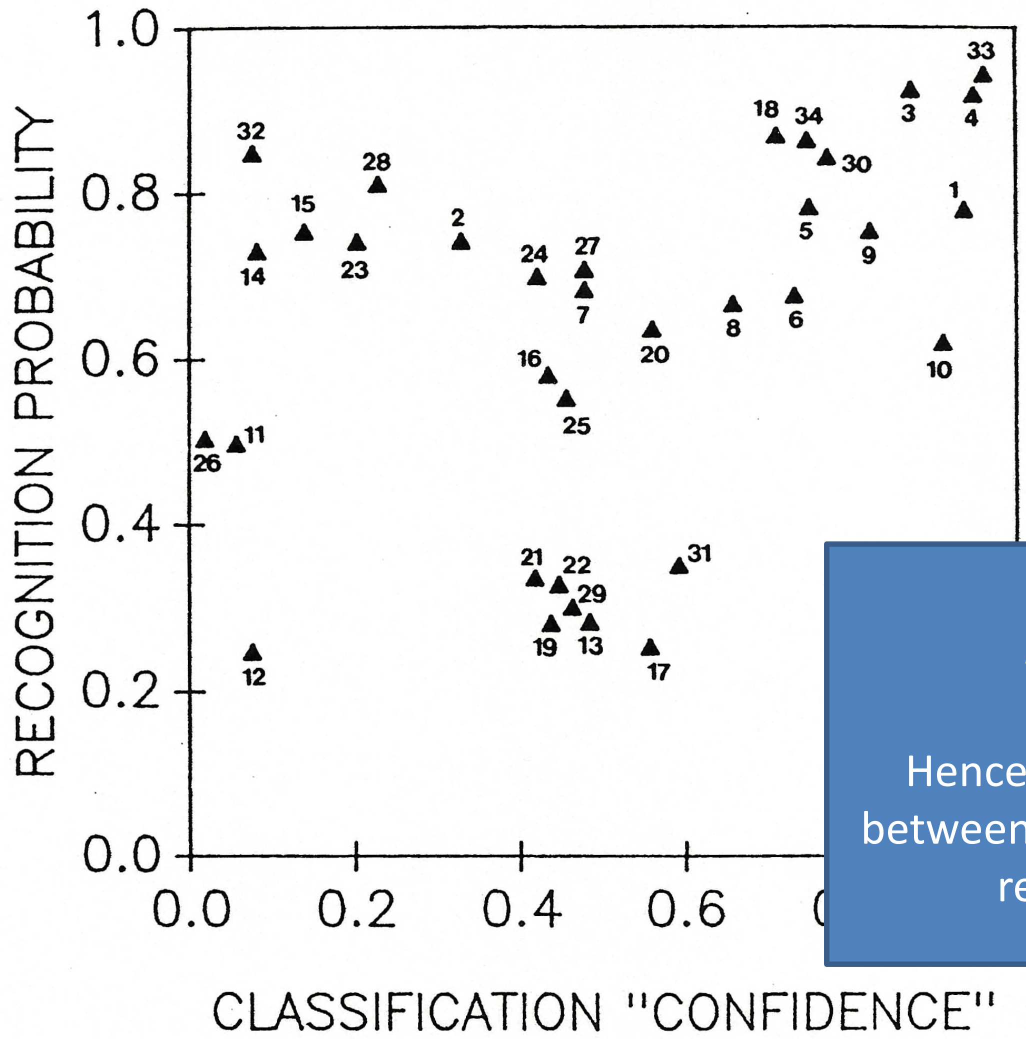
A Cognitive Example



Training:
Classify stimuli into two categories

Transfer:
Classify *and* recognize

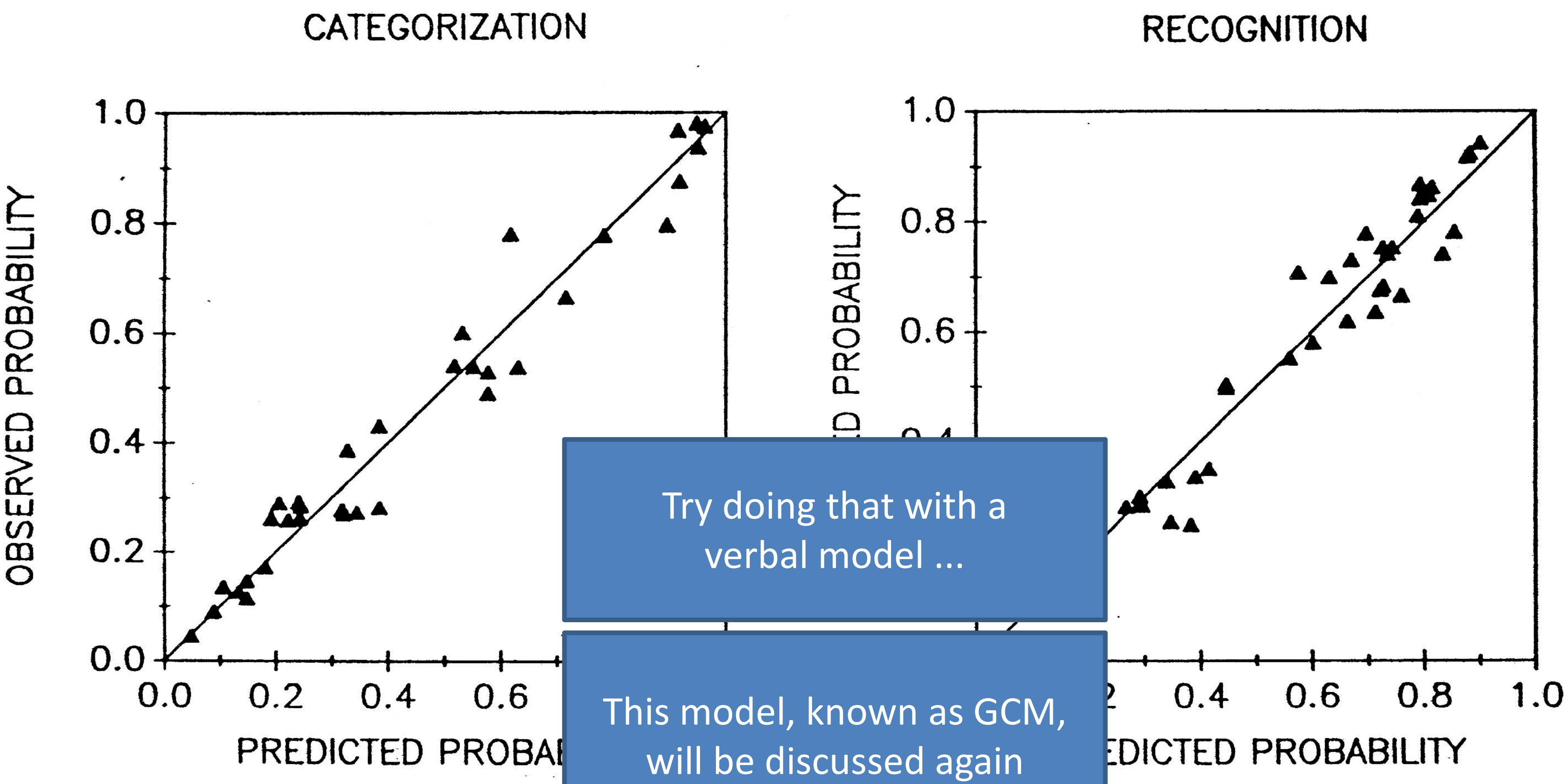
A Cognitive Example



r = .36

Hence no relationship between classification and recognition?

Uncovering a Hidden Relationship



Try doing that with a verbal model ...

This model, known as GCM, will be discussed again

Conclusions (II.)

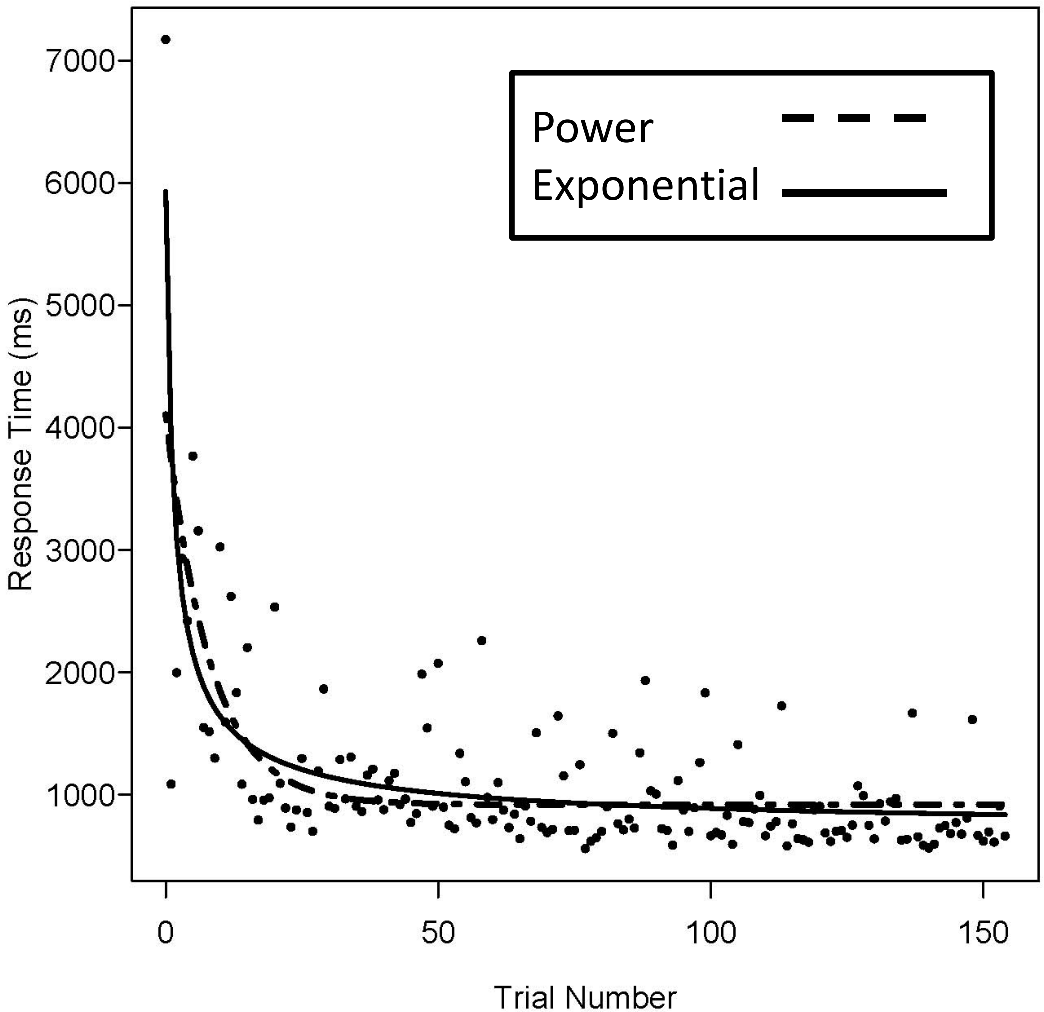
- Computational models can reveal relationships between psychological measures that would otherwise escape detection
- The model then *explains* performance in two disparate tasks
  - psychological model
  - explains rather than just describes data
- But not all models always explain....

Classes of Models

- Data description
  - focuses on data only
  - may have psychological implications
- Process models
  - look inside the "black box"
  - explain

Primary focus

Data Description:
The Case of the "Power Law"



Exponential implies constant relative rate of learning

Power implies reduction in learning rate with practice

Conclusions (III.)

- Data description can have psychological implications
  – "laws" of learning or practice
  – forgetting function
  – utility functions

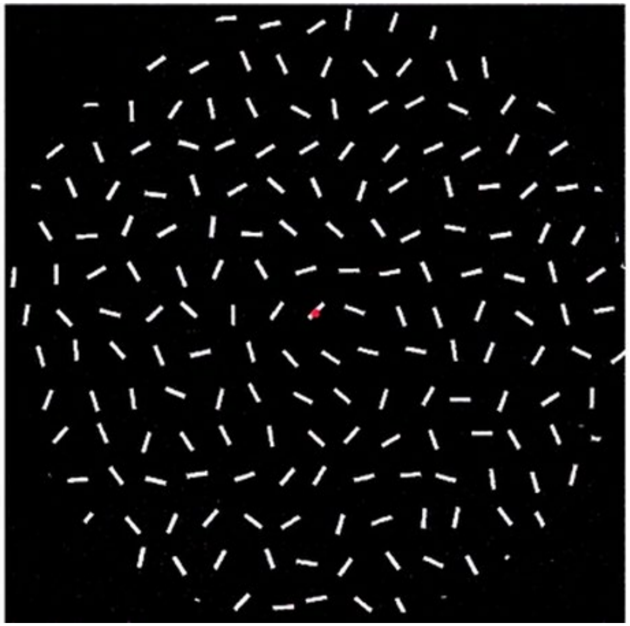
Where Does the Model Come From?

- Suppose we have a verbal theory
- We recognize the limitations of verbal theories
- We seek to instantiate the theory in a computational model
  - this forces us to be explicit about *everything*
  - and many decisions h

Klaus & Michael:
Later today, in-depth look at this process

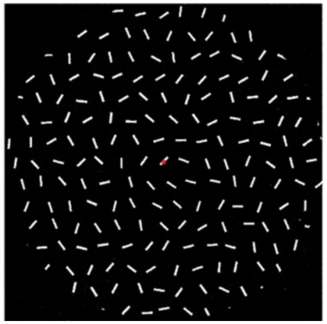
Inside a Simulation

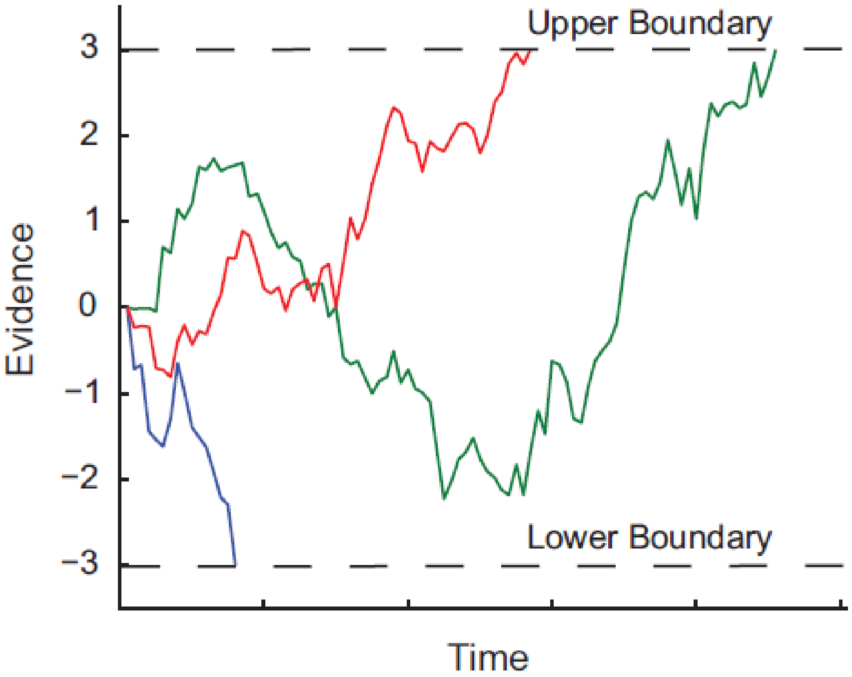
How Do People Make Decisions?



- Account for latencies and accuracies simultaneously
- Sequential sampling models
- “Random Walk”

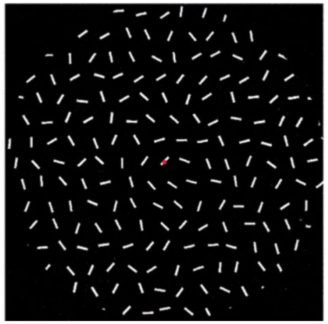
Random Walk Model

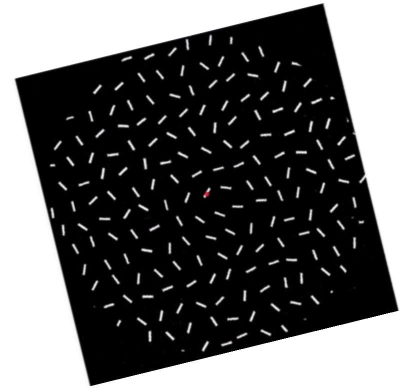


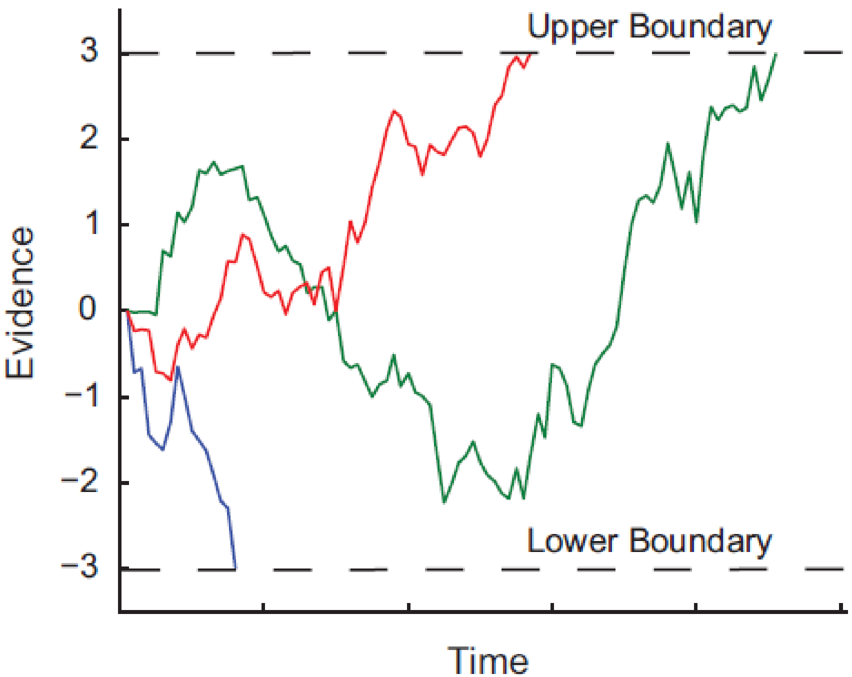


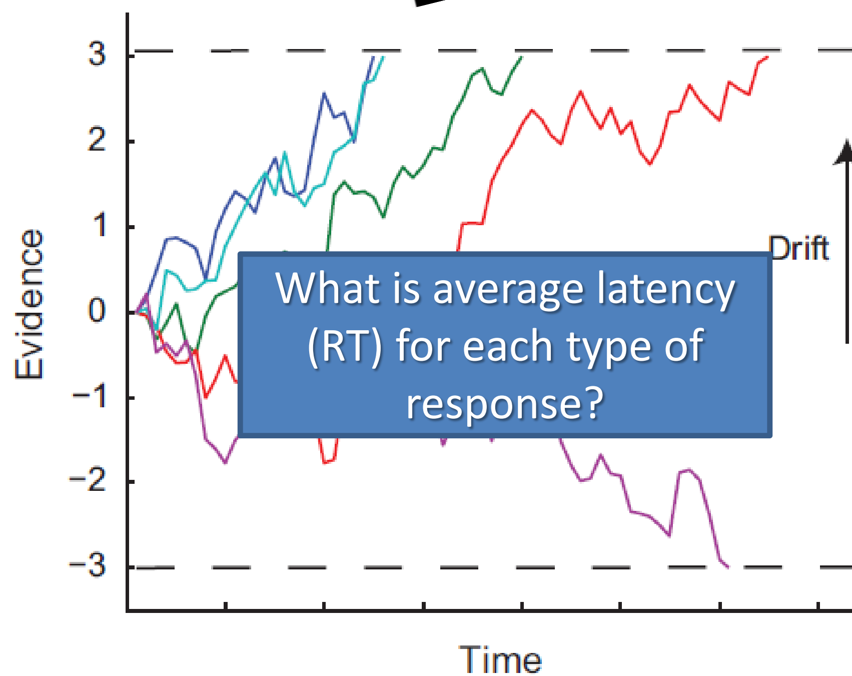
What is average latency (RT) for each type of response?

Random Walk Model





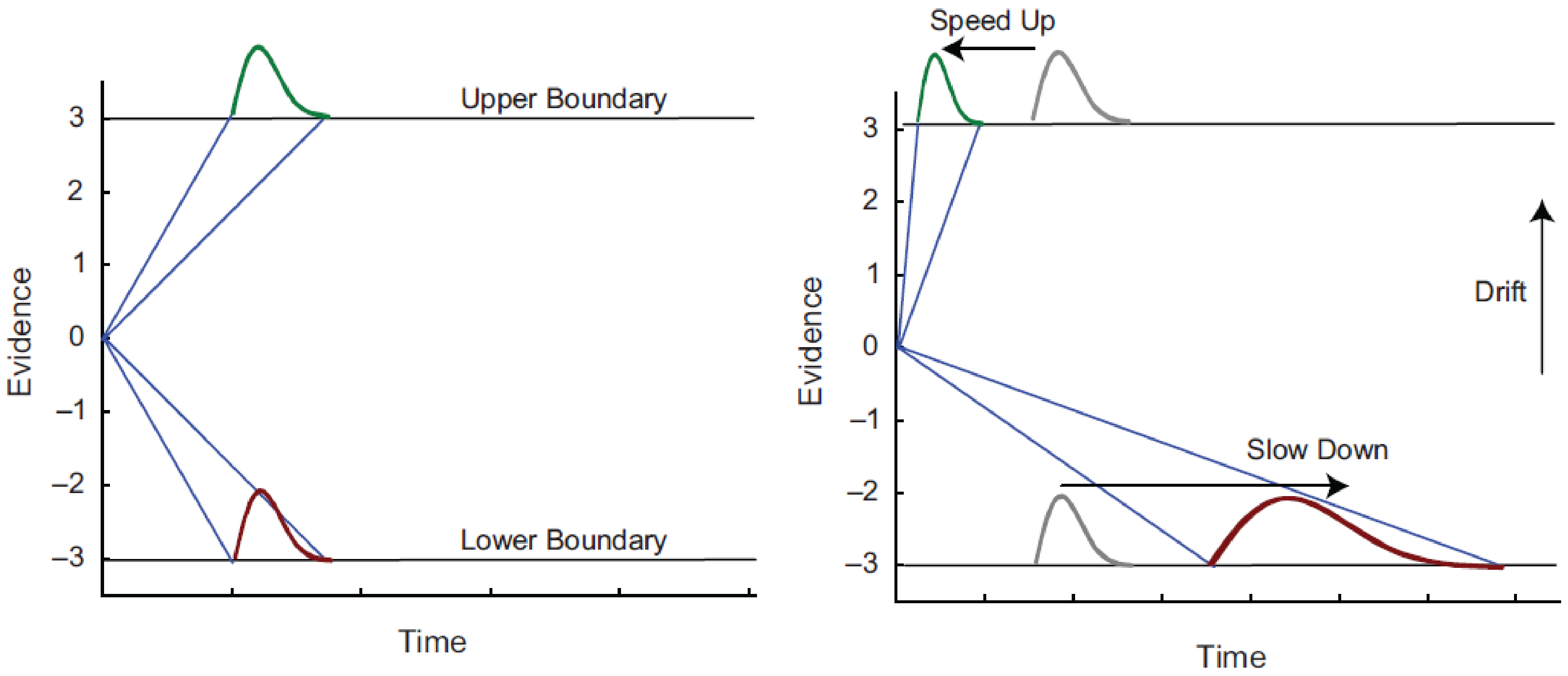




What is average latency (RT) for each type of response?

Random Walk and Errors

- What happens to error latencies if there is a non-zero drift rate?

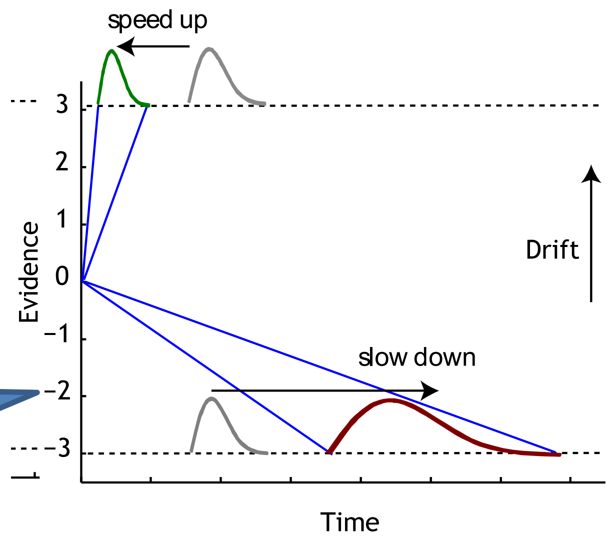


Testing our intuitions ….

RW: Why?

- Bottom boundary crossed only if series of samples, by chance, works against the drift
  - more time = more chance to drift to top
  - RW model agnostic about prior history (time already passed)

If you are here, time to bottom identical regardless of how you got there



Speed of Errors: Data

- Errors can be fast
  - faster than correct responses
  - when under time pressure and discriminability of stimuli is high
- Errors can be slow
  - slower than correct responses
  - when time pressure is relaxed and task more difficult
- Sequential sampling models?

From Data to Model …

Speed of Errors in Random Walk

- Starting point trial-to-trial variability
  - fast errors when starting point by chance close to wrong boundary
- Drift rate trial-to-trial variability
  - low drift rate: slow errors and slow corrects
  - high drift rate: fast errors and fast corrects

50% errors

10% errors

Over to Jana …