Commentary

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Today's Sessions

- Memory
- ACT-R as Software
- Teaching ACT-R

Teaching ACT-R

- We are far ahead of where we were 10 years ago.
  - branching out from the CMU home base
- Common threads
  - tutorial units + Dan's code/help are a great success
  - textbook situation is ok but not ideal
  - difficult to split instruction among cognitive modeling vs. ACT-R as a theory vs. ACT-R in code
  - challenge of students with different backgrounds

"(The students) model until they have a fit."

Architecture as Software

- The ACT-R software has come a *long* way.

- Frank:
  - having a test suite to validate the architecture, and doing this for every change
  - we don't have libraries! -- more on this soon
- Coty: Explanation of ACT-R can be difficult.
  - describing a single component of ACT-R isn't bad, but describing the unified theory is very hard
  - mini-theories and mini-mechanisms?

Memory

- Not much has changed in 10 years, but there's still a ways to go.

- Tony: Associative learning is critical.
  - and so is context
- Bill: We can learn from Soar.
  - understanding (ACT-R) vs. functionality (Soar)
- Jerry: Language is critical.
  - great to see a major player applied to comprehension
  - (interesting nugget: Levenshtein for visual similarity)

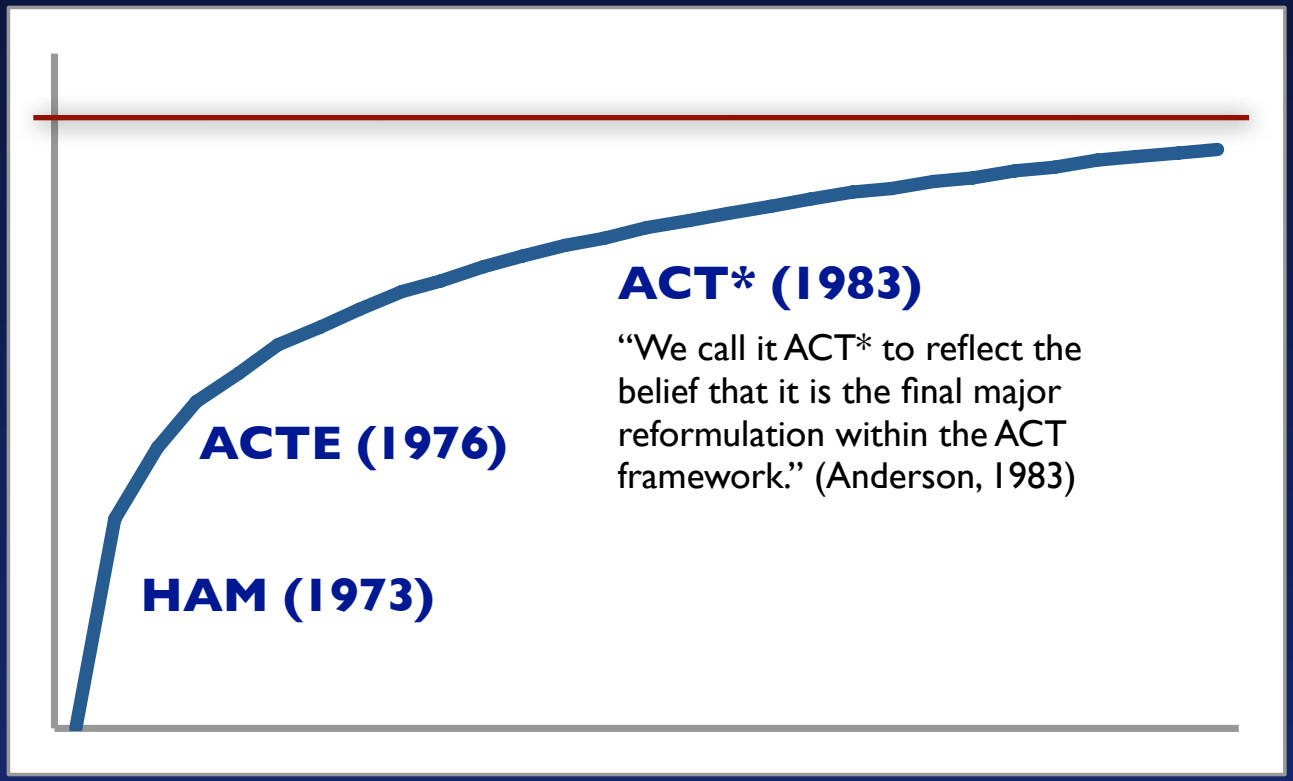
The Holy Grail?

- What is the "ideal" ACT-R we're working toward?
  - can model many, many tasks we're interested in
    - both laboratory & complex/applied tasks
    - at the grain size we're interested in
    - with the behavioral measures we're interested in
- How much work is there still to do?
- My contention...
  - We're done.
  - Or at least close enough.
  - Sort of.

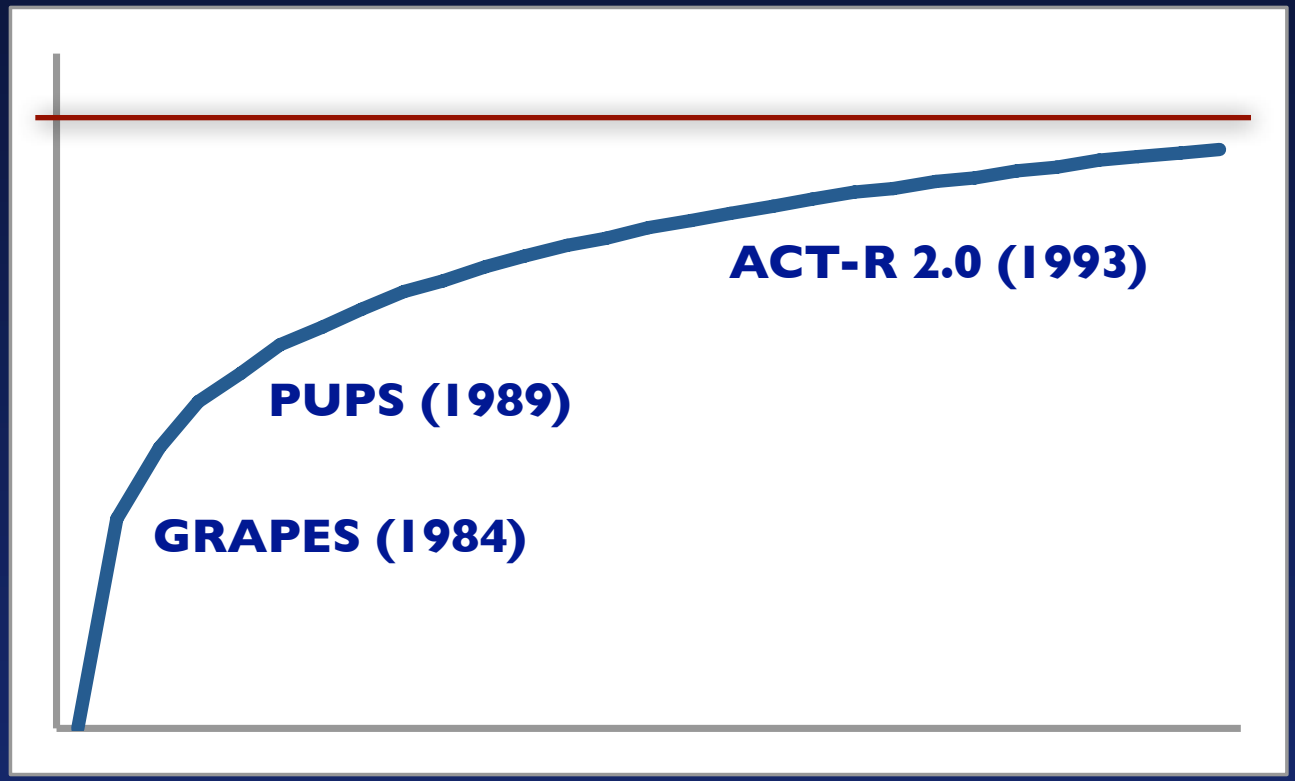
ACTsymptote #1

Ideal for Understanding Basic Cognitive Phenomena

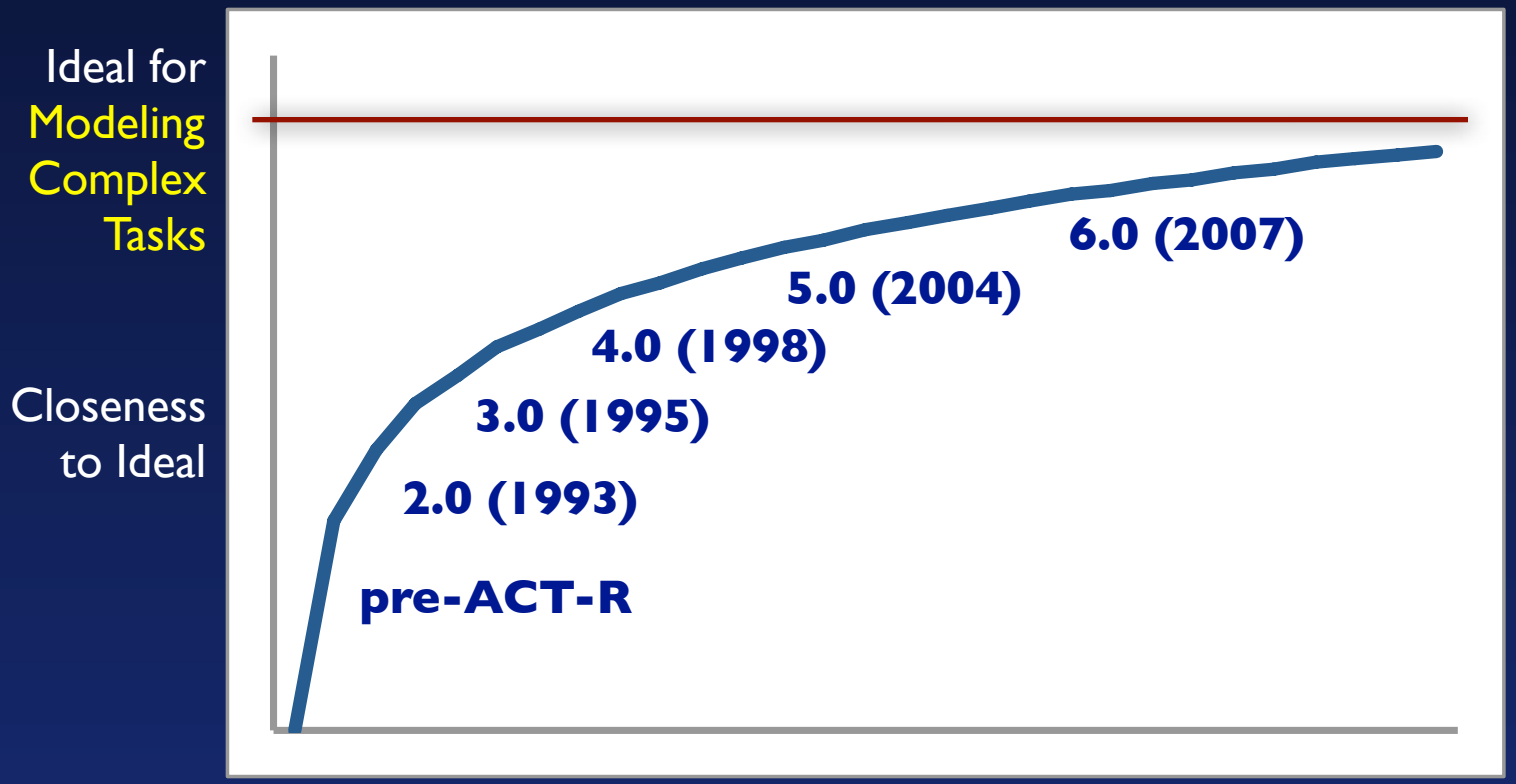
Closeness to Ideal



ACTsymptote #2

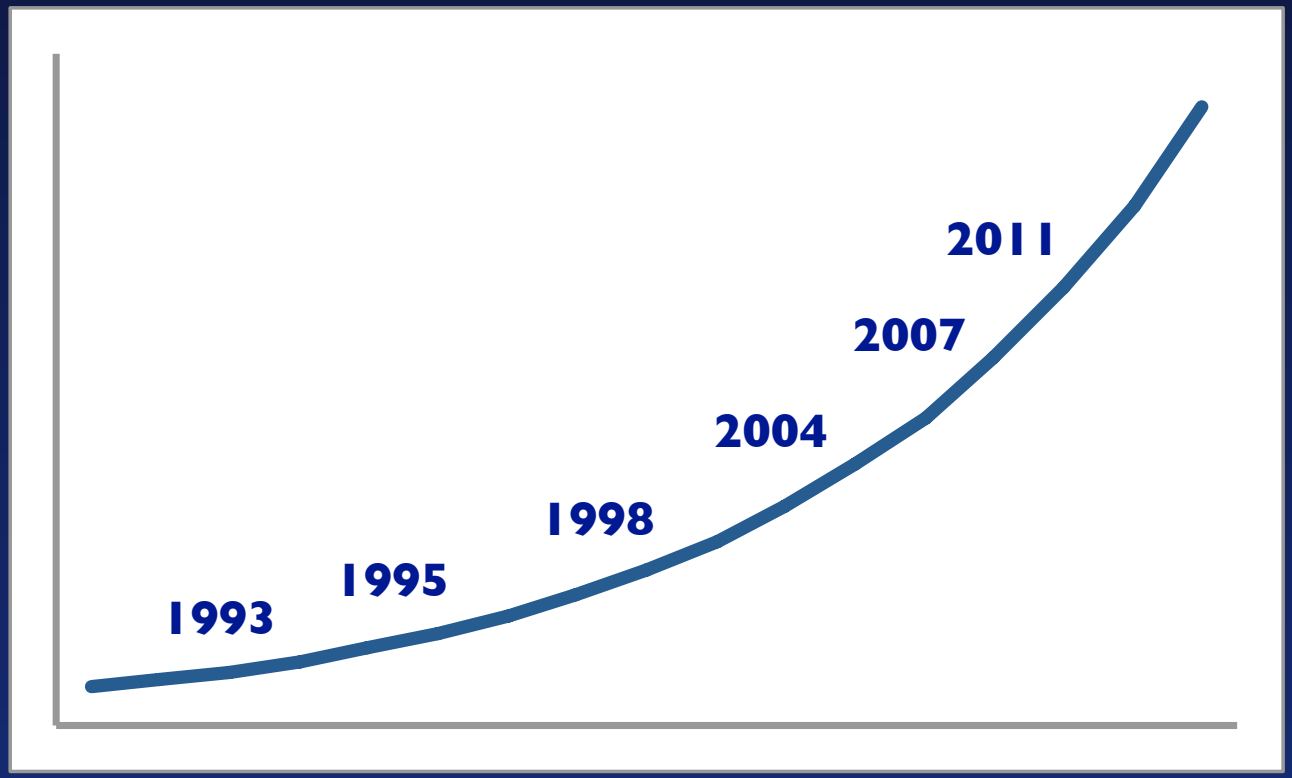


ACTsymptote #3



A Different Graph

- Task models developed in ACT-R
- (or, Domain coverage of ACT-R models)



Thought

- This is terrific!
- Sort of.

- It reminds me of...

PHENOMENA

1. Physical - name match difference (Posner)
2. Continuous rotation effect (Shepard)
3. Subitizing (Klahr)
4. Chess position perception (DeGroot)
5. Chunks in STM (Miller)
6. Recency effect in free recall (Murdock)
7. Instructions to forget (Bjork)
8. PI release (Wickens)
9. Linear search in sets in STM (Sternberg)
10. Non-improvement of STM search on success (Sternberg)
11. Linear search on displays (Neisser)
12. Non-difference of single and multiple targets in display search (Neisser)
13. Rapid STM loss with interpolated task (Peterson and Peterson)
14. Acoustic confusions in STM (Conrad)
15. High recognition rates for large set of pictures (Teghtsoonian and Shepard)
16. Visual icon (Sperling)
17. LTM hierarchy (Collins and Quillian)
18. LTM principle of economy (Collins and Quillian)
19. Successive versus paired recall in dichotic listening (Broadbent)
20. Click shift in linguistic expressions (Ladefoged and Broadbent)

PHENOMENA (cont'd)

31. Concept difficulty ordering: conjunct, disjunct, cond, ... (Hovland)
32. Reversal learning (Kendlers)
33. von Restorff effect
34. Log dependency in disjunctive RT
35. Forward masking
36. Backward masking
37. Correlation between RT and EEG
38. Moon illusion (Boring)
39. Perceptual illusions (Mueller-Lyer, etc.)
40. Ambiguous figures (Necker cube)
41. Cyclopean perception (Julesz)
42. Imagery and recall (Pavio)
43. Constant time learning (Murdock, Bugelski)
44. Probability matching (Humphreys)
45. Transmission capacity in bits (Quastler)
46. Pupillary response to interest (Hess)
47. Stabilized images (Ditchburn)
48. Meaningful decay of the stabilized image (Hebb)
49. Categorical concepts (phonemes) (Lieberman)
50. Effect of marking (Clark)

I am a man who is half and half. Half of me is half distressed and half confused. Half of me is quite content and clear on where we are going.

My confused and distressed half has been roused by my assignment to comment on the **models** of this **PGSS** It is curious that it should be so. We have just listened to a sample of the best work in current **cognitive modeling**. For instance, the beautifully **modeled fMRI data of Borst et al.** make me positively envious. It is a pleasure to watch **Gunzelmann et al.** clean up the **fatigue** data. The demonstrations of **Gray's microstrategies** produce a special sort of impact. And so it goes.

+ Tony
+ Jerry
+ Coty
+ Niels
+ ...

in my role as discussant, a question: Suppose you had all those additional **models**, just like those of today (except being on new aspects of the problem), *where will* **ACT-R** *then be?* Will we have achieved **a model of** man adequate in power and commensurate with his complexity? And if so, how will this have happened via these **models** that I have just granted you? Or will we be asking for yet another quota of **models** in the next dollop of time?

You Can't Play 20 Models with Nature and Win, Either

Unified Models of Behavior

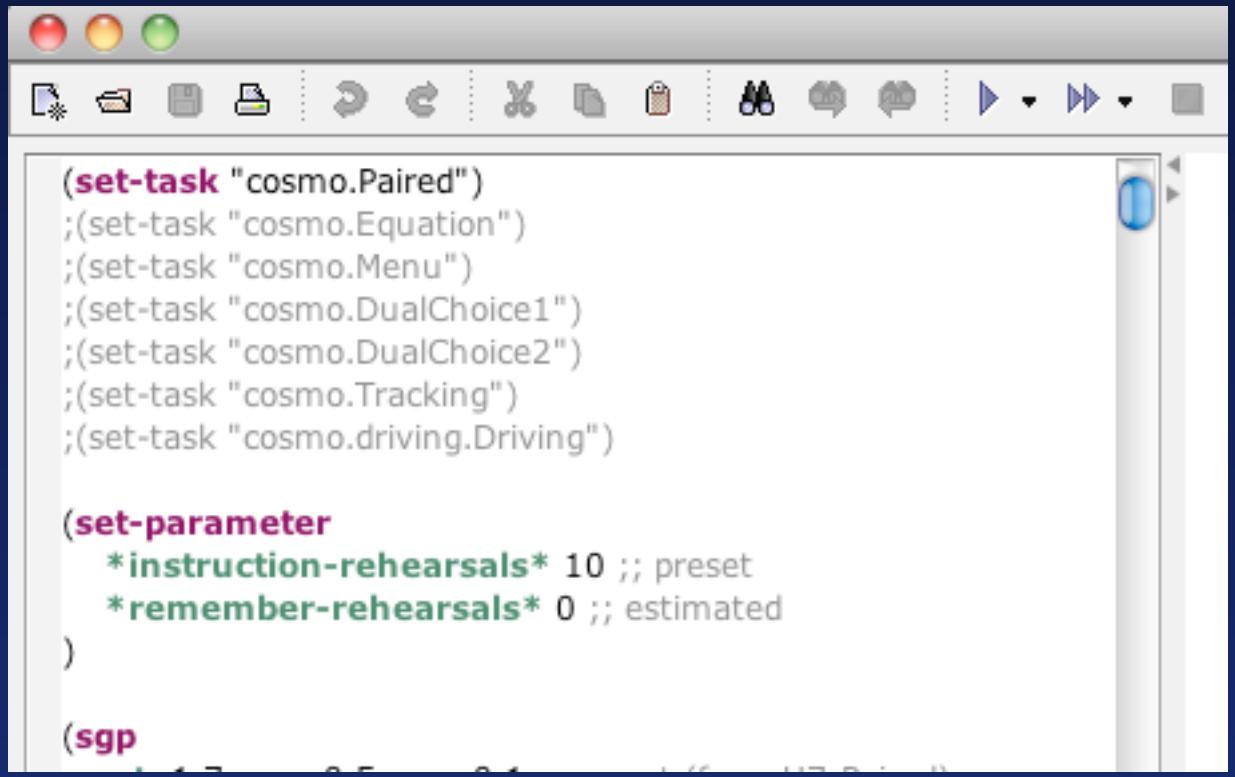
- How do we achieve unified *models* of behavior?
- One answer: model libraries
  - What are "model libraries" in ACT-R?
  - Models — but they have to be *re-usable* models
  - validated explicitly for central empirical data sets
  - eventually, validated implicitly in their use for modeling other empirical data sets
    - just as ACT-R itself is validated implicitly via ACT-R modeling work

Cognitive Supermodels

- Consider a single cognitive model with...
  - a single (initial) set of declarative chunks
  - a single (initial) set of production rules
  - with (initially) fixed parameter settings
  - on a fixed cognitive architecture
- ... and try to account for behavior across a range of diverse domains
- Basically, a model of a person (from a target population) walking into an experiment

Cognitive Supermodels

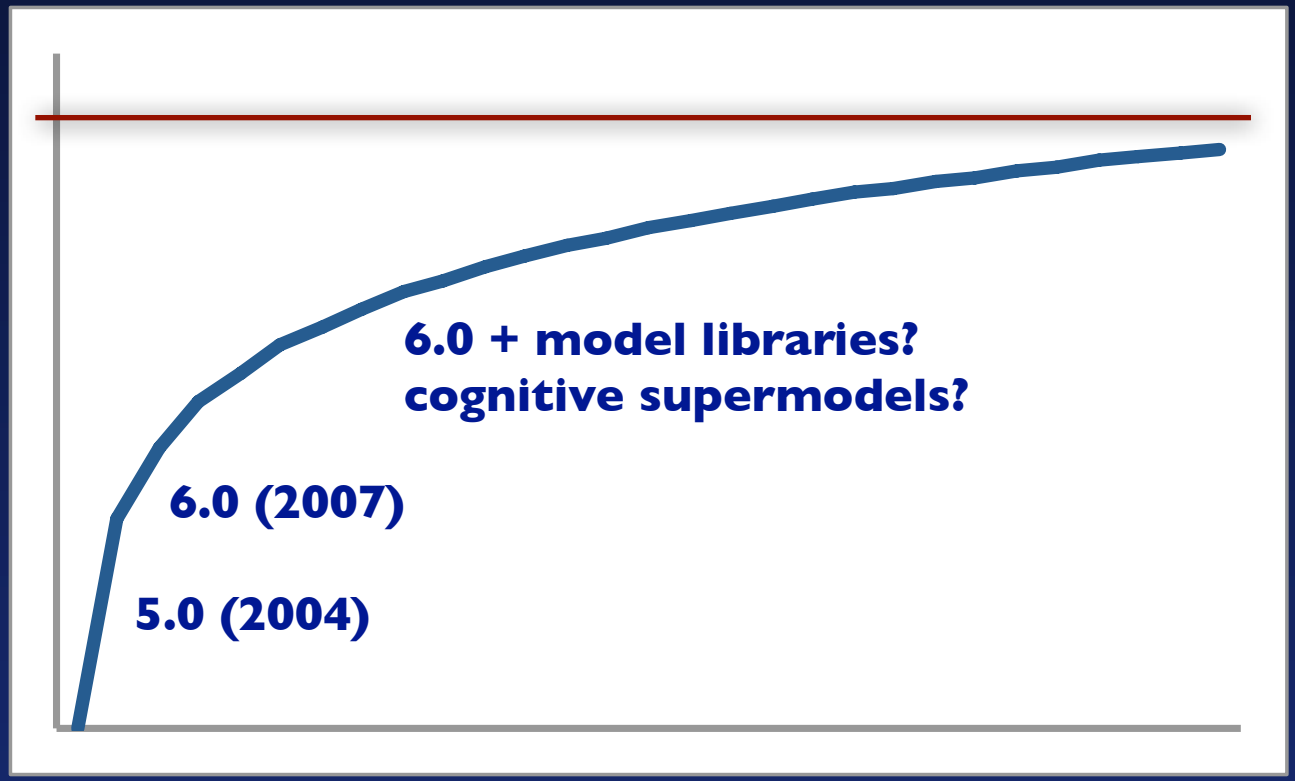
- One model — just change the task / experiment... (including the task instructions)



Summary

Task	R	Err	Pts
Paired RT	>.99	0.11	8
Paired Correct	0.97	0.08	8
Tracking Error	0.97	0.10	24
Tracking RT	0.69	0.09	24
Equation Gazes	0.93	0.30	3
Equation GazeDur	>.99	0.16	3
Menu RT	0.90	0.57	27
Menu FirstFix	0.96	0.09	27
DualChoice1 RT	0.93	0.12	16
DualChoice2 RT	0.77	0.20	10
Driving-Dialing RT	0.99	0.10	8
Driving-Dialing LD	0.96	0.09	5
Driving-Dialing LV	>.99	0.07	5

ACTsymptote #4



Other Possible ACTsymptotes

- Neural phenomena
  - fMRI work
  - some neural modeling (with LEABRA)
- Developmental learning
  - Trafton et al., Lebiere
- Team/social interaction
  - Matessa
- Tools for interface evaluation
  - CogTool, Distract-R, etc.

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