Reaping the Rewards of Teaching ACT-R: Class Projects Spring 2002

Michael D. Byrne
David Maurier
Christopher Fick
Department of Psychology
Rice University
Houston, TX 77005
byrne@rice.edu
http://chil.rice.edu

Overview

- Structure of the class
- Thoughts on 5.0 vs. 4.0
- Maurier's project: Learning in PRP
- Fick's project: Contingent capture

Class Structure

- Starts with general readings on computation and cognition (Pylyshyn, Simon)
- A couple weeks of connectionism
  - Readings
  - Building simple models
- Transition to symbolic systems
  - Fodor & Pylyshyn critique
  - Newell on symbolic systems
- ACT-R the rest of the way
  - Readings
  - CMU tutorial units
  - Projects

Project Requirement

- Select a published data set
- Model it!
  - Did not have to be with ACT-R
  - Most used ACT anyway
- Grades were based more on showing what they learned than on r-squared of fits
- I wrote all the supporting Lisp code
  - 9 students, only 8 of whom used ACT

Pros and Cons of 5.0 (vs. 4.0)

- Pros
  - More uniform syntax
  - Buffer basis simplifies explaining all the things that happen on a production cycle
    - Especially dealing with retrieval failures
  - Parallels between declarative retrieval and visual attention
  - Simpler PG-C formulation
- Cons
  - Lack of a book like *Atomic Components*
  - Lack of a manual for 5.0
  - Debugging 5.0 seems a little harder
- Environment was a wash

David Maurier's Project: Learning in the PRP Paradigm

- Anyone **not** know the PRP paradigm?
- Data from Van Selst, Ruthruff, & Johnston (1999)
- Setup
  - Task 1: 4-choice tone discrimination with vocal response
  - Task 2: 8-choice visual character discrimination with manual response
  - SOAs of 17, 67, 150, 250, 450, and 850 ms
  - A bunch of difficulty manipulations
- Focus on first phase of the experiment
- 18 sessions, roughly 1 hour each

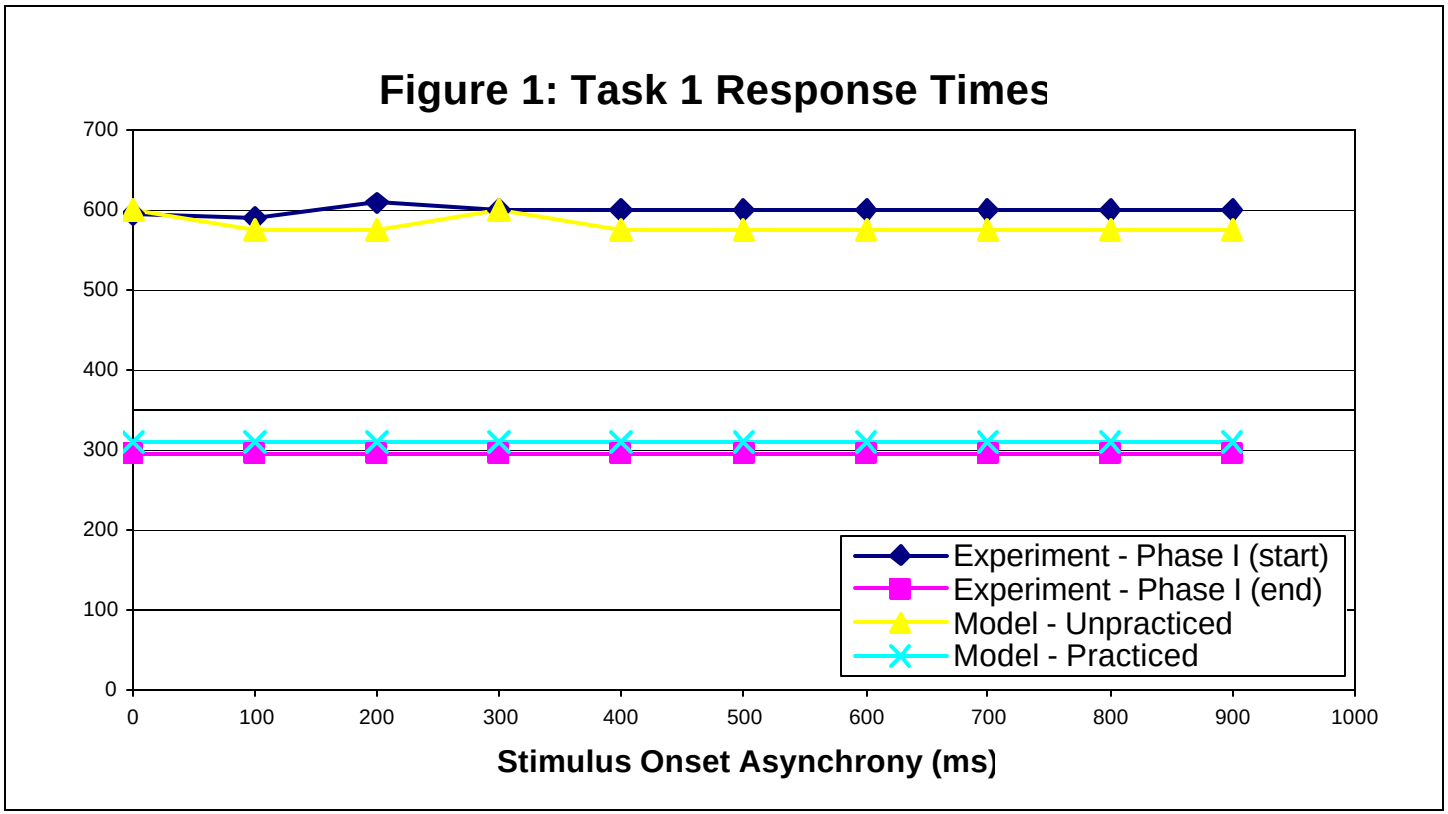
Maurier's Model

- Attempt to model endpoints
  - Session 1 performance
  - Session 18 performance
  - No initial attempt to have ACT-R do the learning
- Each task requires three productions:
  - Register
    - Relies on buffer-stuffing
    - Shifts attention to new location in buffer
  - Retrieve chunk which maps stimulus to appropriate response
  - Respond
  - No complex unlocking

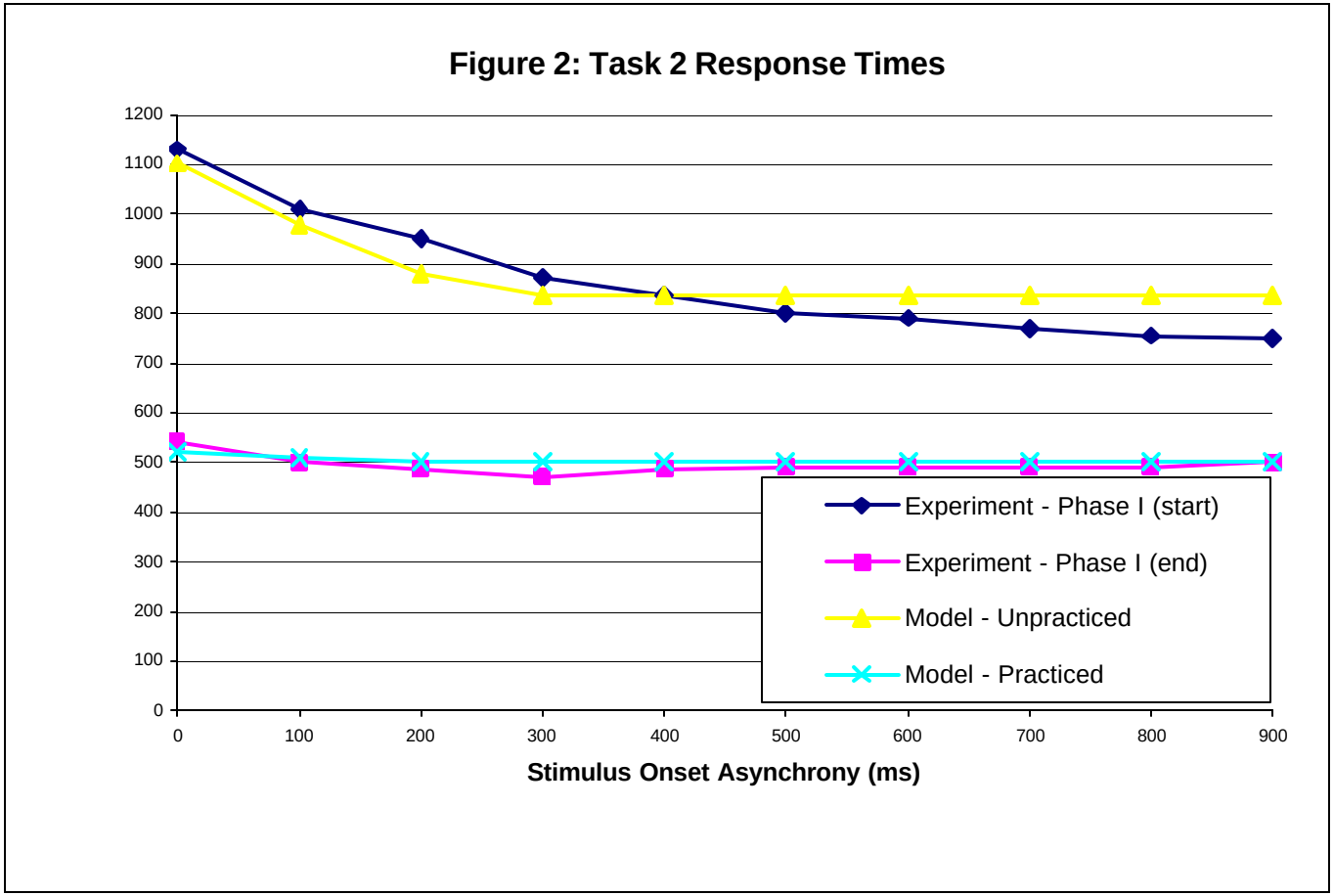
Parameters

- Session 1 model
  - Tone recode 100 ms
  - SR mapping chunk activation
    - For Task 1: 1.6
    - For Task 2: 1.0
  - Default cognitive cycle time of 50 ms
- Session 18 model
  - Tone recode time 70 ms
  - SR mapping chunk activation to 16 and 15
  - Cognitive cycle time to 5.5 ms (!)

Fit to Task 1 RTs



Fit to Task 2 RTs

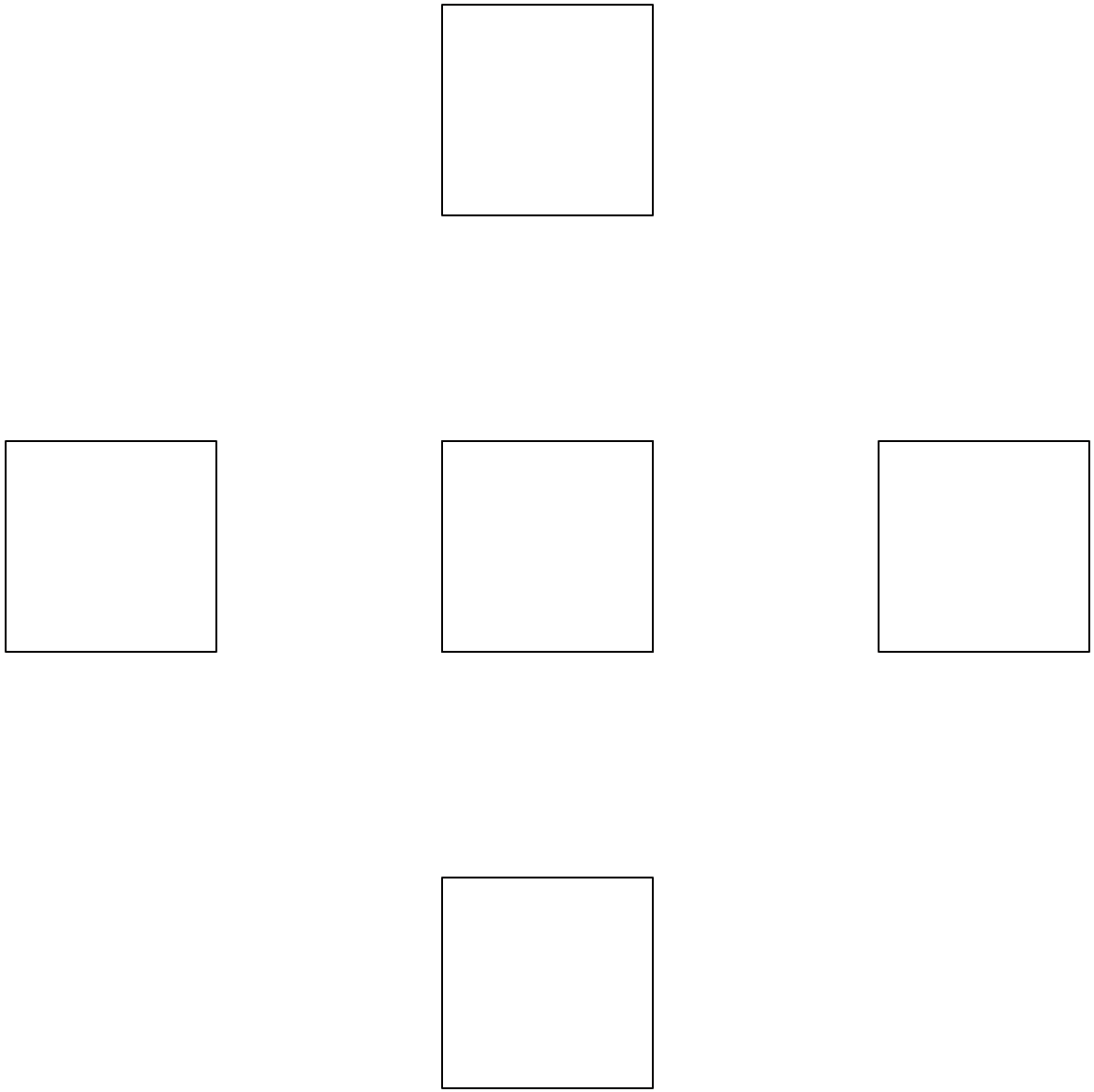


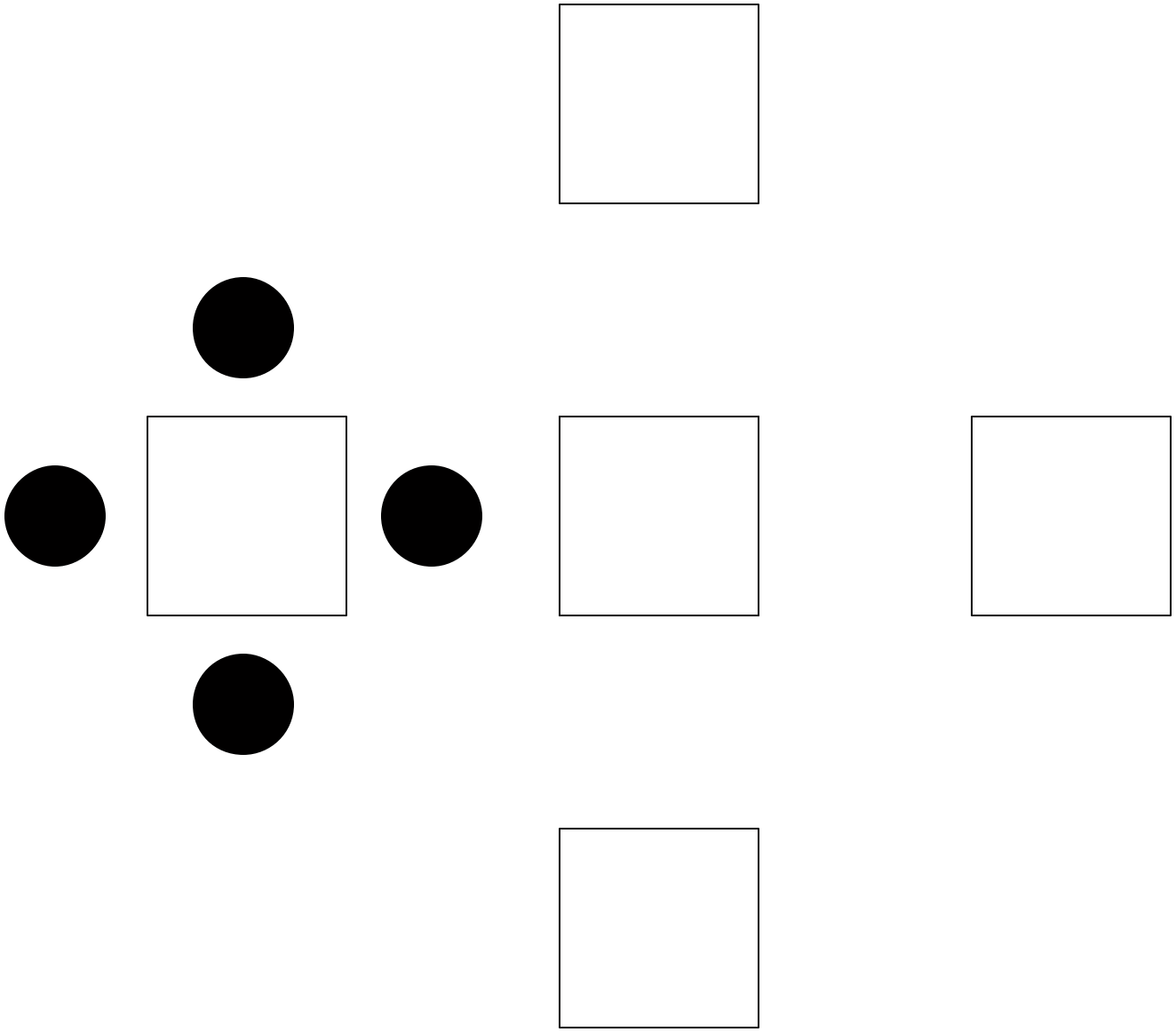
Discussion

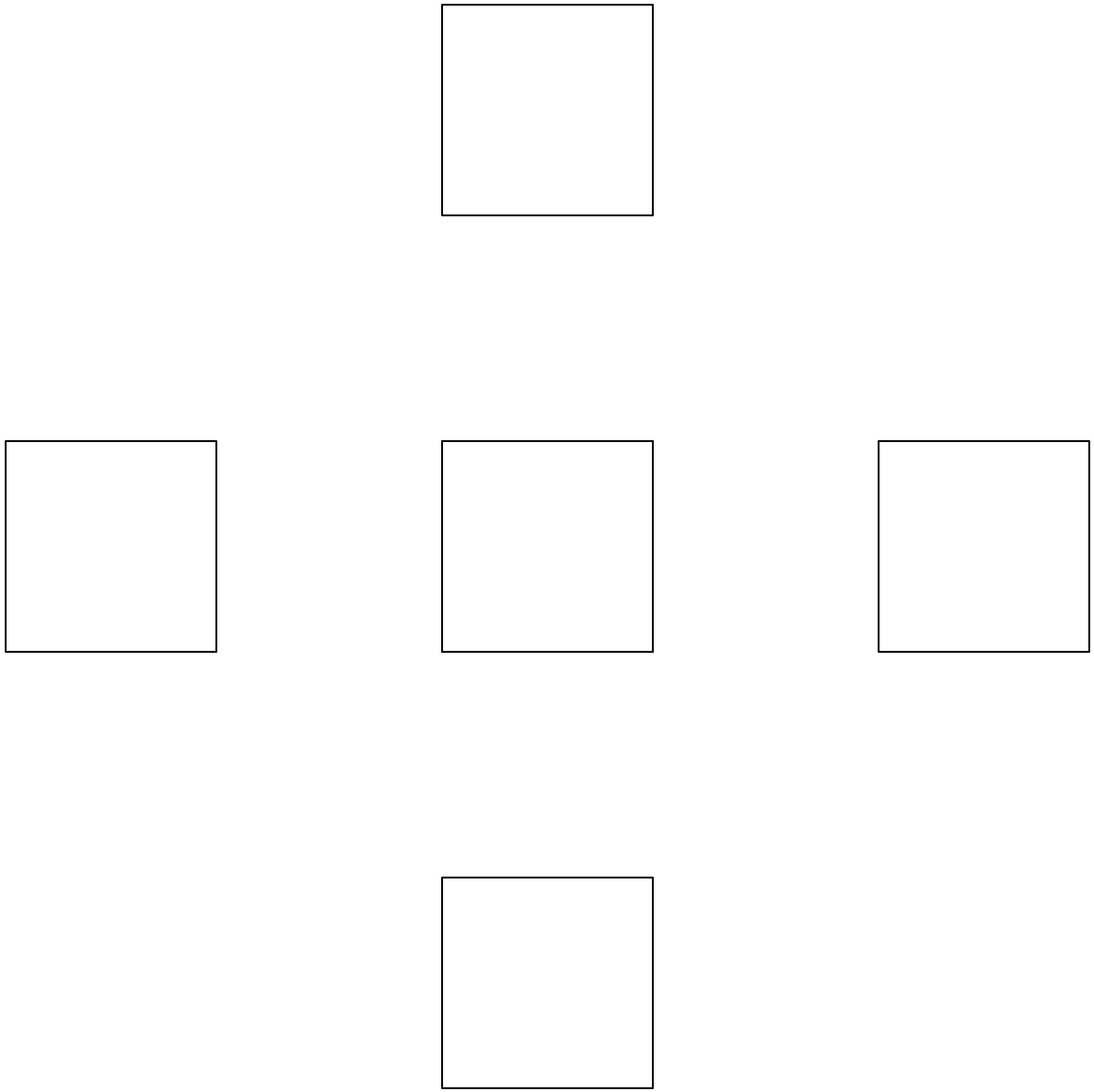
- Could ACT-R learn it?
  - Chunk activations would certainly go up a lot with that much practice
  - However, might not be necessary with production rule learning on
  - Production learning might also solve the problem of reducing the cycle time
  - Cannot right now learn to reduce tone recoding time
  - Not clear if it would learn at the right rate
- Hopefully we'll have more to report at ICCM

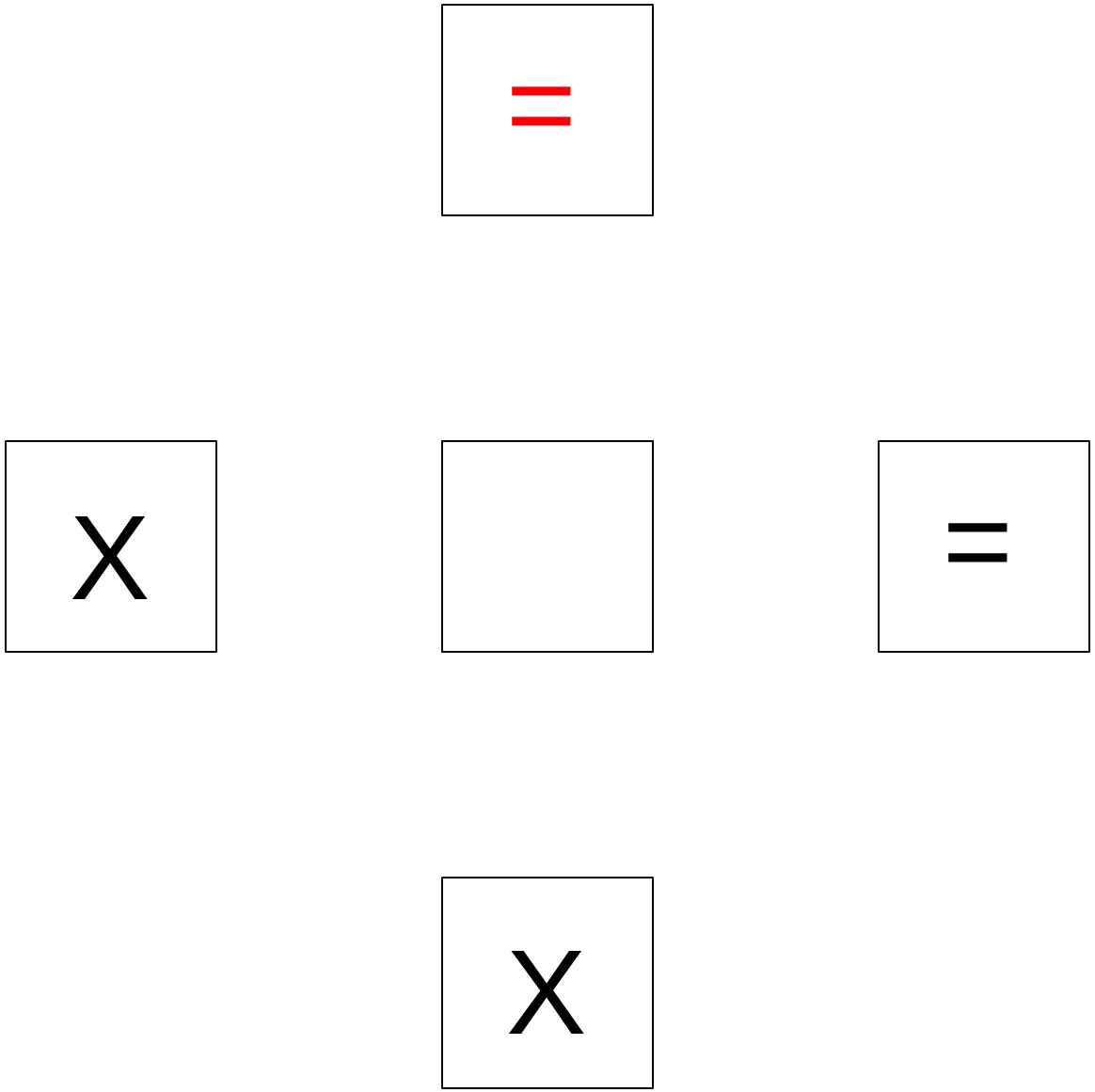
Chris Fick's Project: Contingent Orienting

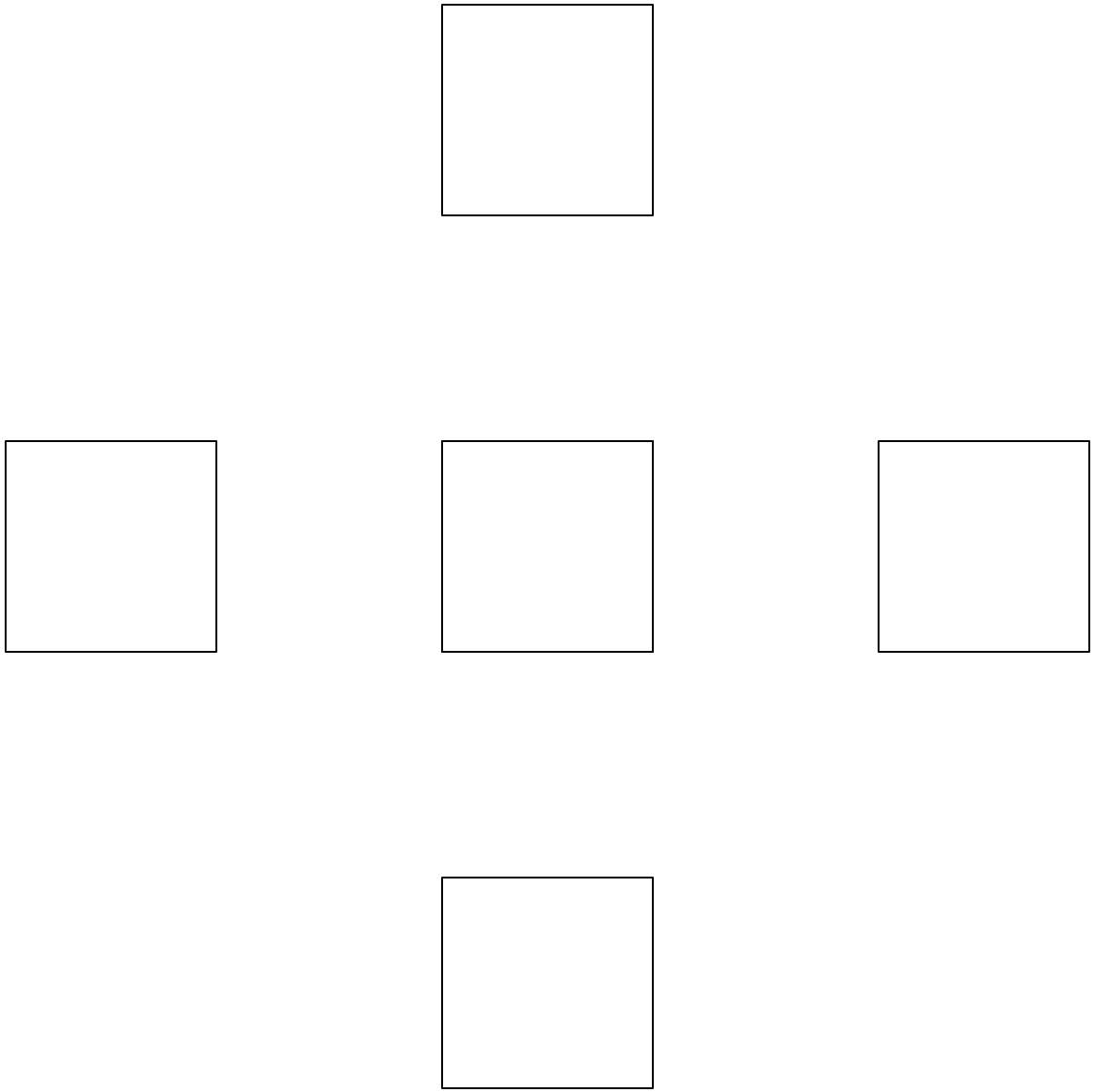
- Main research question: Do onsets of new visual stimuli "capture" attention?
- Widely believed to be the case until famous paper by Folk, Remington, & Johnston (1992)
- Three cue types
  - Color singleton
  - Onset singleton
  - None
- Two target conditions
  - Onset singleton
  - Color singleton
- Cues could be valid or invalid

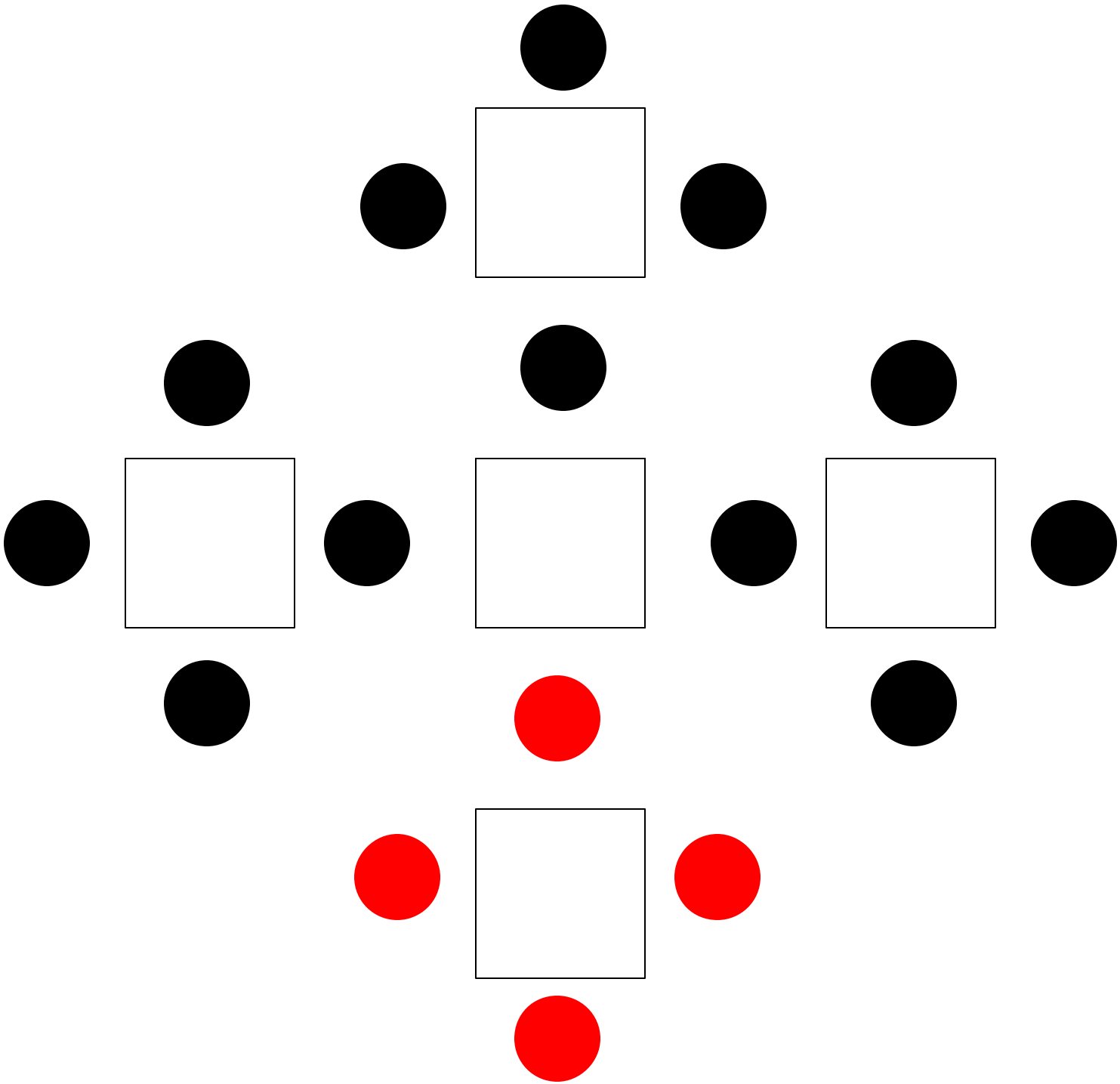


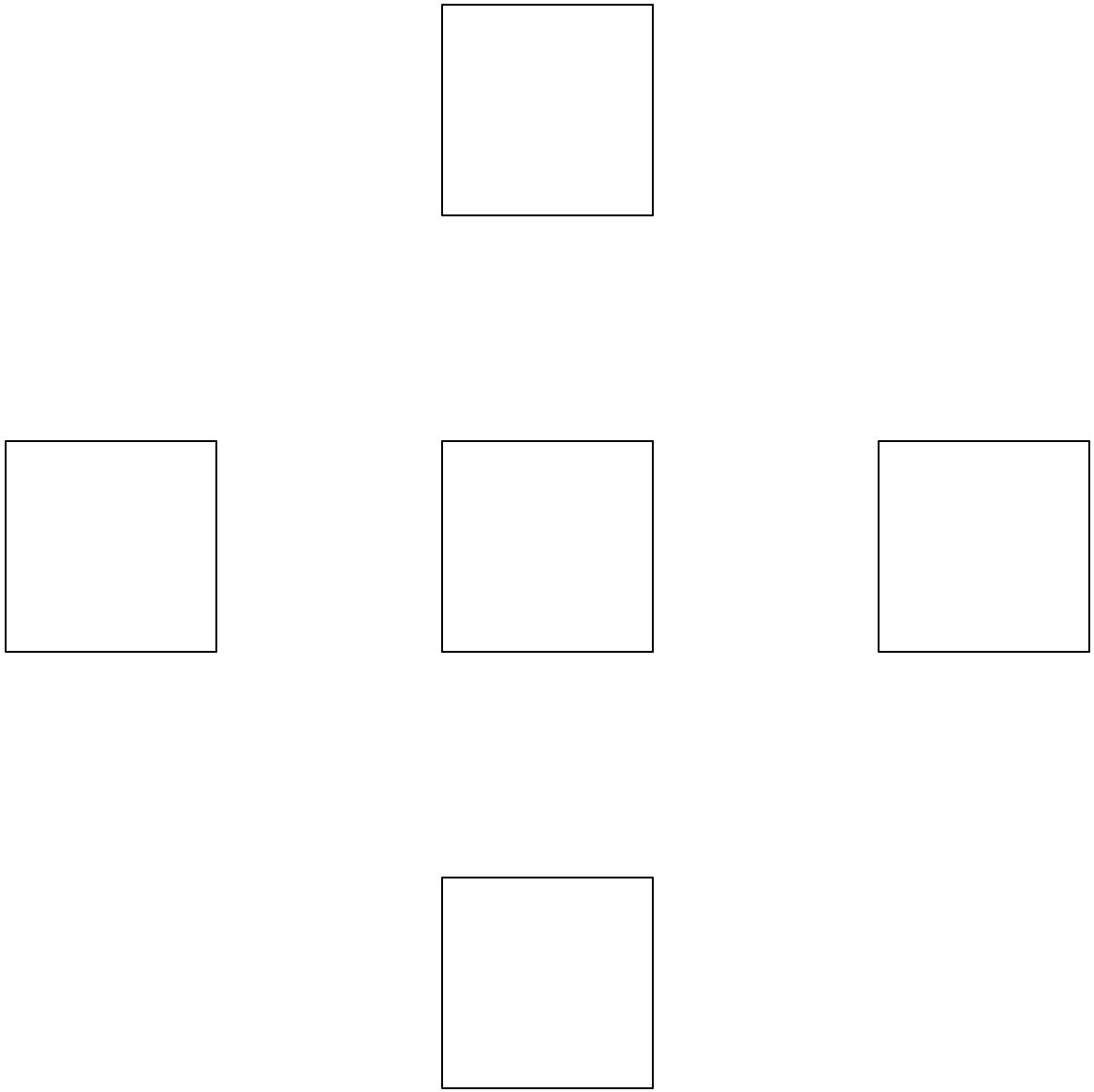


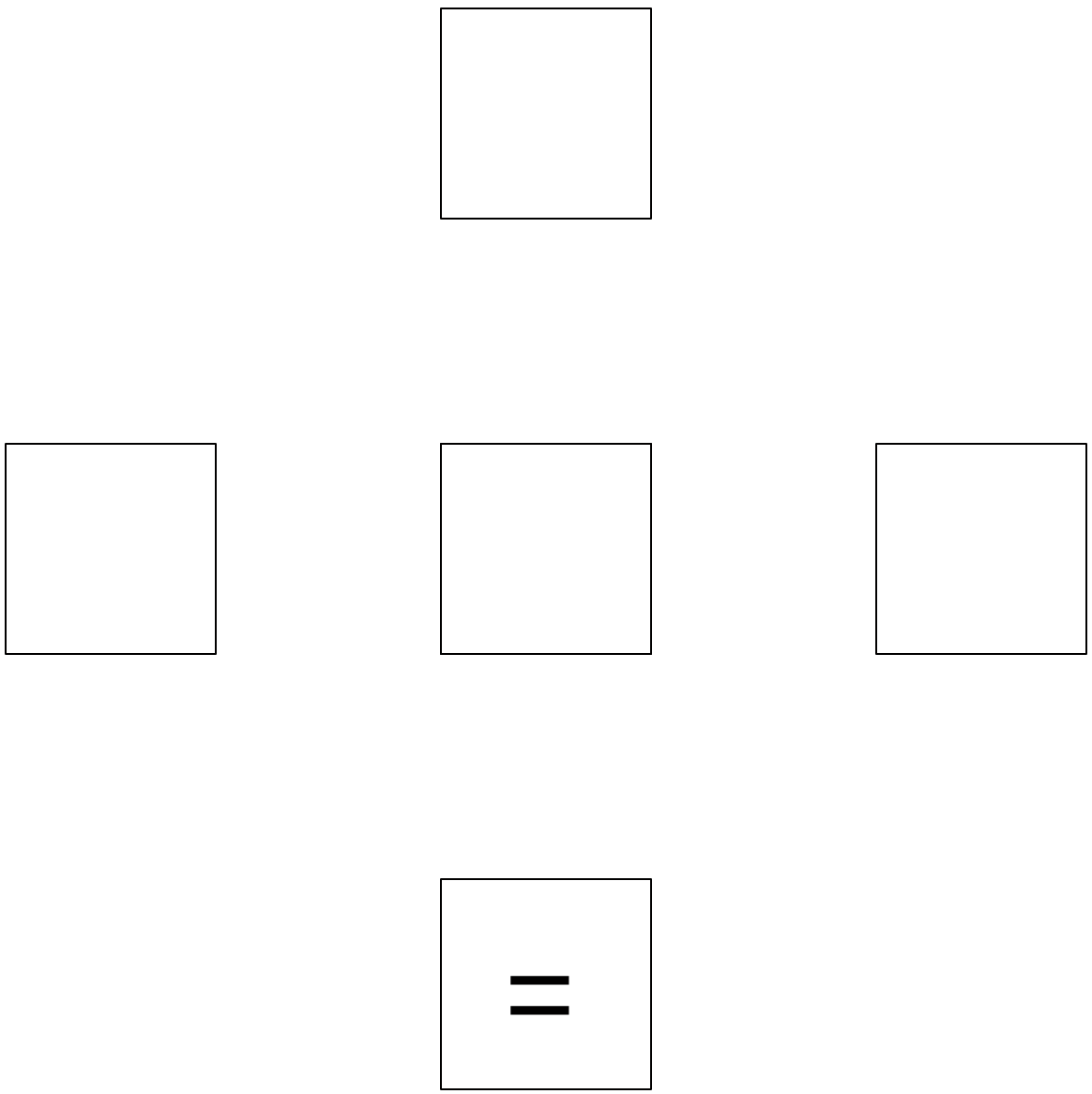



=
X
=
X

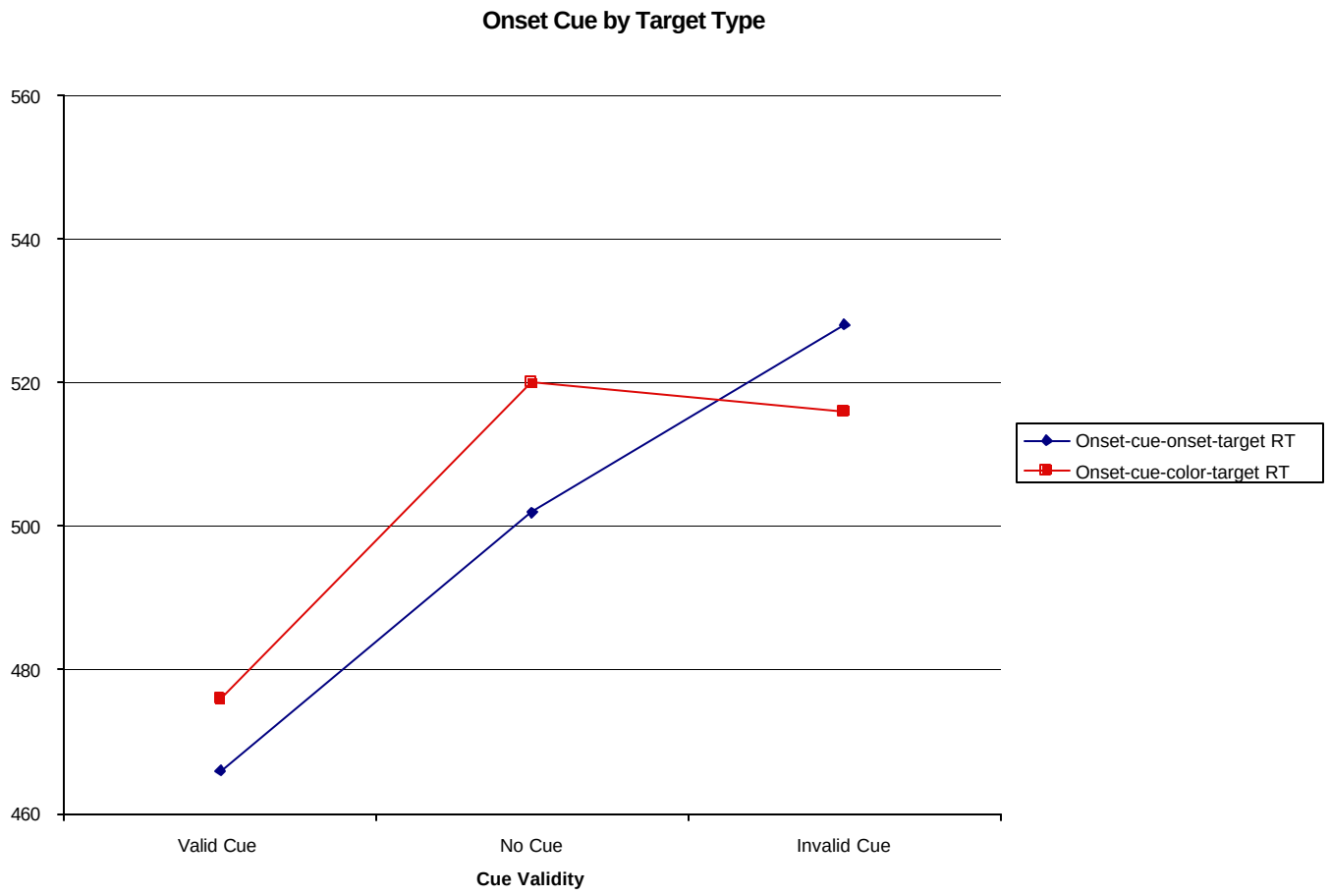




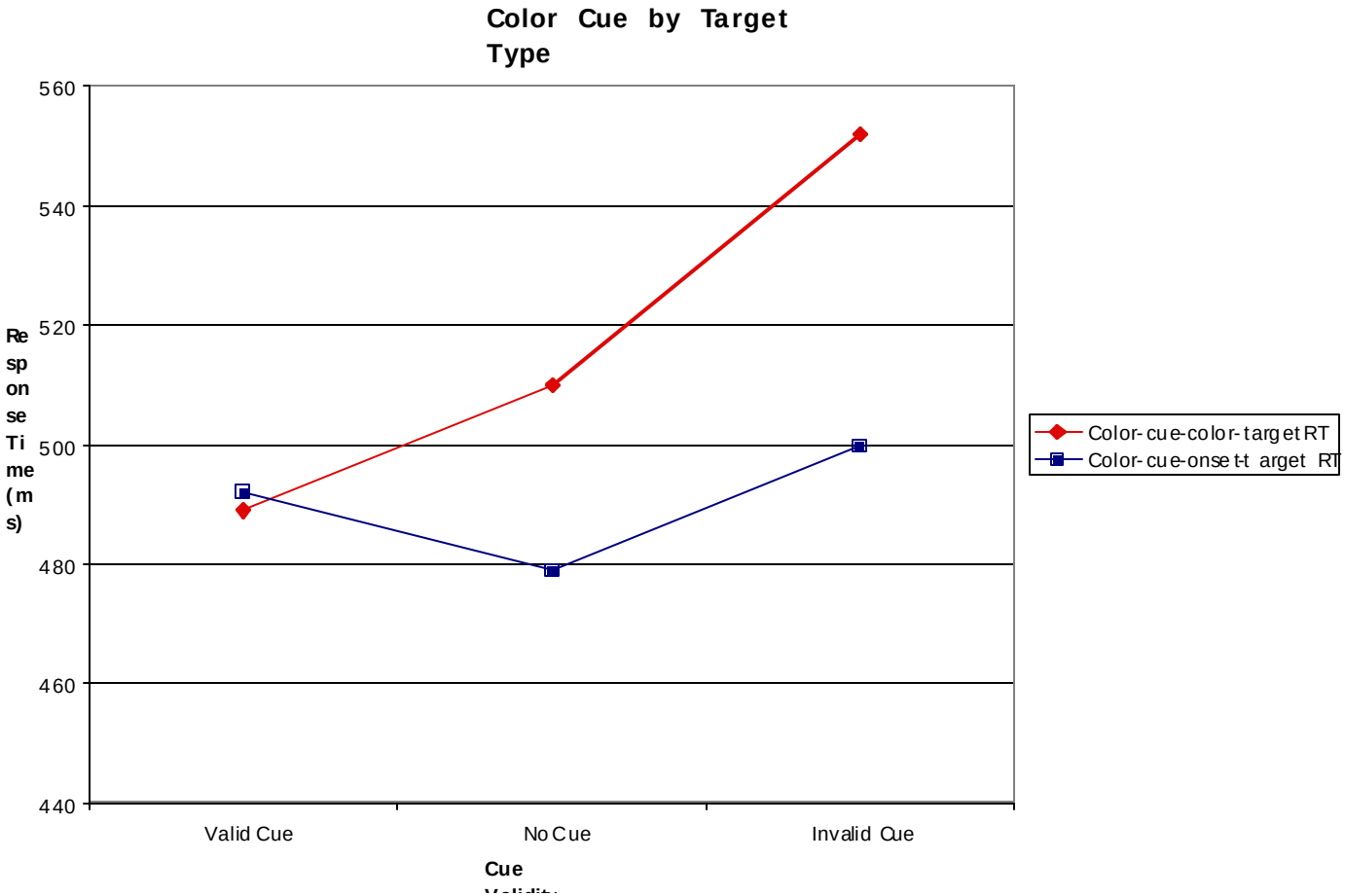




Results: Onset Cues



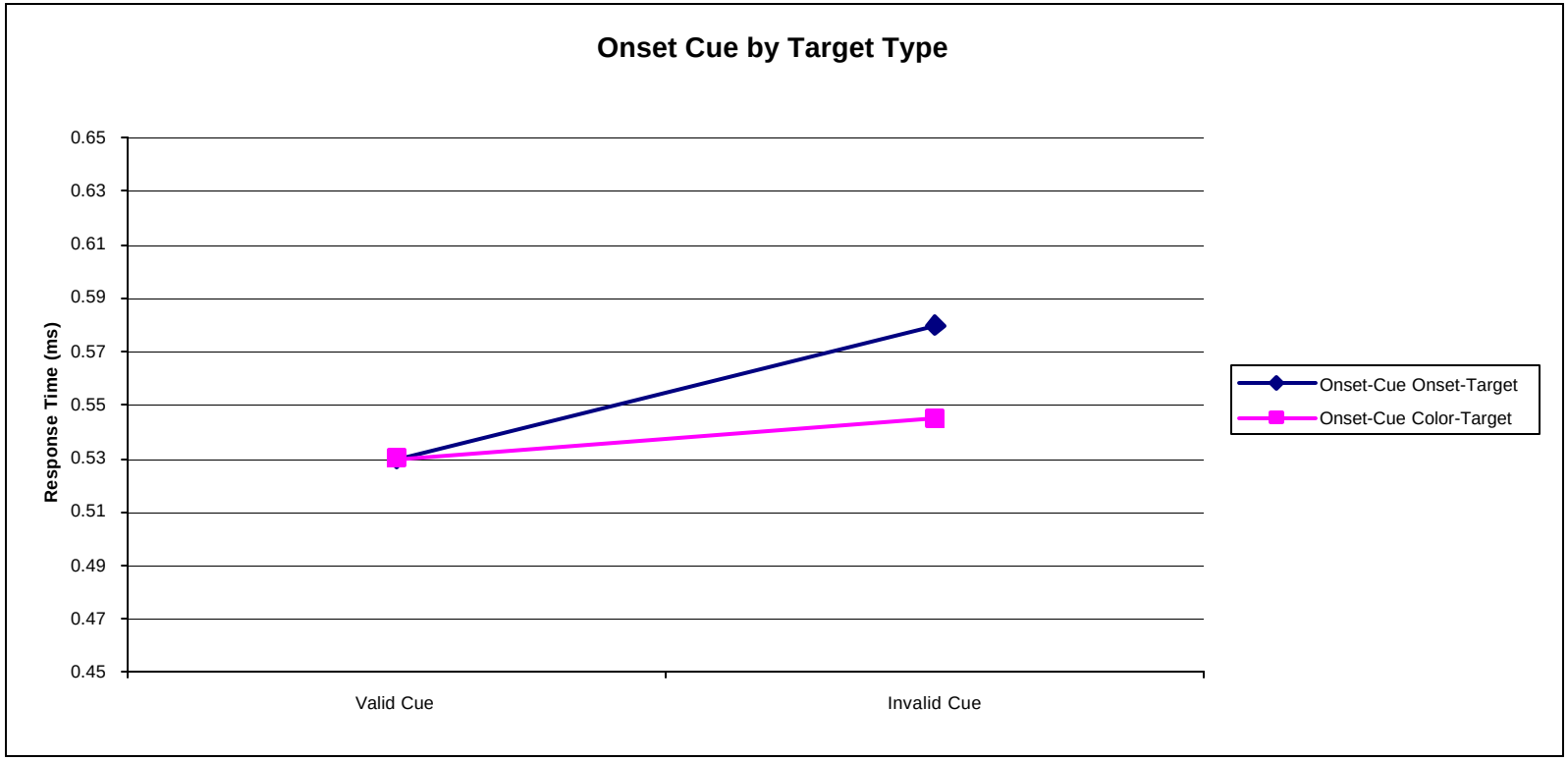
Results: Color Cues



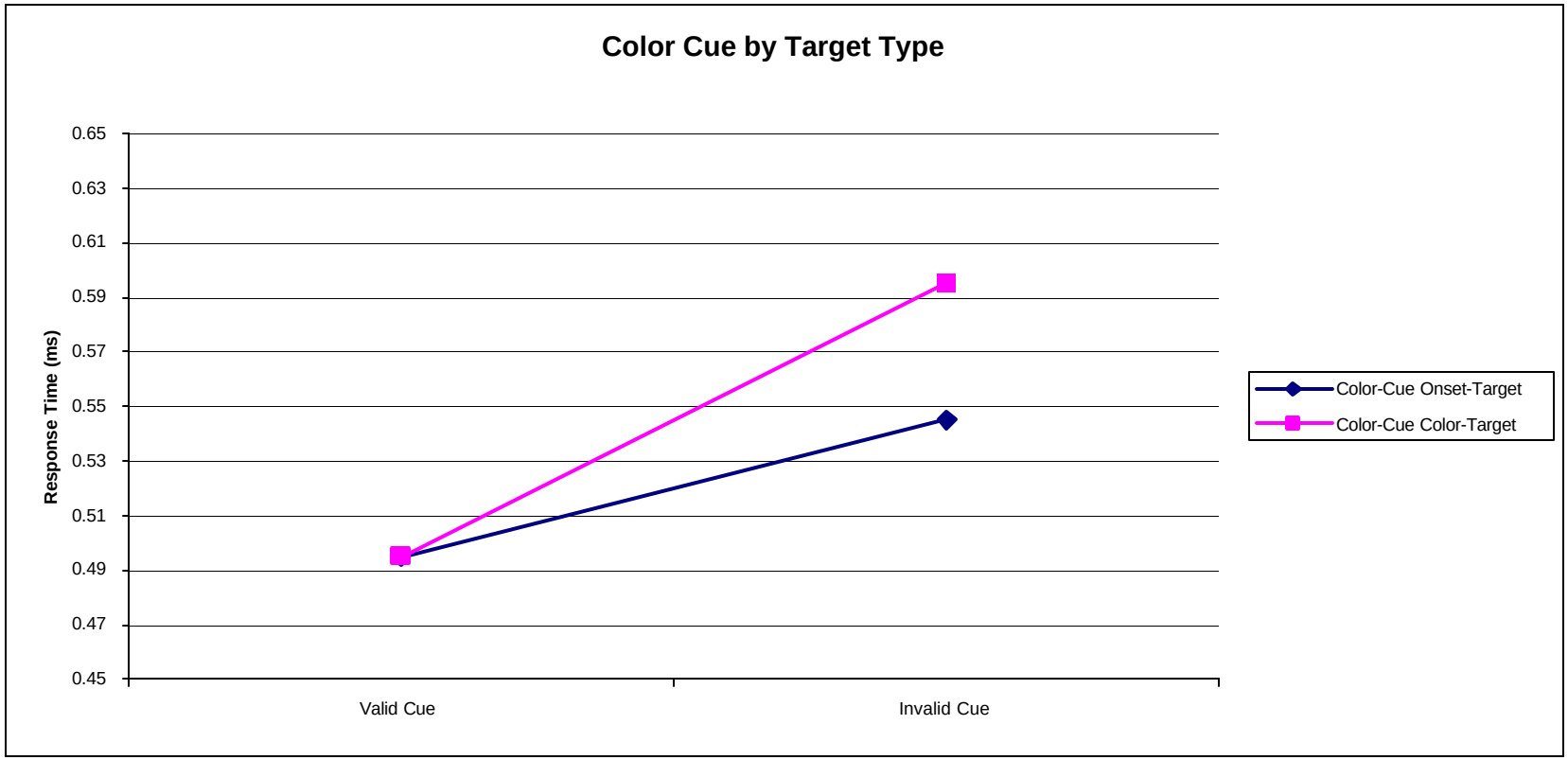
The Model

- Didn’t model “no cue” conditions
- Capitalizes on strange aspect of the original experiment
  - Trial types were blocked
  - Including blocking by validity
  - Model knows if cue is valid
- Handling cues
  - Onset cue stuffs buffer
  - Color cue requires feature search, but that’s fast
- Shift attention contingently depending on validity and cue-target match

Model: Onset Cues



Results: Color Cue



Discussion

- Model is a little too slow overall
  - Probably fixable
- Needs no-cue condition in model
  - Proposal: have model randomly select location to attend
- Contingency is not principled, not clear why it would work the way it does
  - May be a function of the way trials were blocked
  - Raises question: What happens when trials are not blocked?

Other Projects

- David Huss will tell you about his shortly
- Another related serial recall/working memory kind of task
- Two people modeled mental rotation experiments with somewhat varied levels of success
- Postcompletion errors
- Goal management (TOH)

Questions?

Emergency PRP Slide

- Very simple dual task
- Two tasks, Task 1 and Task 2
  - Usually choice RT tasks
- Stimulus onset for Task 2 stimulus delayed relative to onset of Task 1 stimulus (SOA)
- Subjects instructed to give priority to Task 1
- Basic findings
  - Task 1 RT unaffected by SOA
  - Task 2 RT a function of SOA; smaller SOA yields higher RT with approximately -1 slope
- Lots of contention, but used to argue for seriality