Rational retrieval of visual objects

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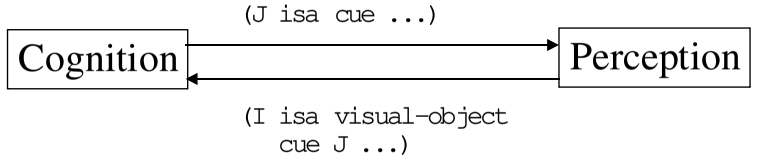
See also:

Altmann & Gray (1998). Pervasive episodic memory: Evidence from a control-of-attention paradigm. *Cognitive Science Conference Proceedings.*

Proposal

- Retrieve perceptual objects rationally
  - Visual objects in particular
- Requires symbolic associations
  - Creating visual object I with chunk J as a value
  - Where J is specified by cognition



Control-of-attention paradigm

- Participant shown an instruction (**Groupsize)**
- Applies it to following trials (**aaaaaa, xxxx, …)**
- Shown another instruction
  - Possibly different (**Position**)
- Applies it to following trials
- Etc.

<u>Start</u> instruction

Groupsize

Trial S+1

aaaaaaaa

More trials

...

Interrupt instruction

Position

Trial I+1

ccc

More trials

...

End of block

Latency and accuracy feedback

Block structure

(Switch block)

Groupsize

aaaaaaa

bb

...

xxxx

Position

ccc

...

feedback

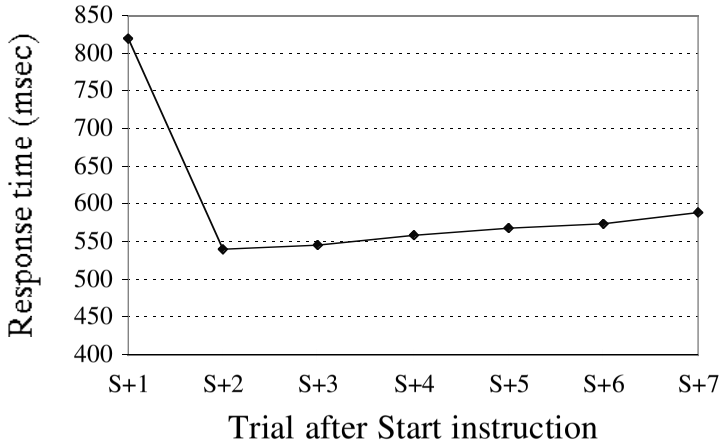
General issues

- Internal attention
  - Alternates between two tasks
- Episodic memory
  - Maintains the current task
- Rich set of effects
  - To constrain a model of executive control

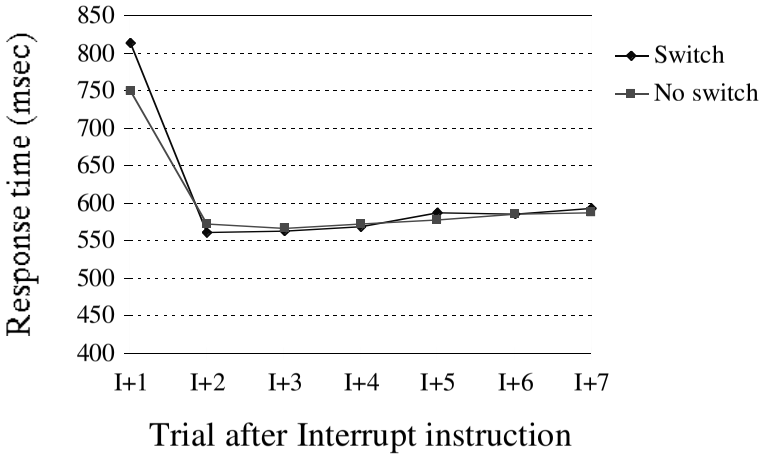
Specific effect

- Within-run slowing
  - S+2 and I+2 are fastest positions
  - Latencies increase gradually across later positions
- Another effect is on latency of S+1 and I+1
  - Work in progress

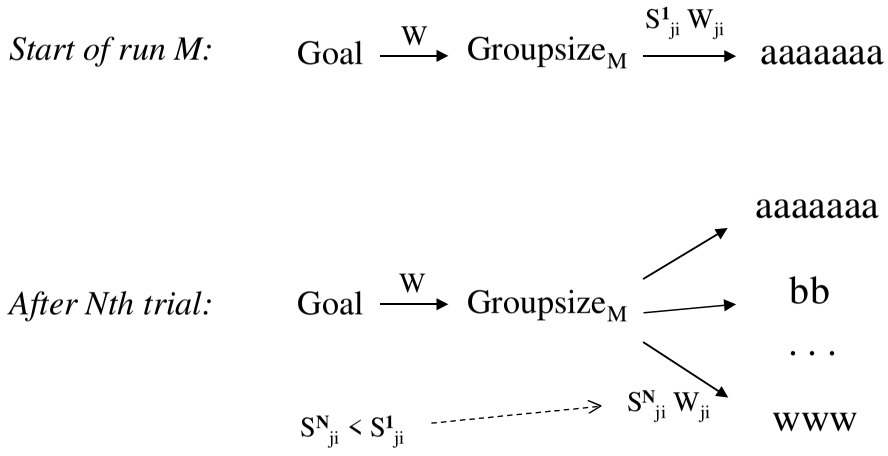
After Start instruction



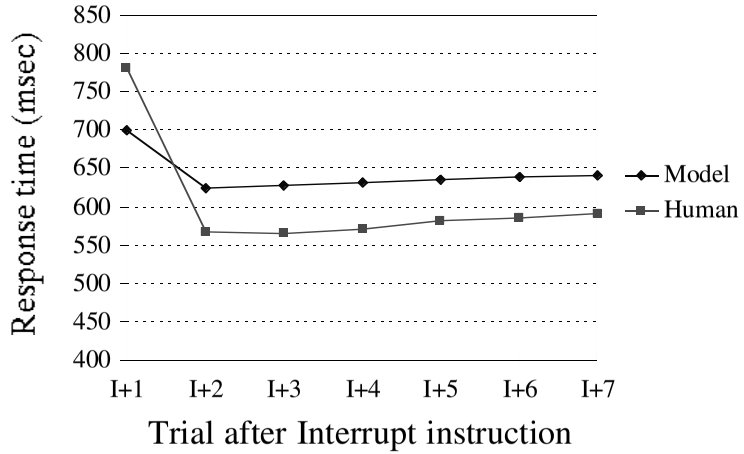
After Interrupt instruction



Hypothesis: Instructional priming



Simulation vs. empirical data



Prediction

- If no separate instruction, then no priming
  - So no within-run slowing
- Experiment 2:
  - Stimulus carries the instruction

Trial 1

Digit means that the task is Even/Odd

9

Trial 2

4

Trial Sw+1

Letter means that the task is Consonant/Vowel

A

Trial Sw+1

Switch back to Even/Odd

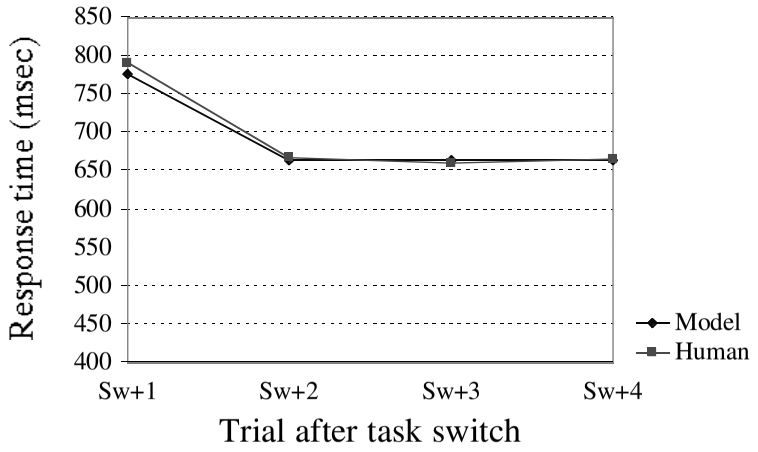
9

More trials

Switches every 1 to 4 trials

...

Simulation vs. empirical data



Other support

- Other factors ruled out by Experiment 3
  - Reminiscence and motor programming
- Other functional interpretations
  - A kind of cognitive anticipation
  - Bundling instruction and trial may reduce error
- Other constraints
  - 600 msec/trial doesn't leave time for many retrievals
  - Instruction and stimulus are colocated
    - If there were a fan from visual location, it shouldn't change

Summary: Instructional priming

- Current instruction primes current trials
- Trials interfere with each other
- New instruction releases interference
  - Meaning of instruction doesn't matter
  - Release is purely episodic

Implications for ACT-R

- Rational retrieval of visual objects
  - Now simulated by a "perception" subgoal
- Requires symbolic associations
  - Encode instruction chunk with visual object
  - No time to associate through co-occurrence

Current implementation

1. Cognition pushes a perception subgoal

```
(p encode-screen
   =goal>
     isa experiment
     instruction =i                    i38
==>
   =p>
     isa perception                    (p42
     instruction =i                       isa perception
   !push! =p)                             instruction i38)
```

2. Perception adds stimulus, then pops object into DM

```
(p42
   isa perception
   instruction i38
   text "aaaaaa")
```

Current implementation

3. Cognition retrieves primed object from DM

```
(p retrieve-trial
   =goal>
     isa experiment
     instruction =i
   =p>
     isa perception
     instruction =i

==>
   =goal>
     trial =p)
```

```
(p42
   isa perception
   instruction i38
   text "aaaaaa")
```


Proposed implementation

1. Cognition moves attention, passing a parameter

```
(p encode-screen
   =goal>
     isa experiment
     instruction =i                          i38
==>
   !send-command!
     :vision move-attention
     :location =loc
     :parameter (instruction =i))            i38
```

2. Vision module creates object with parameter

```
(p42
   isa visual-object
   instruction i38
   text "aaaaaa")
```


Proposed implementation

3. Cognition retrieves primed object from DM

```
(p retrieve-trial
   =goal>
     isa experiment
     instruction =i                 i38

   =p>
     isa visual-object              (p42
     instruction =i                    isa visual-object
                                       instruction i38
                                       text "aaaaaa")
==>
   =goal>
     trial =p)
```