The Subtraction Method & Stimulus Programming

BCS 206

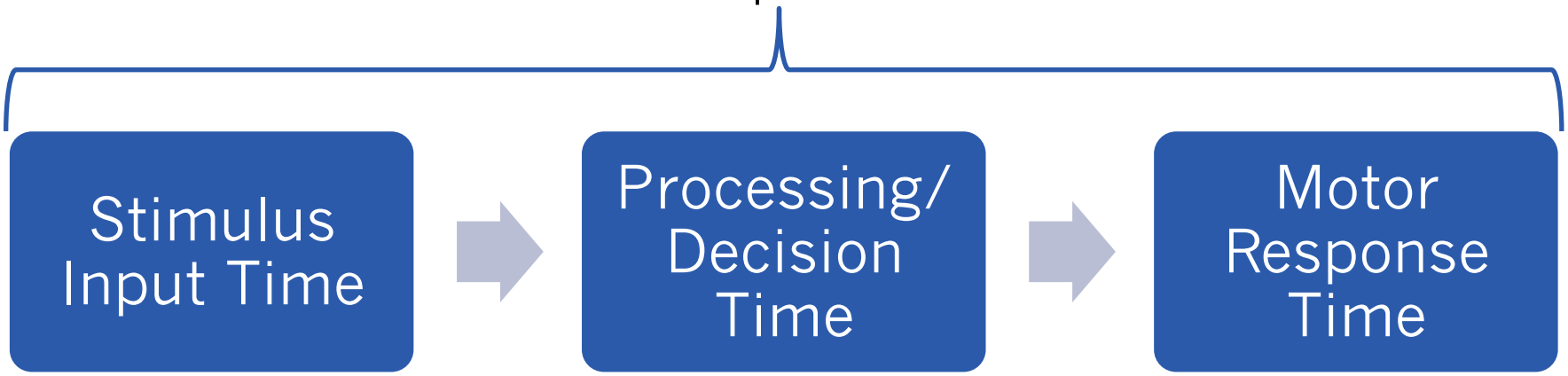
September 30, 2015

The Subtraction Method

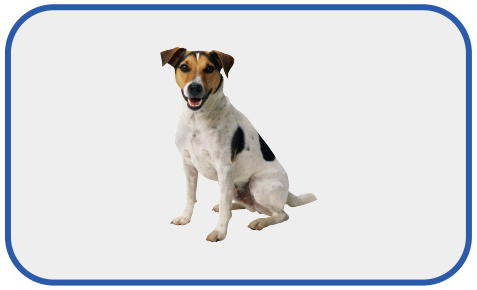
Snodgrass et al. (1985)

Cognitive Processing

a-reaction: Simple Reaction Time



Example Task: Press a button when a picture is presented.



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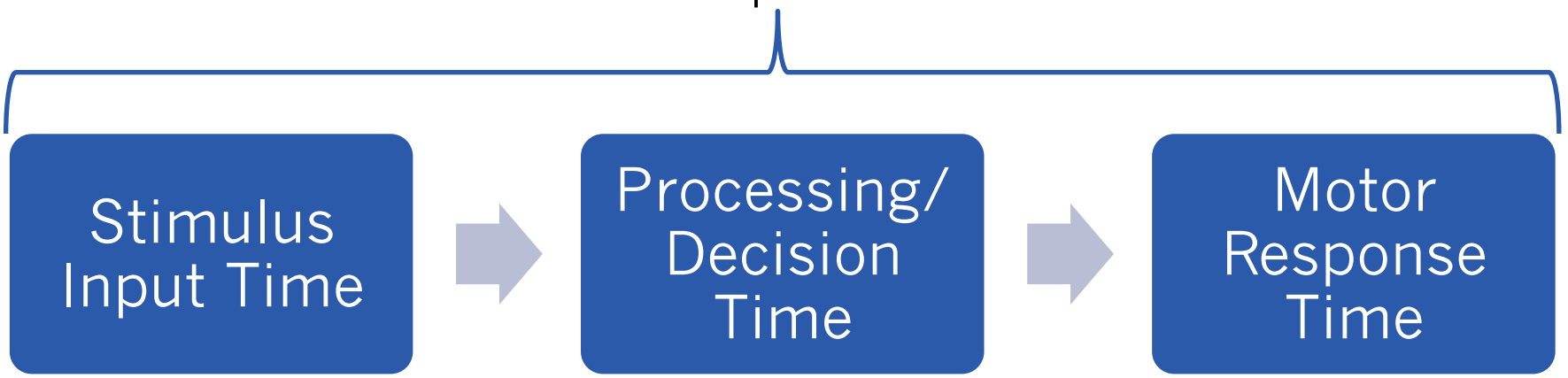

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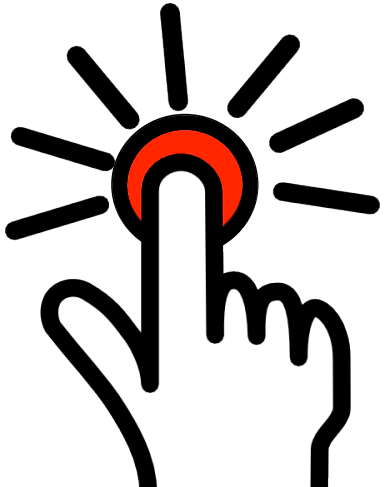

Cognitive Processing

b-reaction: Choice Reaction Time

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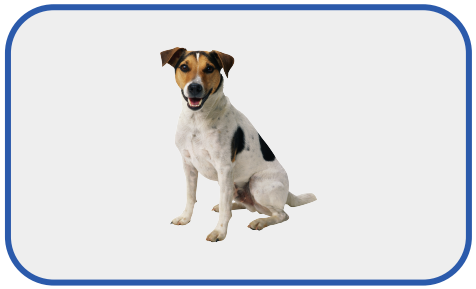

Cognitive Processing

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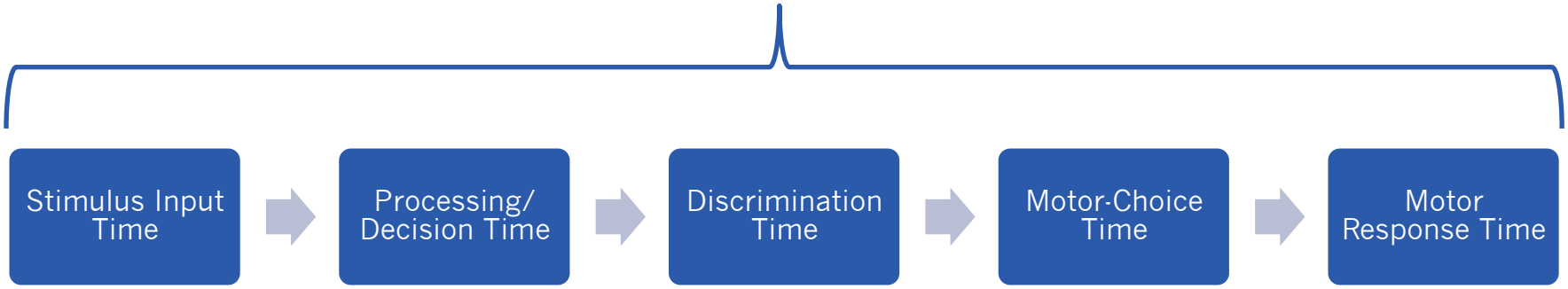

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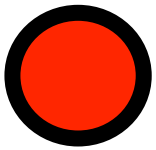
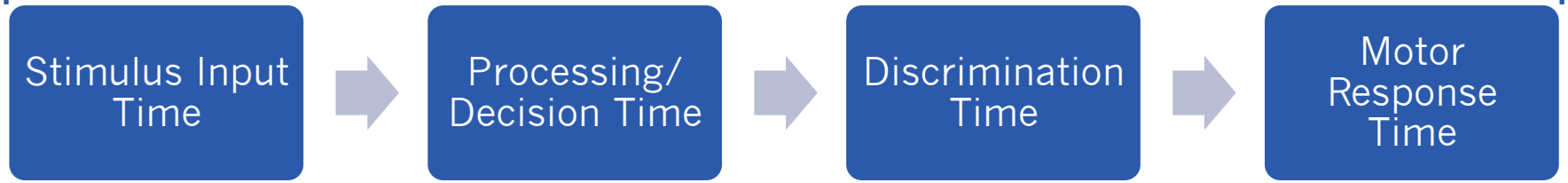


Cognitive Processing

Donder's c-reaction



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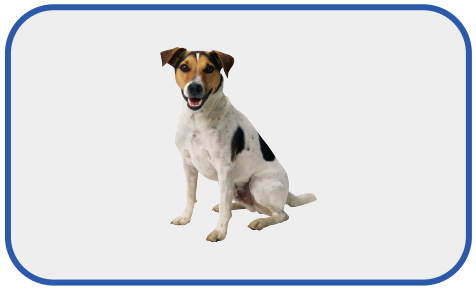

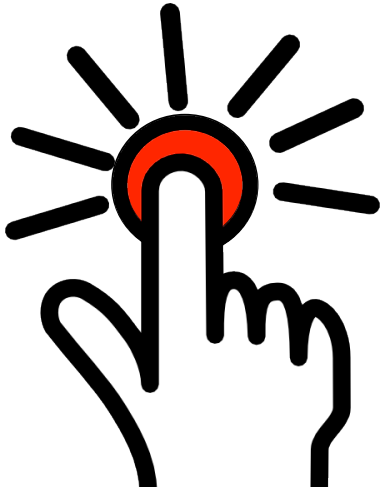

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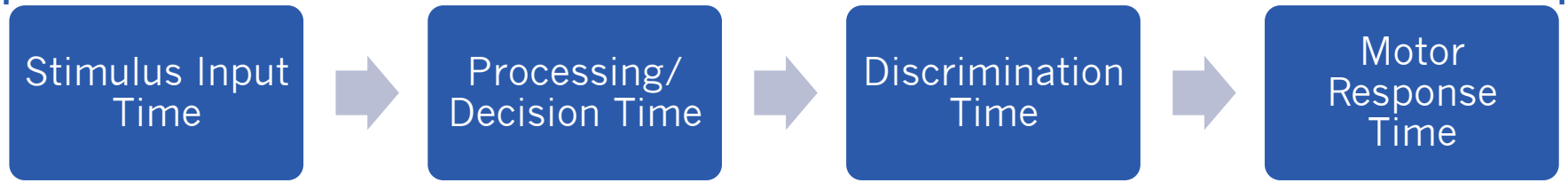

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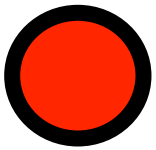
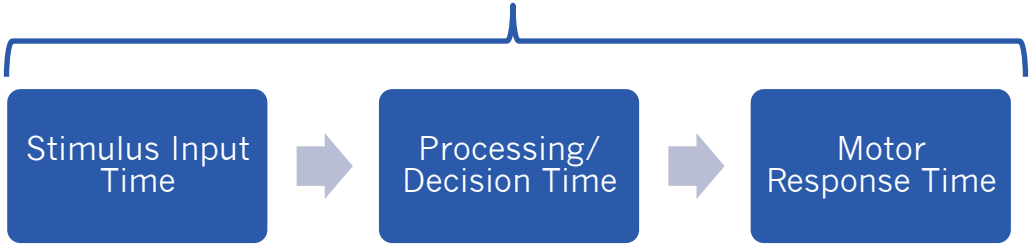


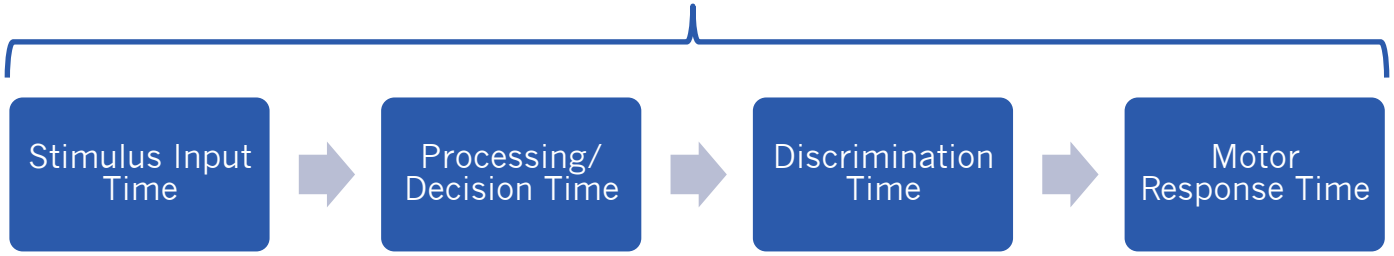
Cognitive Processing

a-reaction: simple reaction time



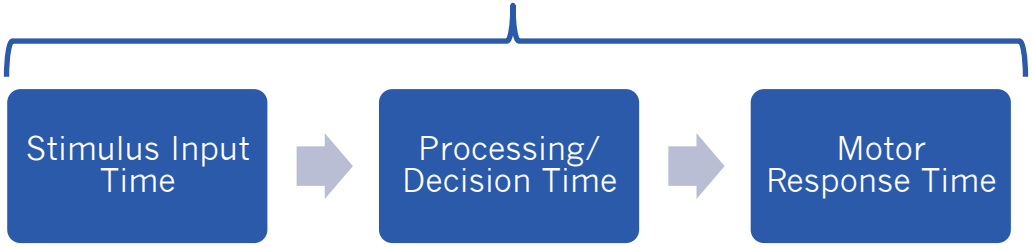
b-reaction: choice reaction time

c-reaction: Donders' c-reaction



Discrimination Time

a-reaction: simple reaction time



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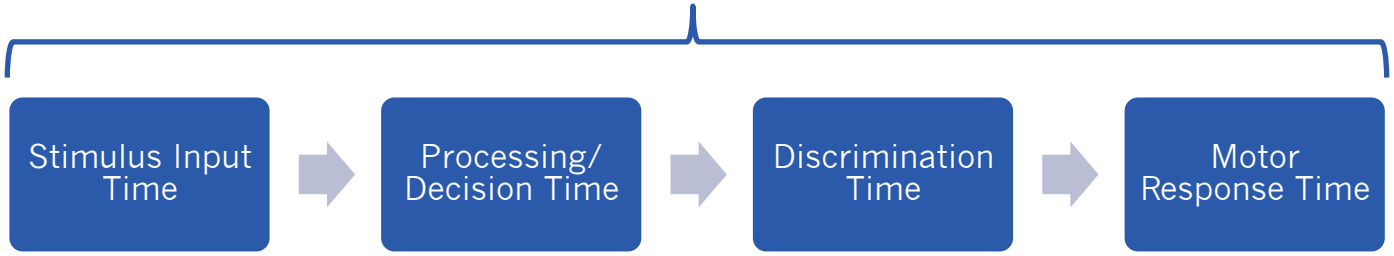

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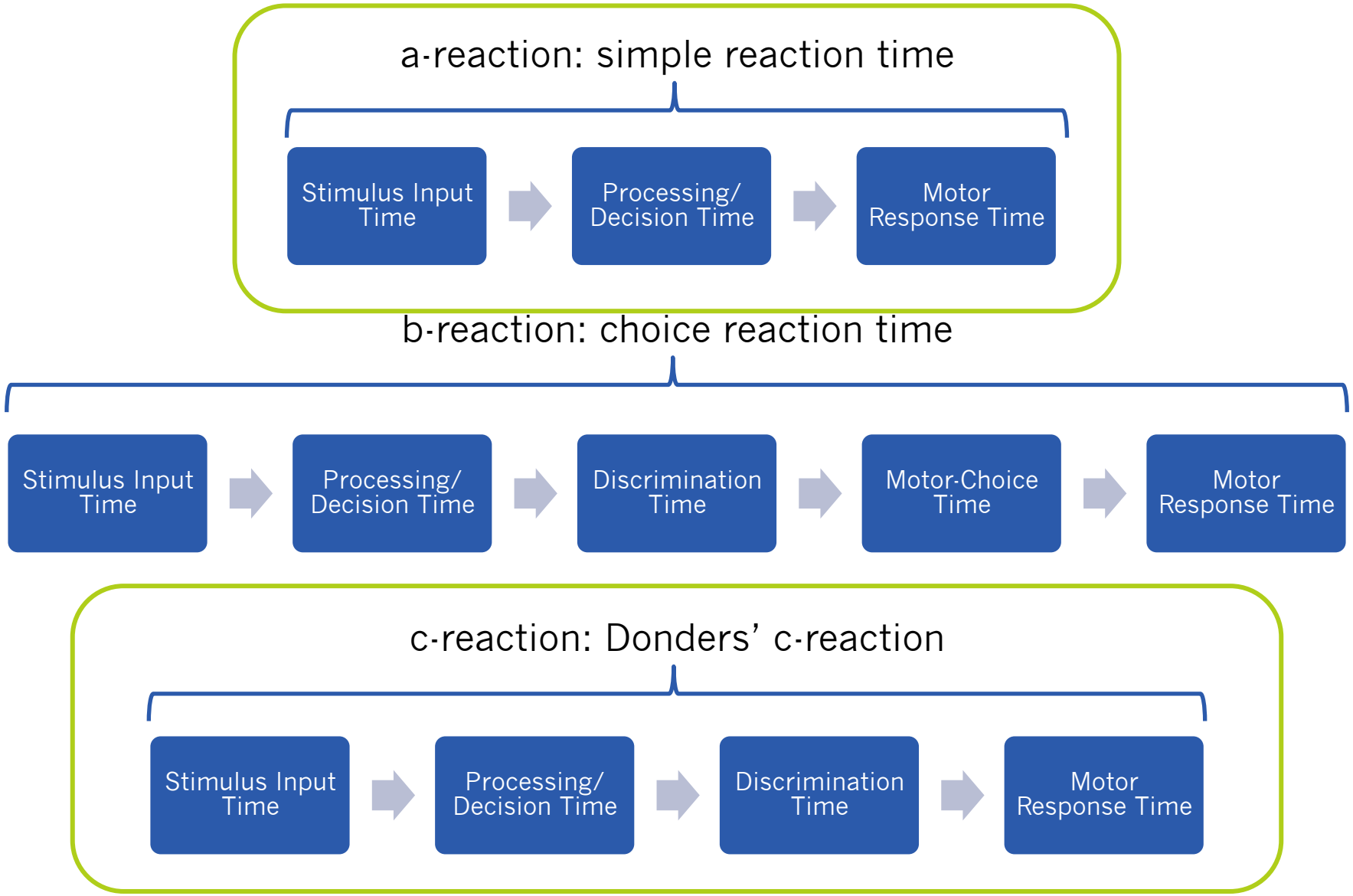

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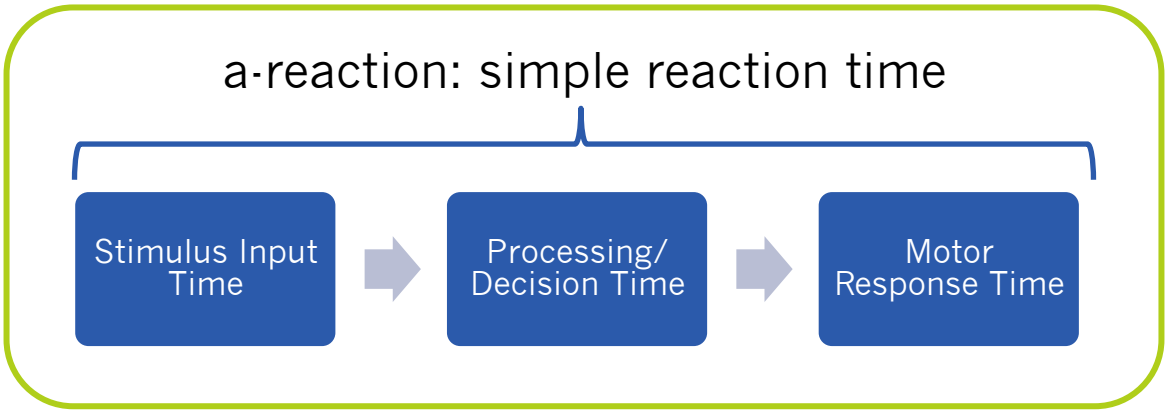
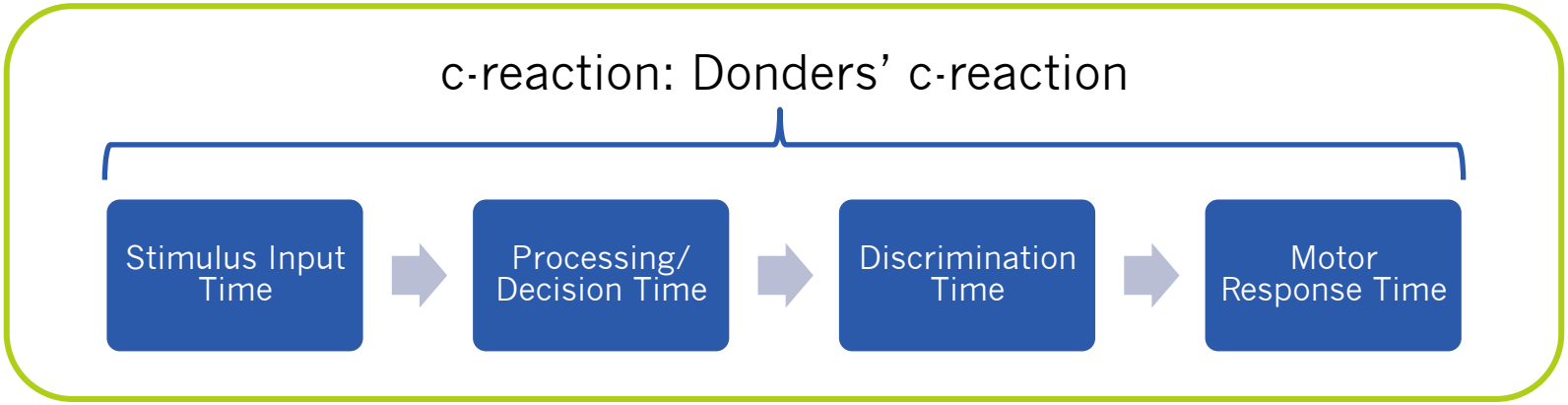
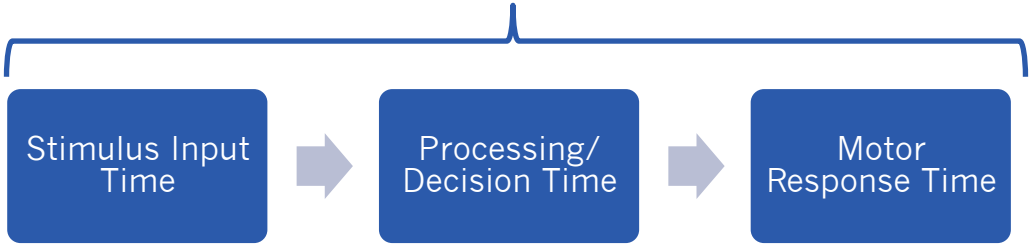


c-reaction – a-reaction = discrimination time



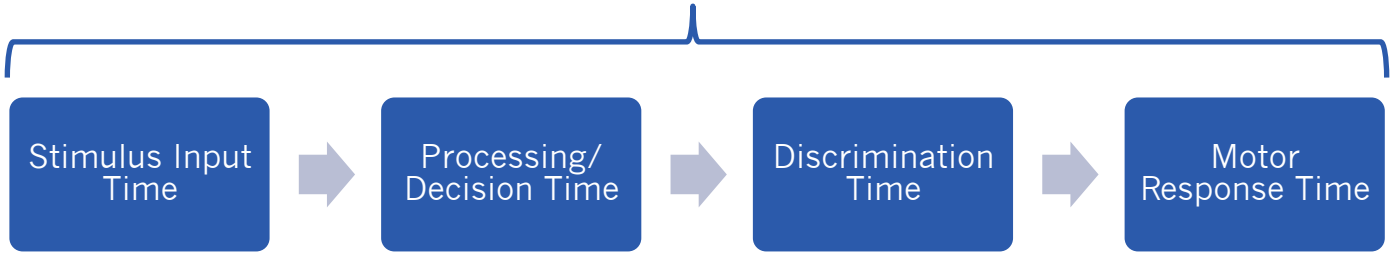
Motor-Choice Time

a-reaction: simple reaction time



b-reaction: choice reaction time

c-reaction: Donders' c-reaction



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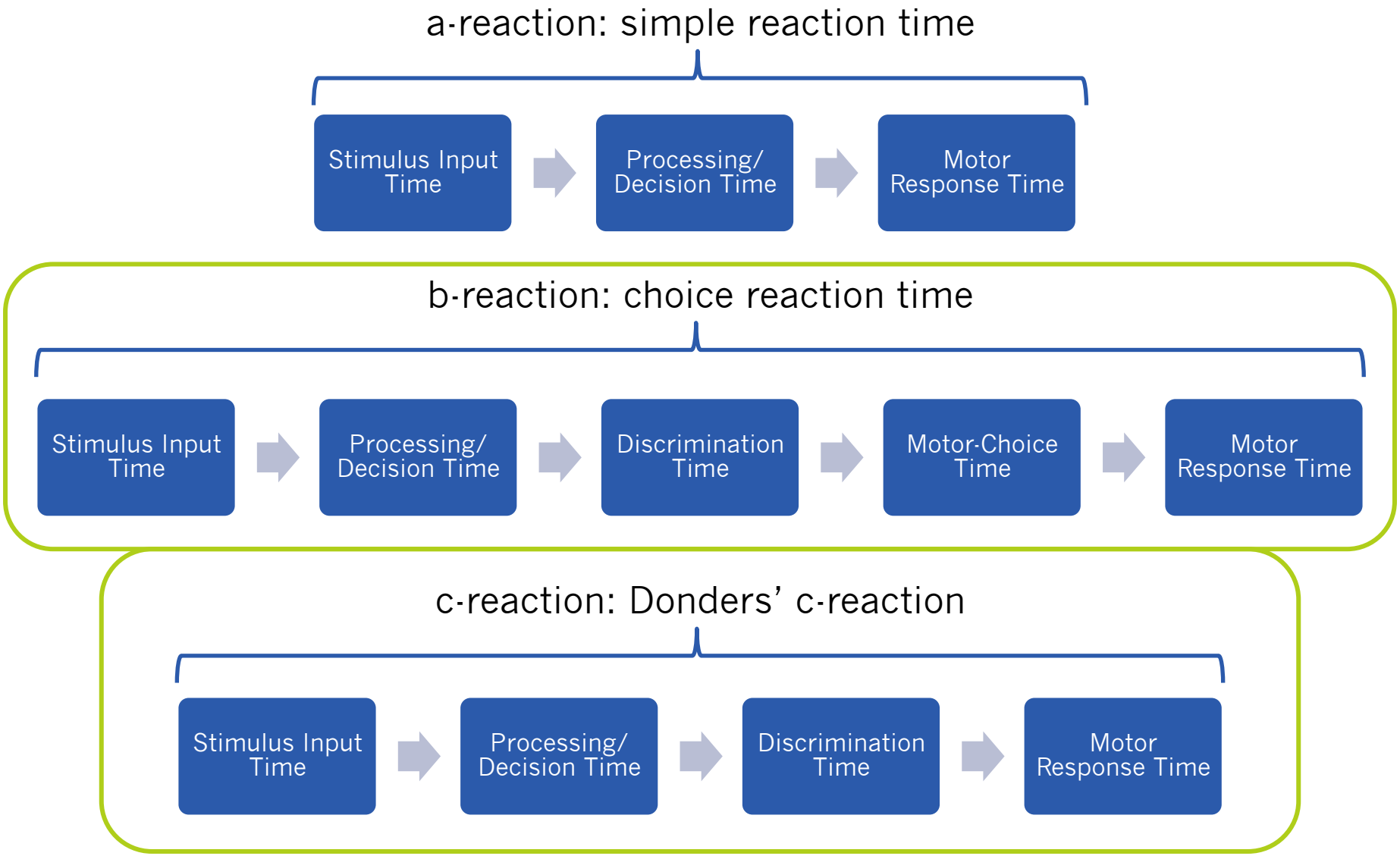
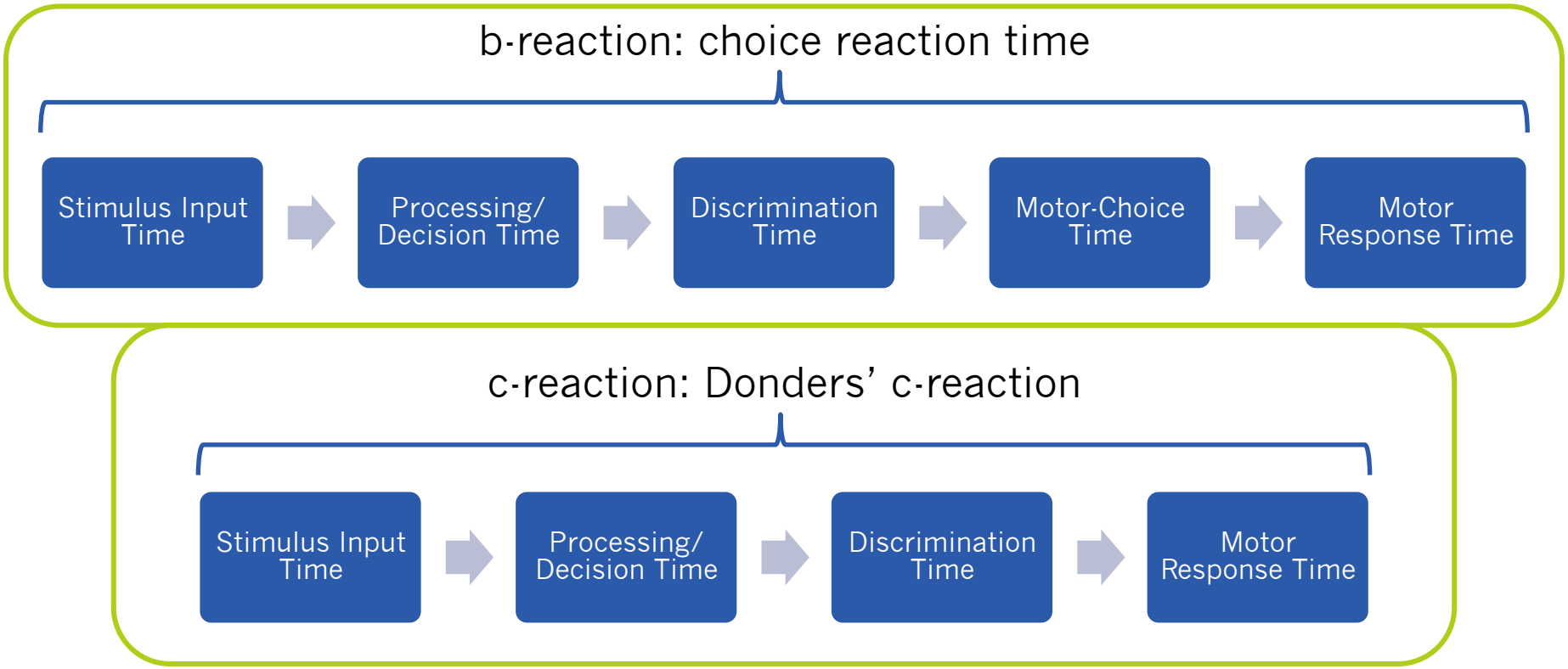


Motor-Choice Time

b-reaction – c-reaction = motor-choice time



Problems with Donders' Subtraction

1. c-reaction sometimes LONGER than b-reaction → negative motor-choice time
   - c-reaction still involves a motor-choice (go/no-go response)

Problems with Donders' Subtraction

1. c-reaction sometimes LONGER than b-reaction → negative motor-choice time
   - c-reaction still involves a motor-choice (go/no-go response)

2. Different mental operations for simple and choice reaction-time tasks
   - Greater motor readiness in simple response than choice reaction time

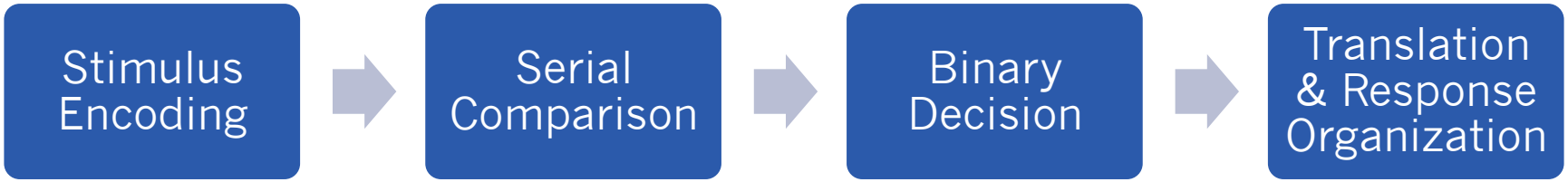
How do we fix it?

How do we fix it?
Sternberg's Additive Factors

Sternberg's Additive Factors

- Instead of deleting a stage, just manipulate one!
- Can help determine the number of stages, the length of a stage or combination of stages, and which variables affect which stages

Stages Proposed for Memory Scanning Task



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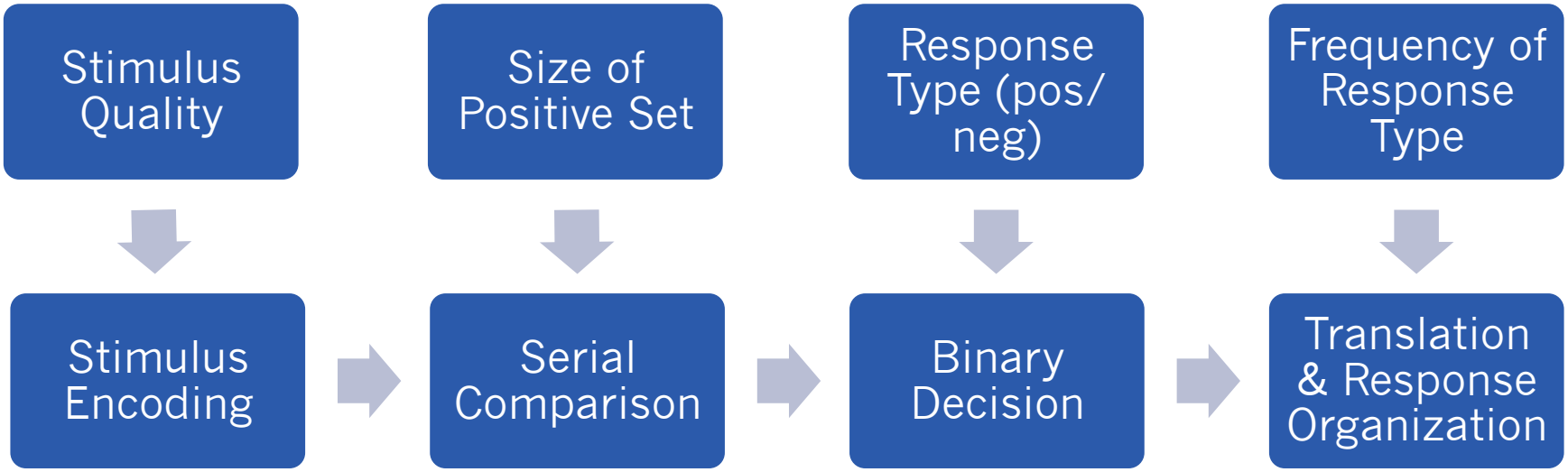


Two Main Effects

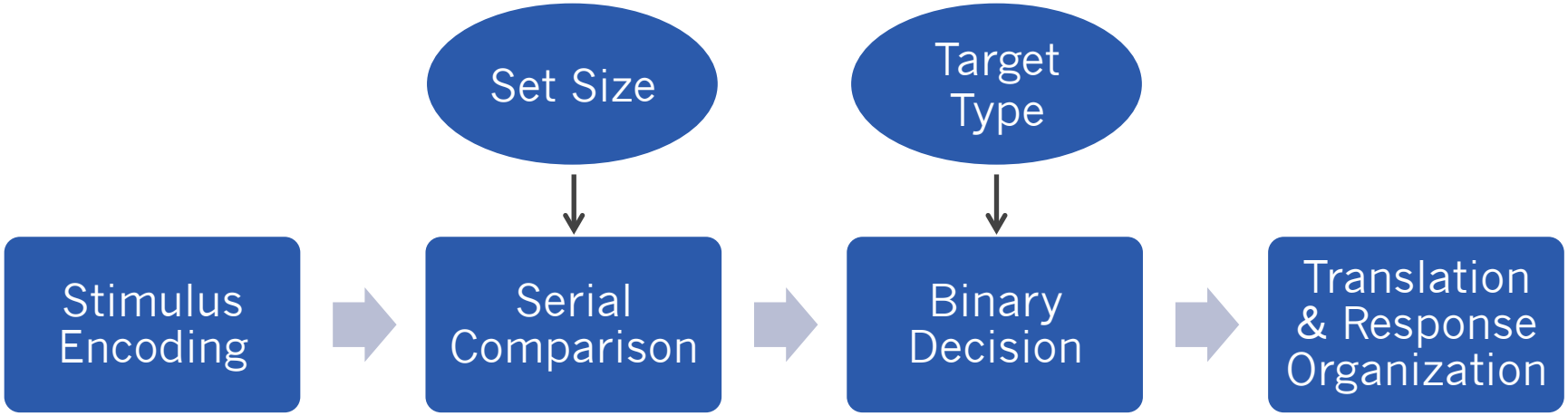
- **Additive Effect:** If two variables effect **different** stages, then their effects will be additive

- **Interaction Effect:** If two variables effect the **same** stages, then their effects will interact

Factorial Design

- An experiment with two or more variables each with 2 or more levels (factors)
- Set Size (6 levels)
  - 1, 2, 3, 4, 5, and 6
- Target Type/Response Type (2 levels)
  - Target Present (respond yes)
  - Target Absent (respond no)

Additive Effect



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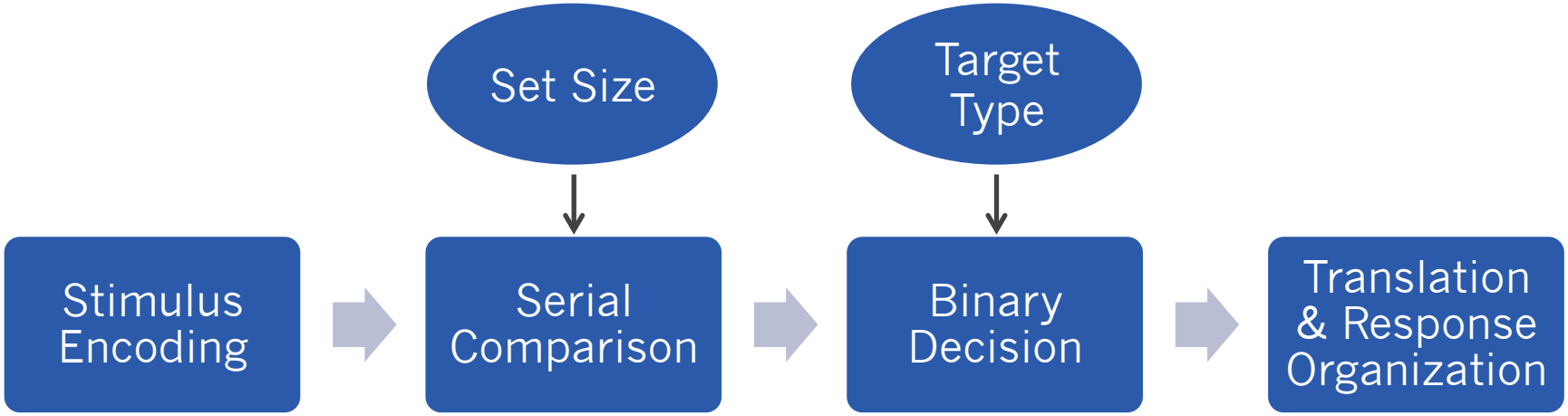
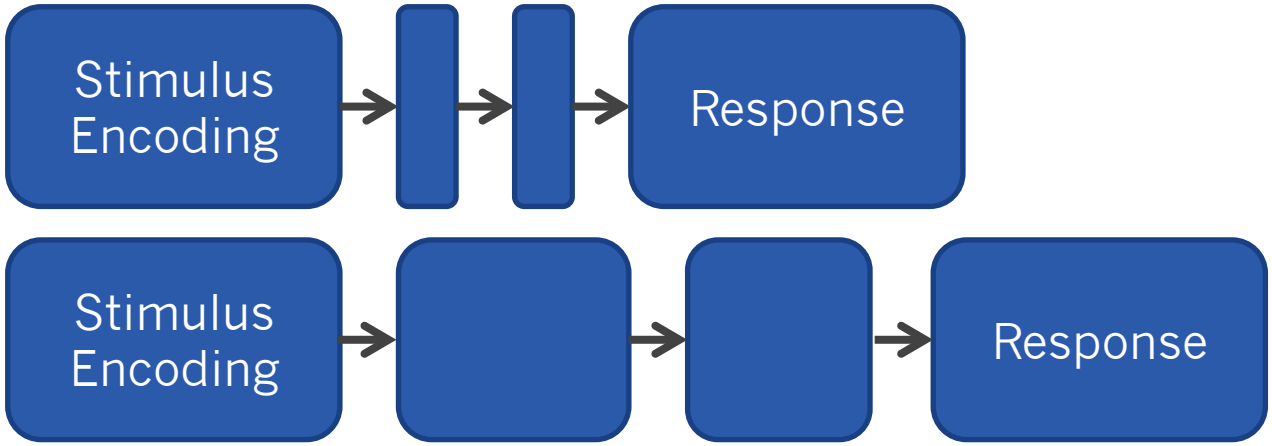


- One comparison = 50 ms
- Target Absent Trial – Target Present Trial = 75 ms
- Set Size of 4 & Target Absent –
  Set Size of 1 & Target Present = 50 + 50 + 50 + 75

Additive Effect



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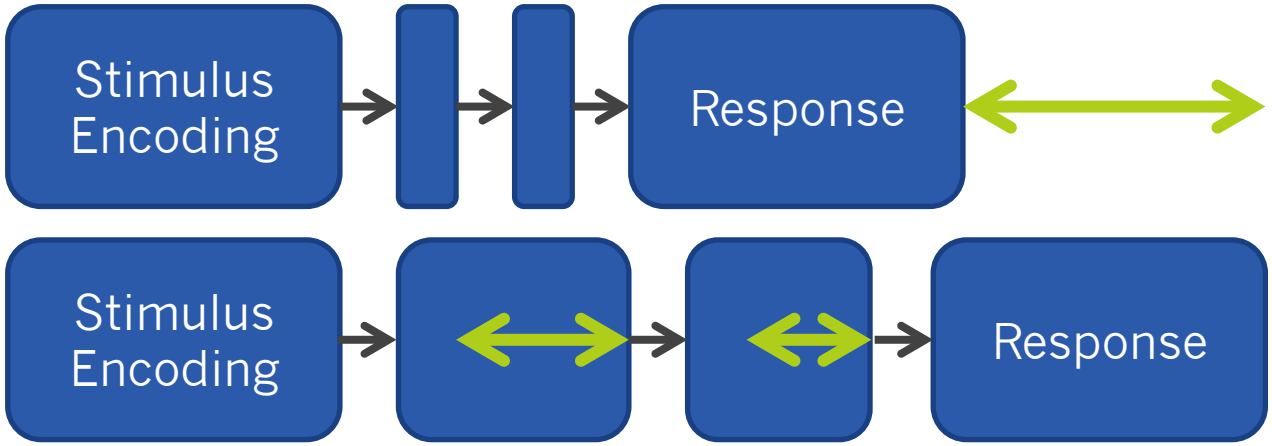

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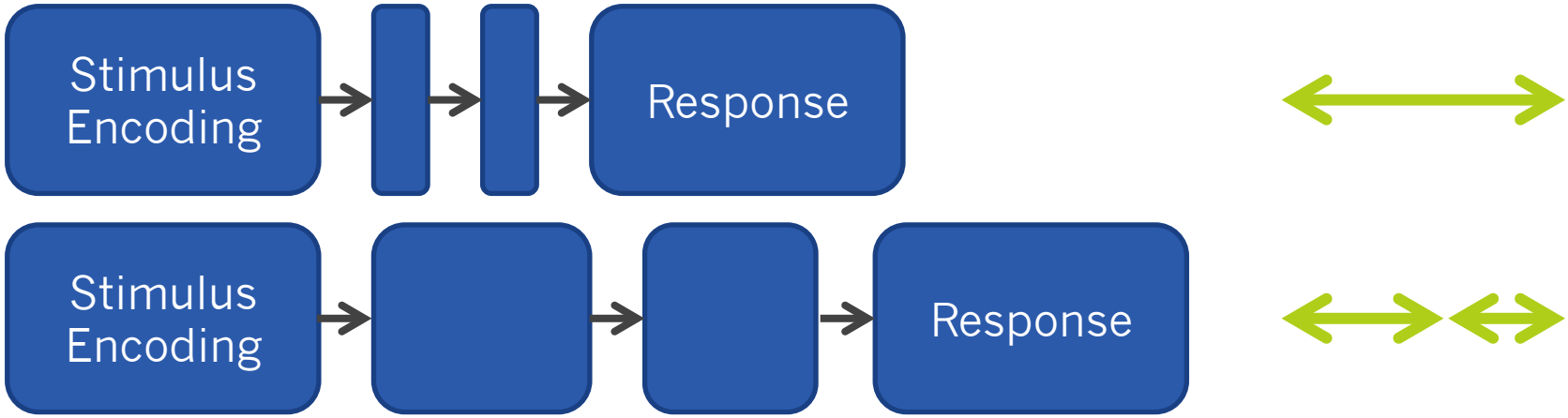

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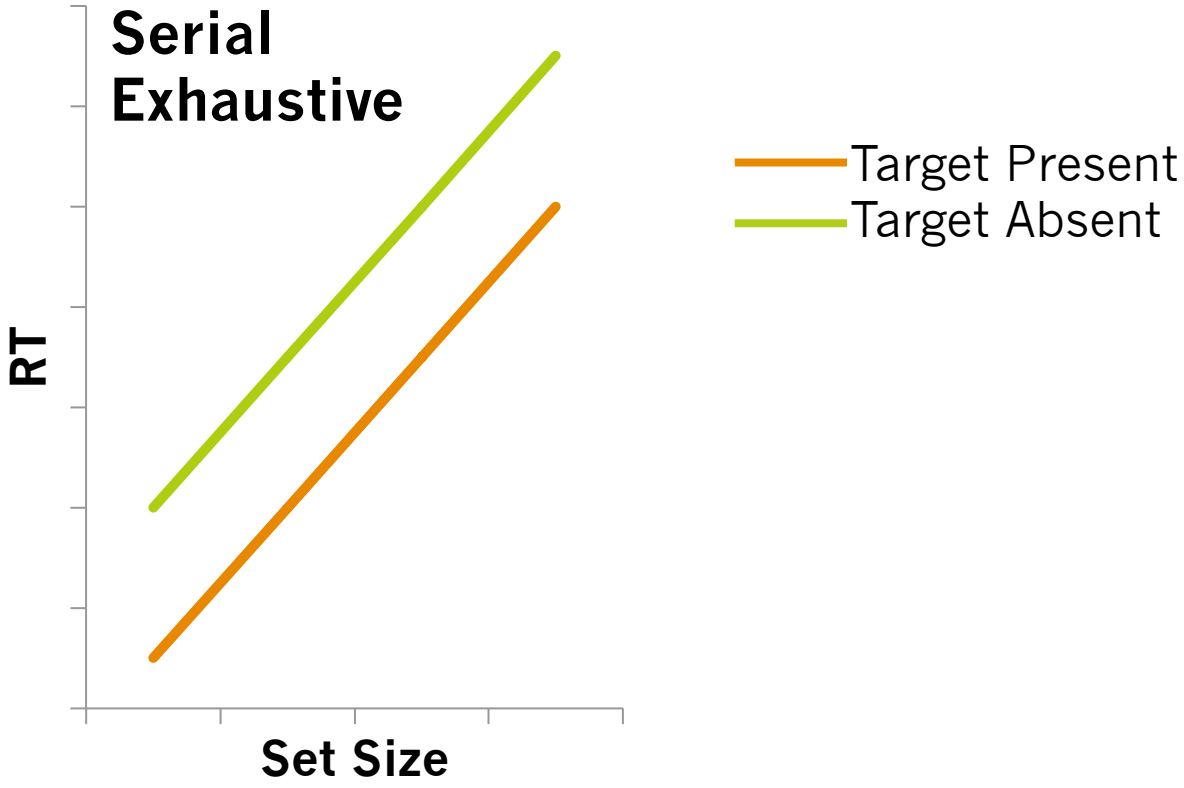
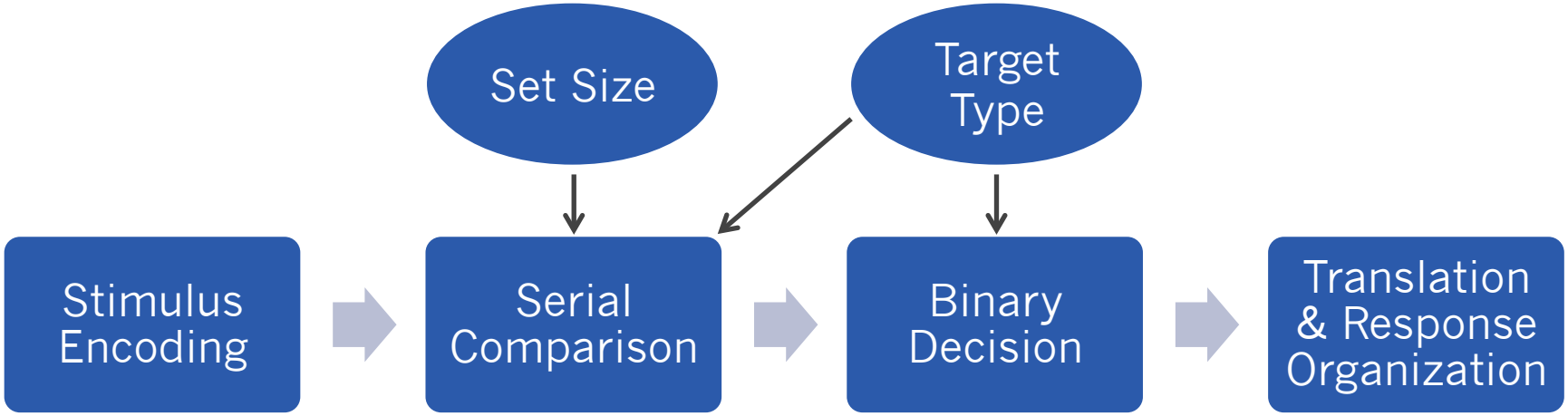


Interactive Effect



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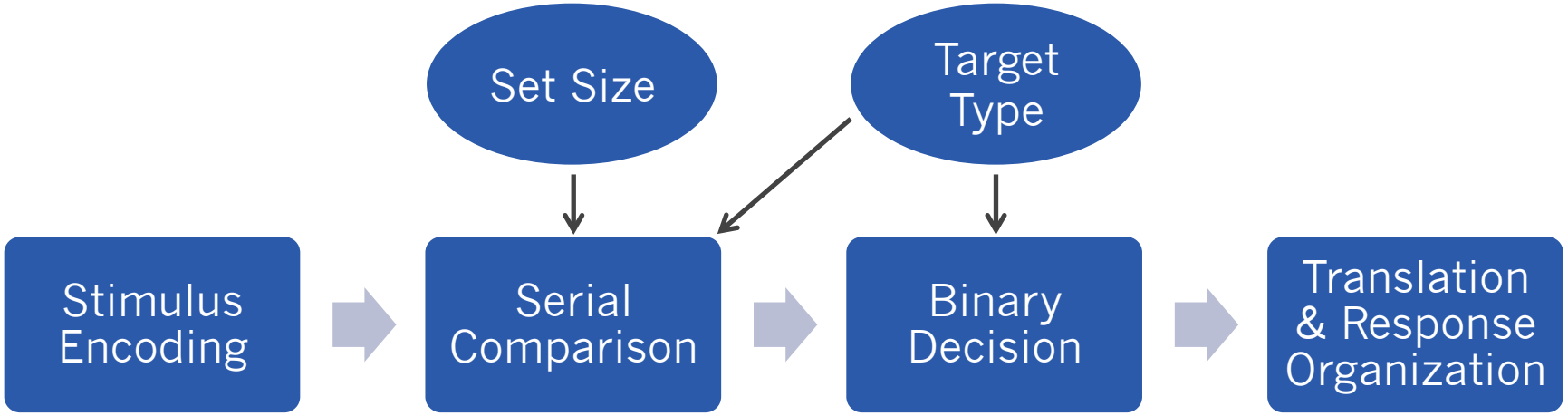

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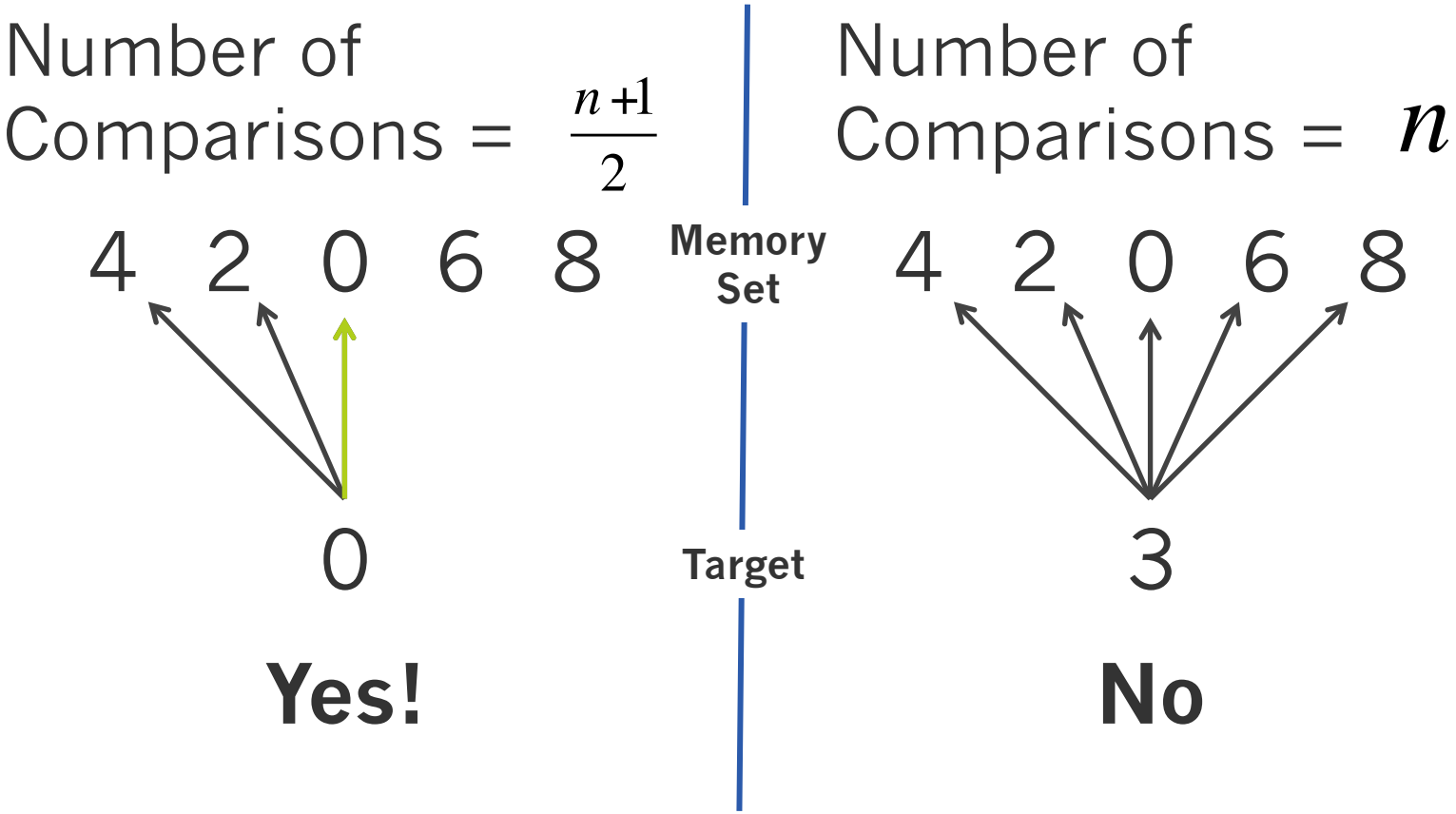
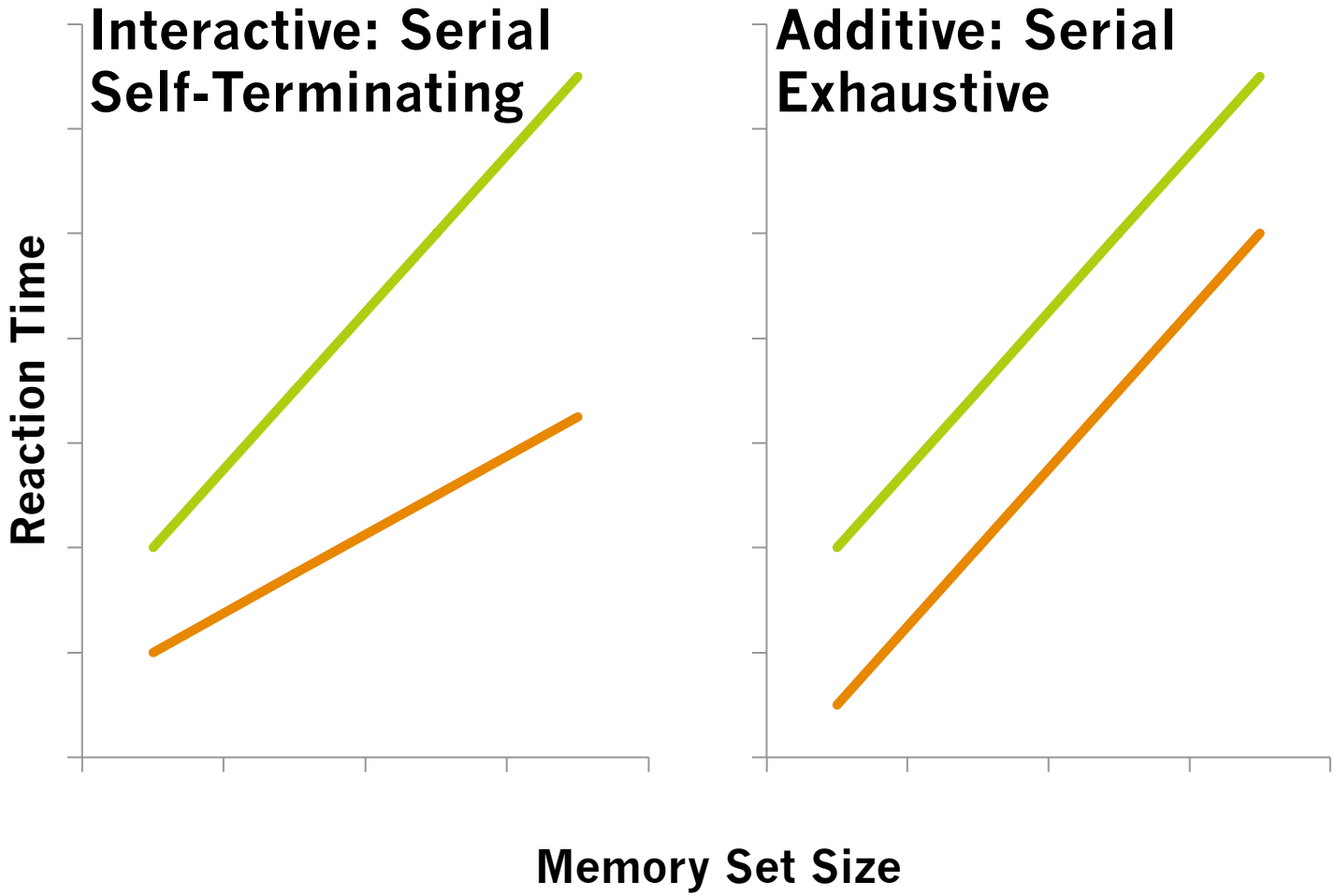


Serial Self-Terminating

Patterns of Different Effects



The key to both of these methods is **comparison.**

What is a (good) control condition?

- A condition that allows you to isolate the effect of the variable of interest on the dependent measure (e.g., reaction time)

Example #1: Object Processing Regions in the Brain

- Activation to Objects – Activation to Non-Objects (control)
- What would be a good control?

Yovel & Kanwisher (2005)

Example #1: Object Processing Regions in the Brain

- Activation to Objects – Activation to Non-Objects (control)
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a r o
e v b
d m

Regions sensitive to properties of pictures? (e.g., luminance)

Yovel & Kanwisher (2005)

Example #1: Object Processing Regions in the Brain

- Activation to Objects – Activation to Non-Objects (control)
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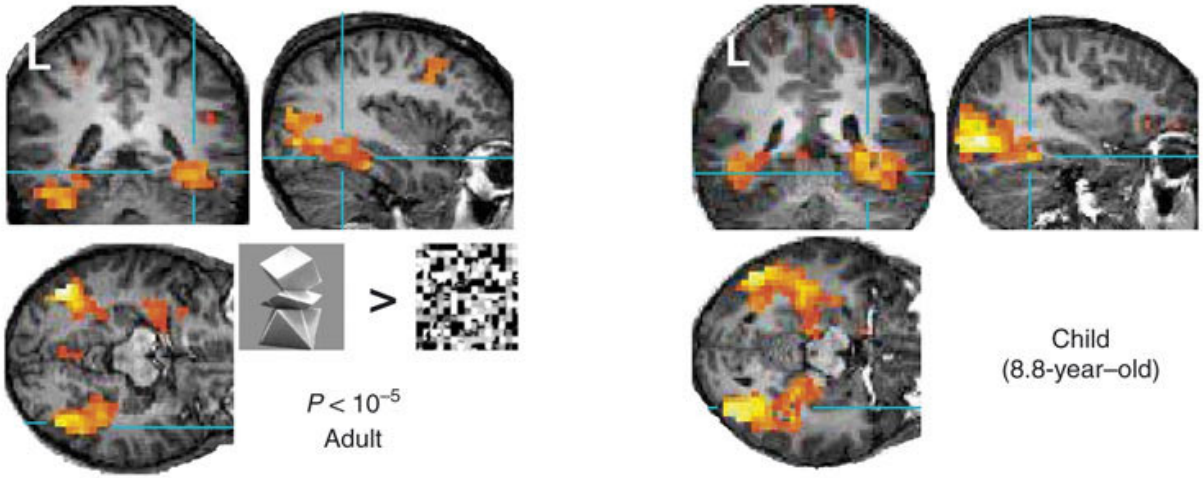
Yovel & Kanwisher (2005)

Example #1: Object Processing Regions in the Brain

- Activation to Objects – Activation to Scrambled Objects



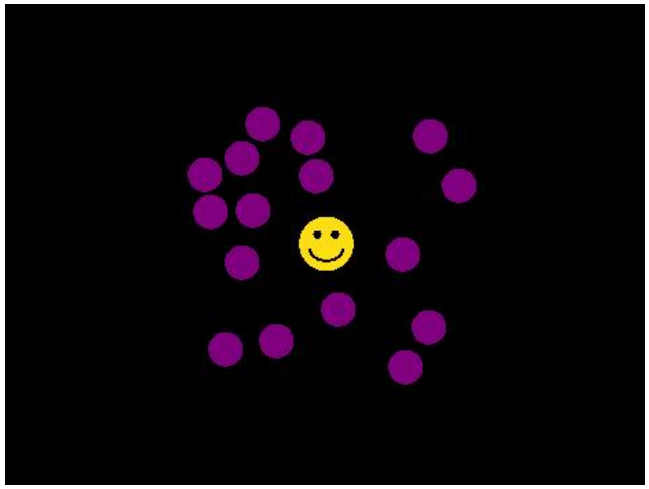
Golarai et al. (2007)

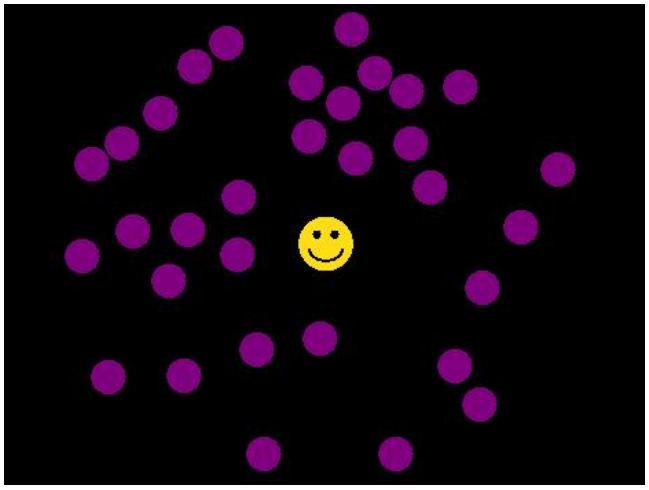
Example #1: Object Processing Regions in the Brain

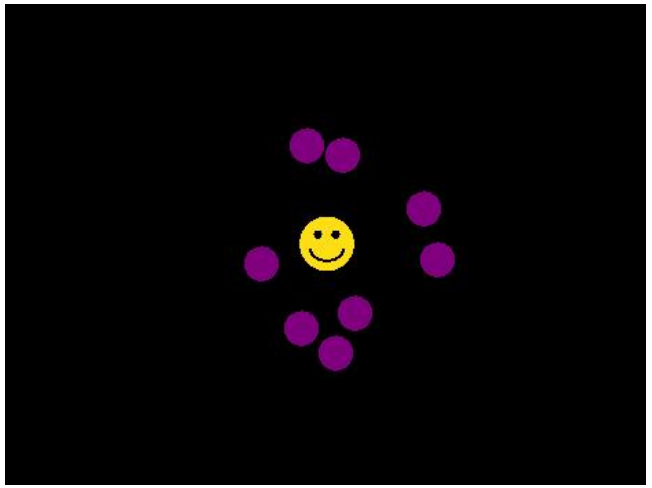
- Activation to Objects – Activation to Non-Object Control

Other types of control stimuli?

Example #2: Number Sensitive Regions in the Brain







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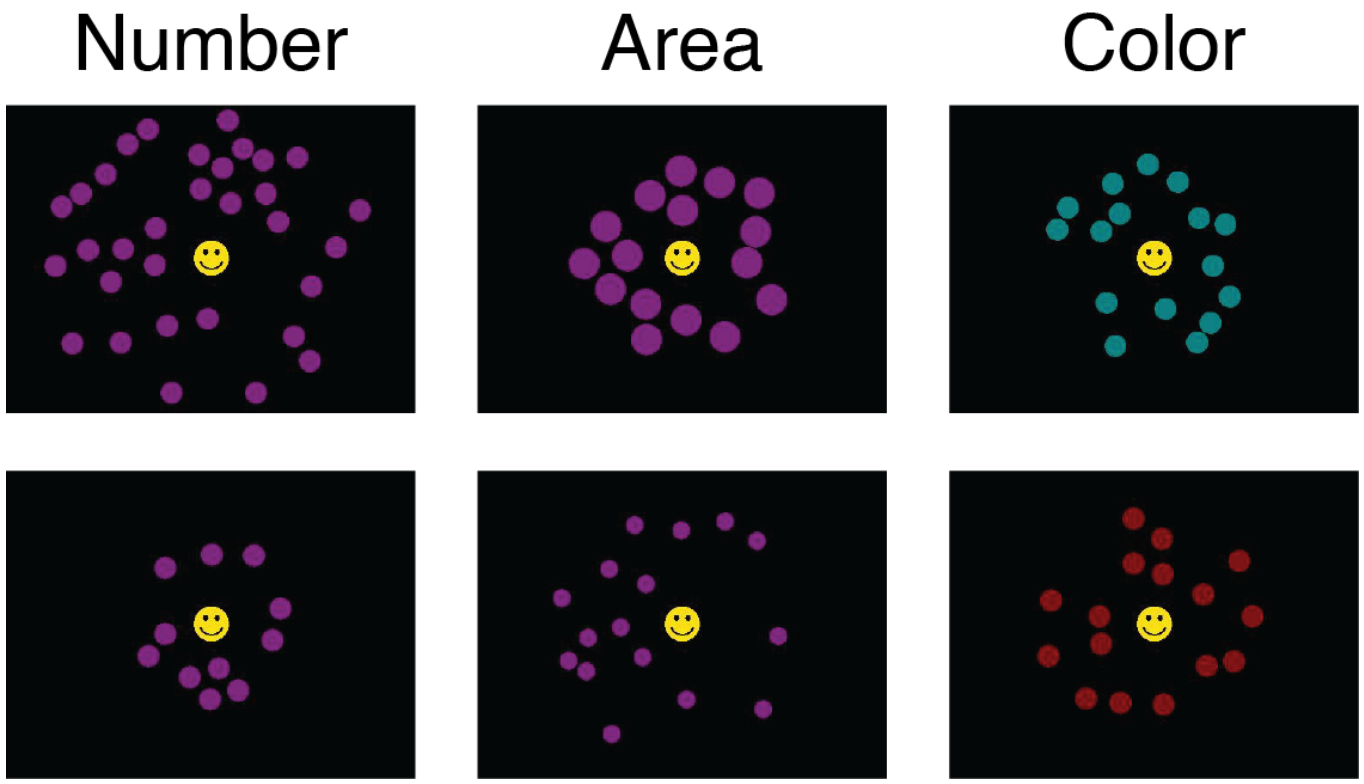
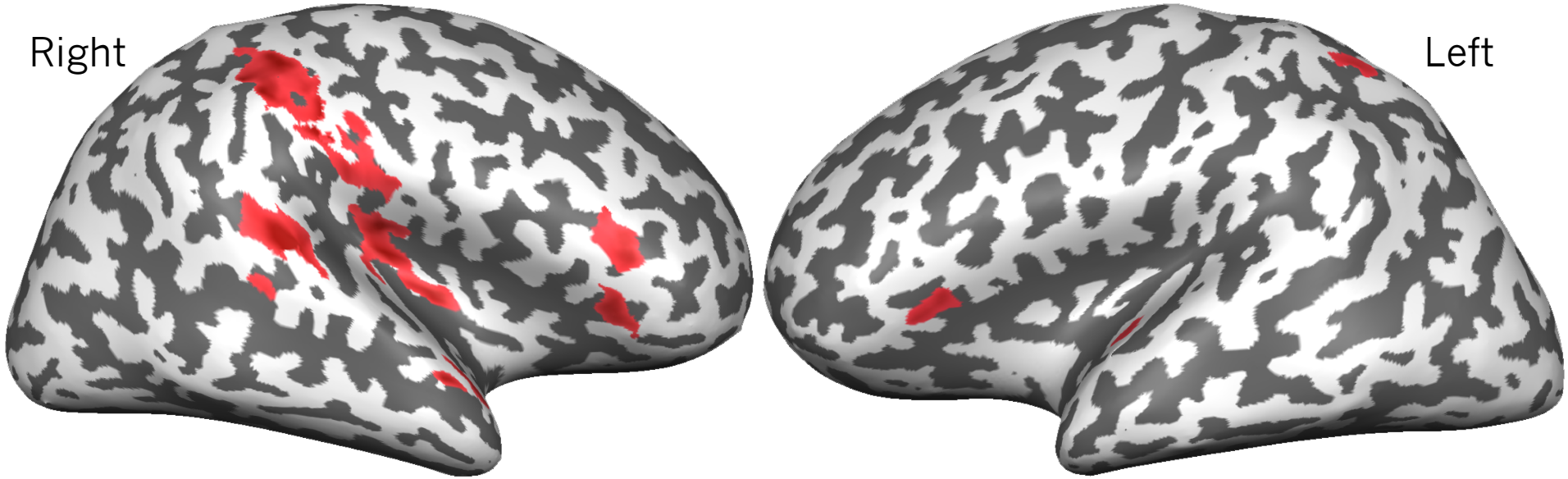


Example #2: Number Sensitive Regions in the Brain

Activation to Number Changes – Activation to Area and Color Changes



Stimulus Programming

SuperLab & MATLAB

SuperLab

- http://www.superlab.com
- Graphical user interface for stimulus presentation and data collection
- Manual: http://www.cedrus.com/superlab/manual/superlab5-manual-rev-d.pdf

MATLAB (Psychtoolbox)

- http://www.mathworks.com/products/matlab/
- Can be used for statistics, plotting data, presenting stimuli, and more!
- Stimulus Presentation: Psychtoolbox
  - http://psychtoolbox.org
  - Must download separately!

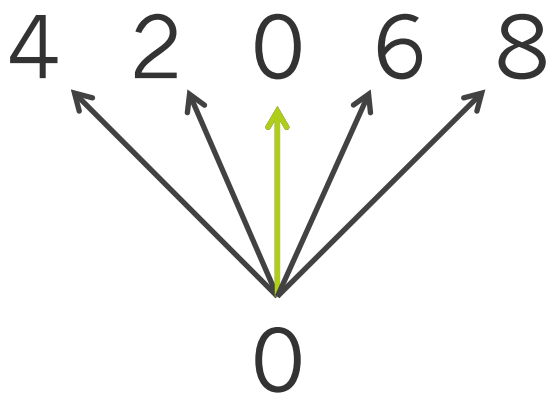
SuperLab Steps

1. Create stimulus lists
2. Set Participant Input (key to begin, keys for correct responses)
3. Set durations for ISIs (Trial Levels)
4. Create Blocks
5. Create Trials
6. Create Events
7. Link Events to Trials
8. Link Blocks to Events

Extra Slides

Additive Effect

Number of Comparisons = n

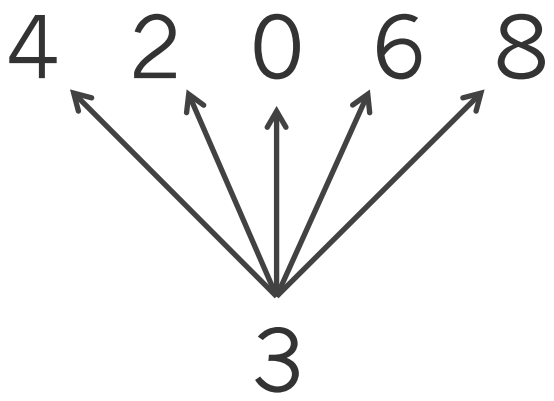


Yes!

Memory Set

Target

Number of Comparisons = n



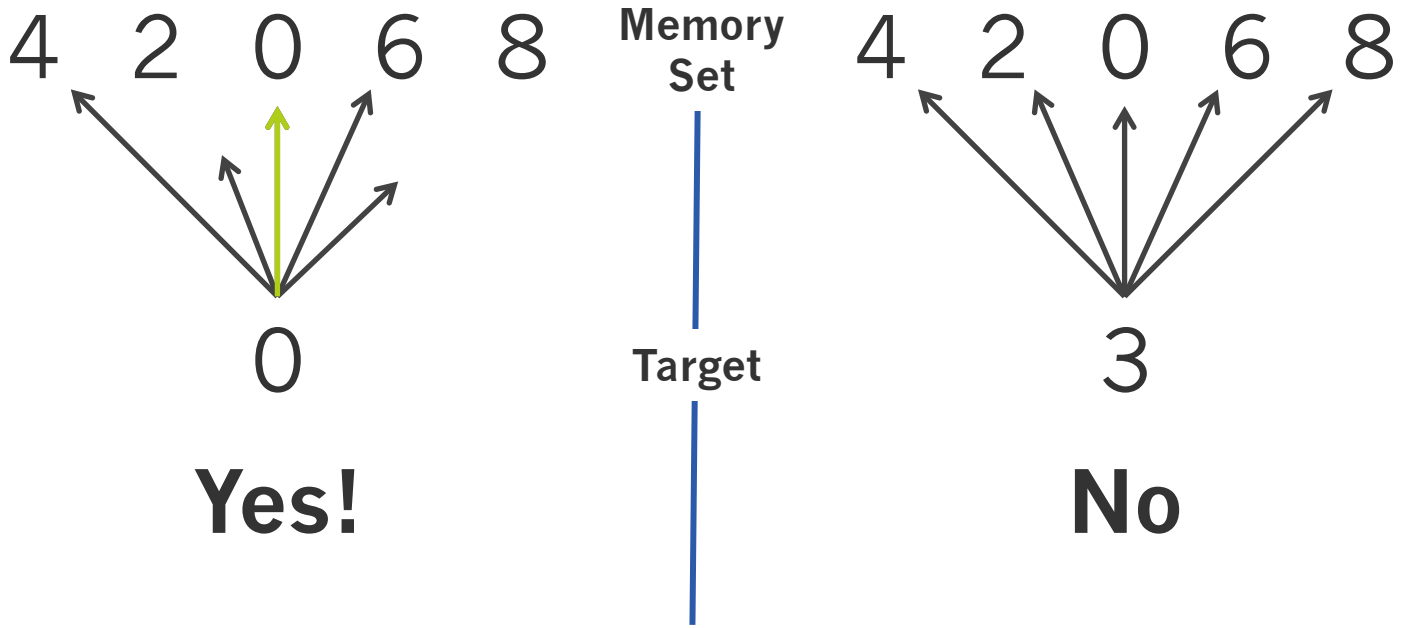
No

Serial Exhaustive

How do we access items in short-term memory?

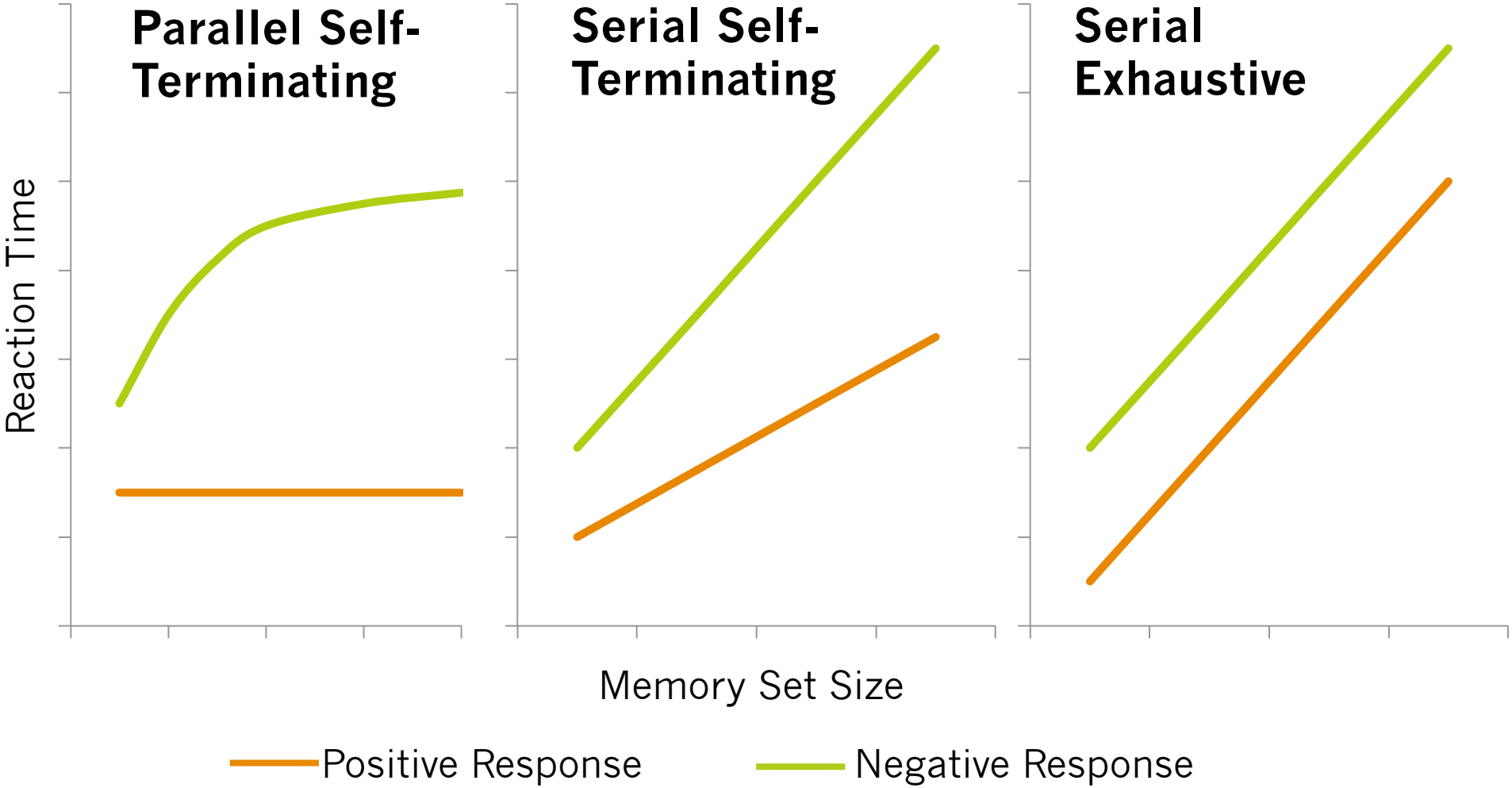
Search time = time to access match

Search time = max time to access an item



Parallel Self-Terminating

Predicted Patterns of Searches



Hypothetical Data