

The Attentional Capacity of Visual Search under Flicker Conditions

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The Attentional Capacity of Visual Search under Flicker Conditions

Failure to detect large changes in scenes when made

- during eye saccades
- during attentional distraction (flicker)

-> Perception = data × attention

Main Issues:

- Which aspects of performance due to **data structures**?
- Which are due to **attentional control mechanisms**?
- How do these structures and mechanisms **interact**?

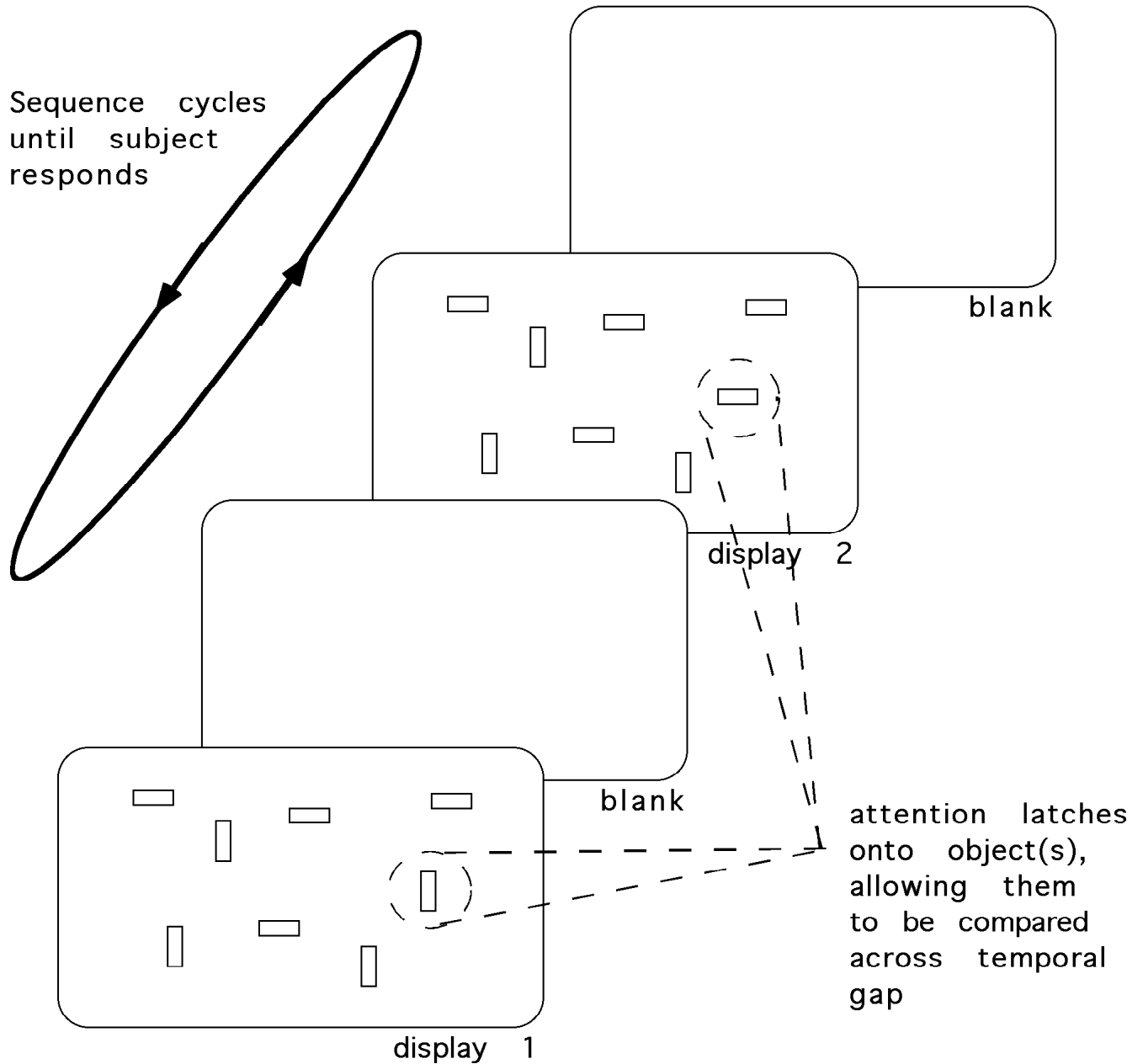
Initial Approach:

Task: detection of change in flicker display

Stimuli: isolated, simple shapes where structural complexity is at a minimum.

Question: how many objects are "grabbed" and compared in each alternation?

Method: Visual search for target that **changes its properties**.
Target cannot be determined from any one display;
must be determined via **comparison**.



To determine how many items are "grabbed" by attention during each display:

E.g. - if display alternates every 100 ms, and 1 item "grabbed" per display, then

$$\text{Search Slope} = \frac{100 \text{ ms / alternation}}{1 \text{ item / alternation}} = 100 \text{ ms / item}$$

E.g. - if display alternates every 100 ms, and 5 items "grabbed" per display, then per-item search is:

$$\text{Search Slope} = \frac{100 \text{ ms / alternation}}{5 \text{ item / alternation}} = 20 \text{ ms / item}$$

In general:

$$\text{Search slope} = \frac{\text{Alternation Time (on-time + off-time)}}{\text{items / alternation}}$$

And so:

$$\text{Capacity} \equiv \frac{\text{items}}{\text{alternation}} = \frac{\text{Alternation Time}}{\text{Search Slope}}$$

Results: Attentional Capacities

For off-times (blanks) of 80 ms:

- Orientation change Capacity

display = 40 ms	1.5 (± 0.2)
80 ms	1.8 (± 0.3)
120 ms	2.0 (± 0.3)
160 ms	2.3 (± 0.4)

- Contrast sign change Capacity

display = 40 ms	1.3 (± 0.2)
80 ms	1.3 (± 0.3)
120 ms	2.0 (± 0.2)
160 ms	2.5 (± 0.4)

- Location change (1°) Capacity

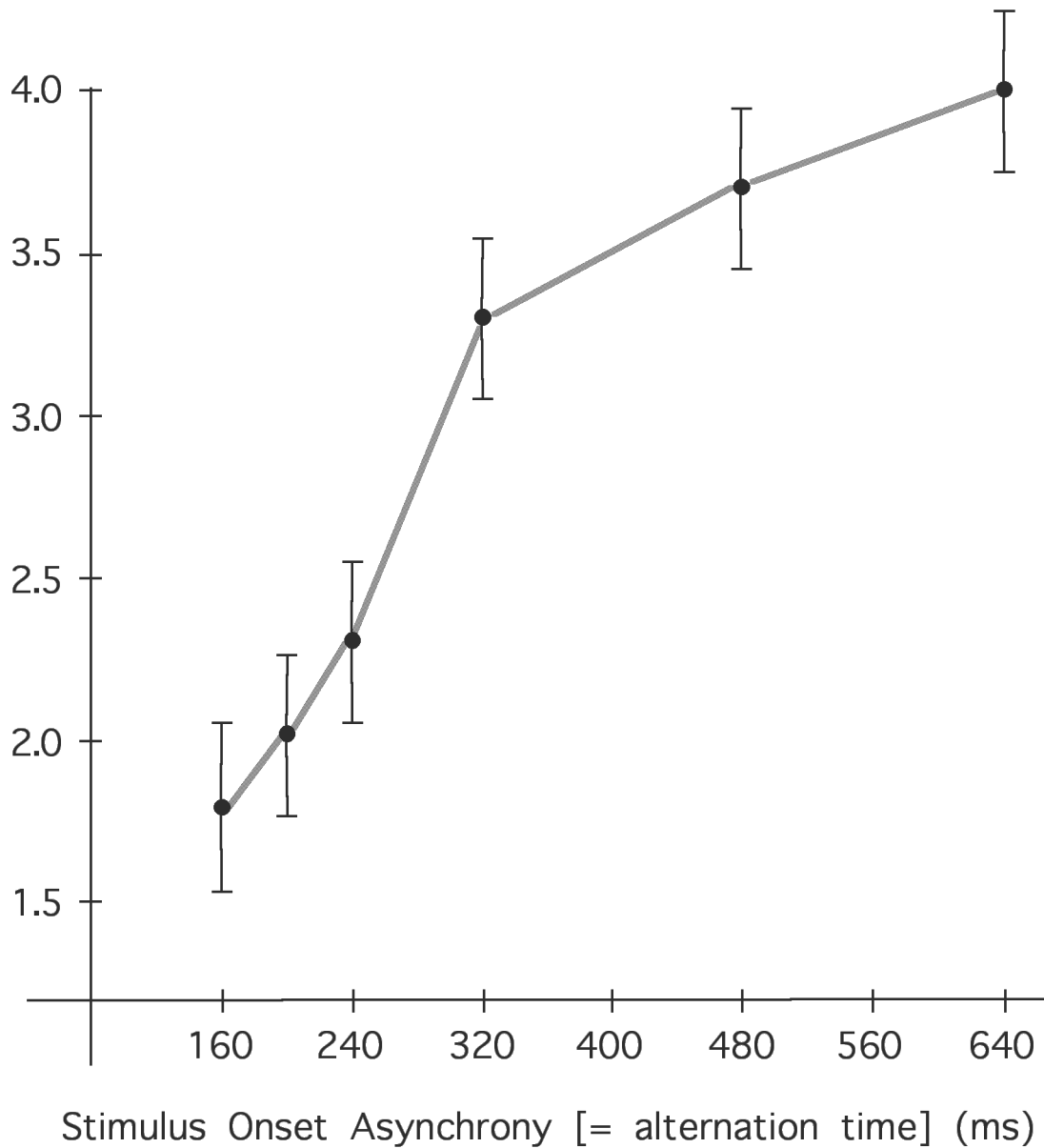
display = 40 ms	1.5 (± 0.2)
80 ms	1.6 (± 0.3)
120 ms	2.7 (± 0.4)
160 ms	3.2 (± 0.7)

- capacities vary more between subjects
 - > some subjects compare item-by-item
 - > some subjects use overall shape of group

What happens as display time per alternation is increased?

Orientation change

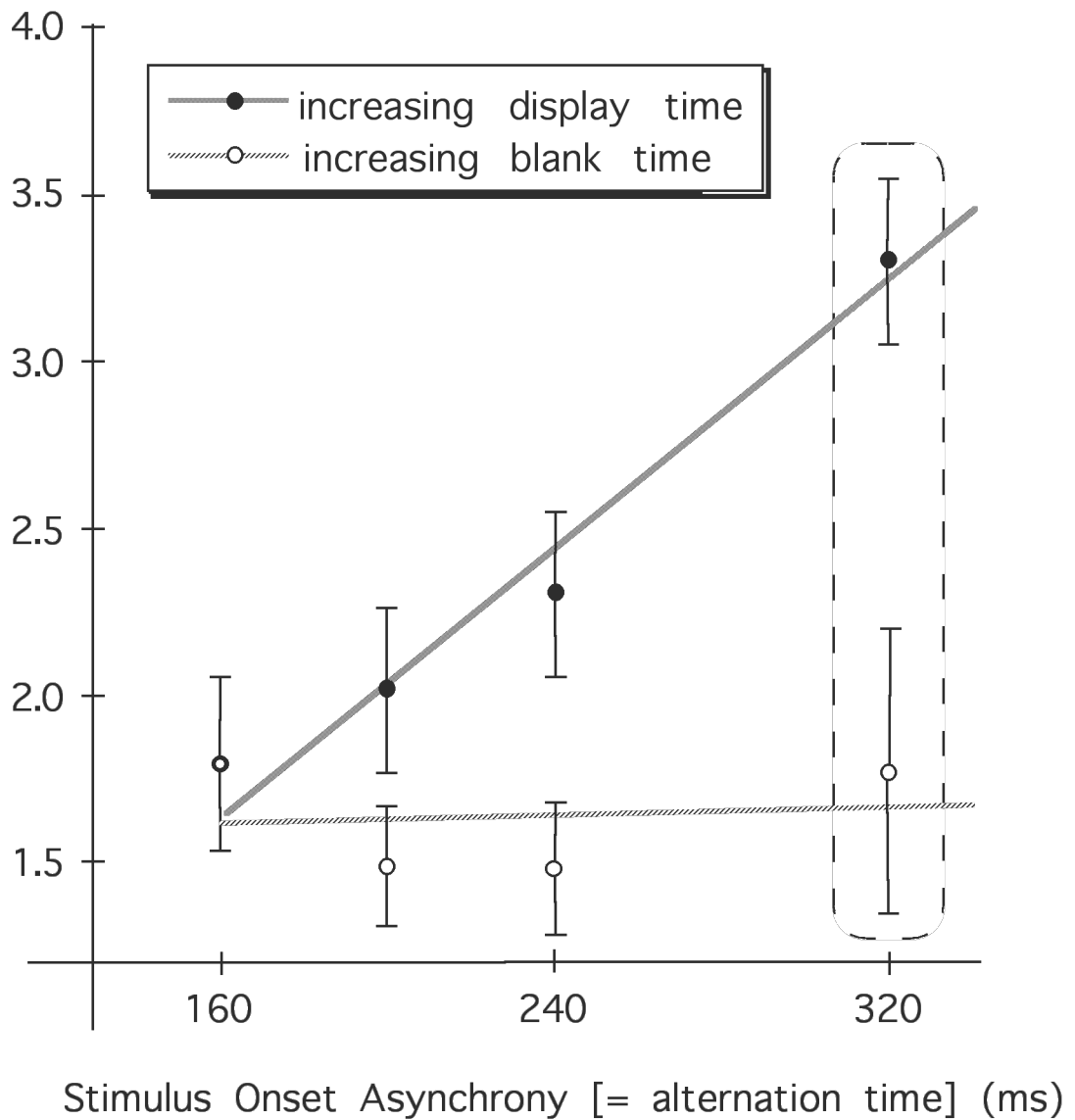
- capacity begins at about 1.5 items
- capacity approaches a maximum of 4-5 items



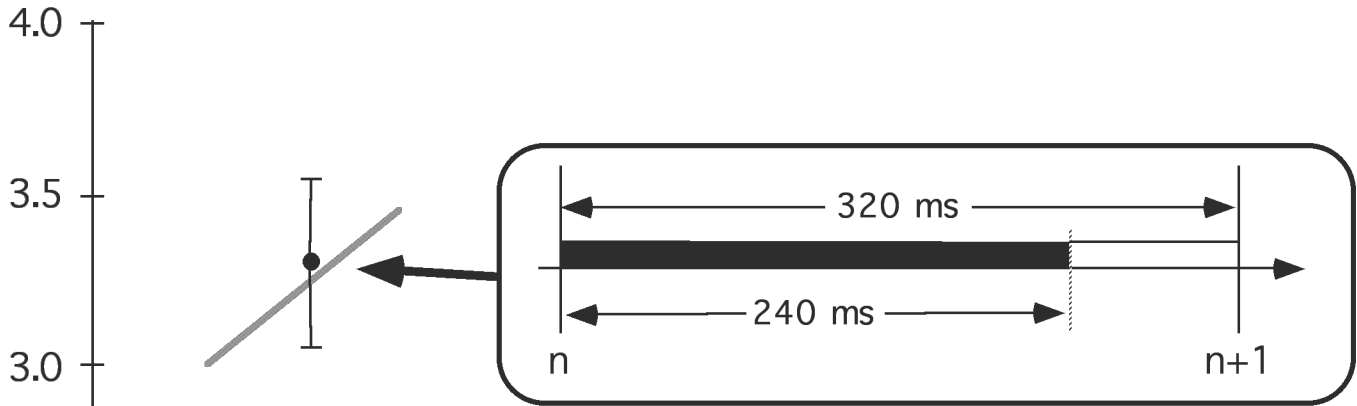
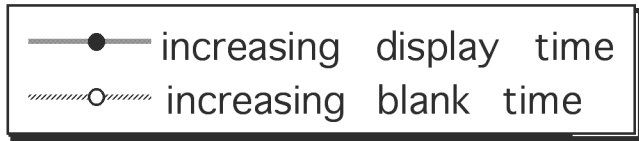
What happens as **blank** time per cycle is increased?

Orientation change

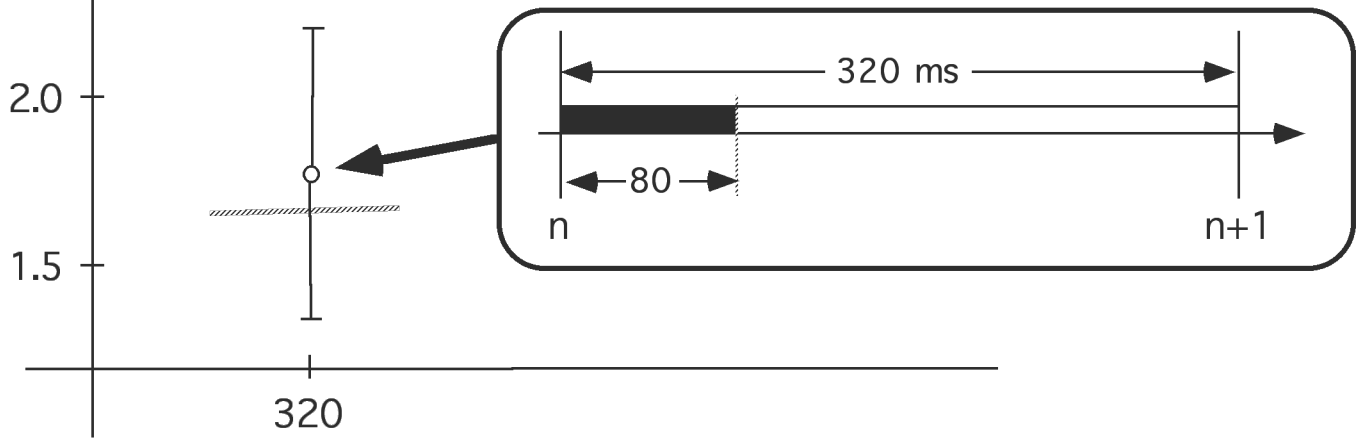
- capacity begins at about 1.5 items
- capacity **does not increase** (or if so, only very little)



Orientation change



Cannot trade display time and blank time
- performance depends on display time only

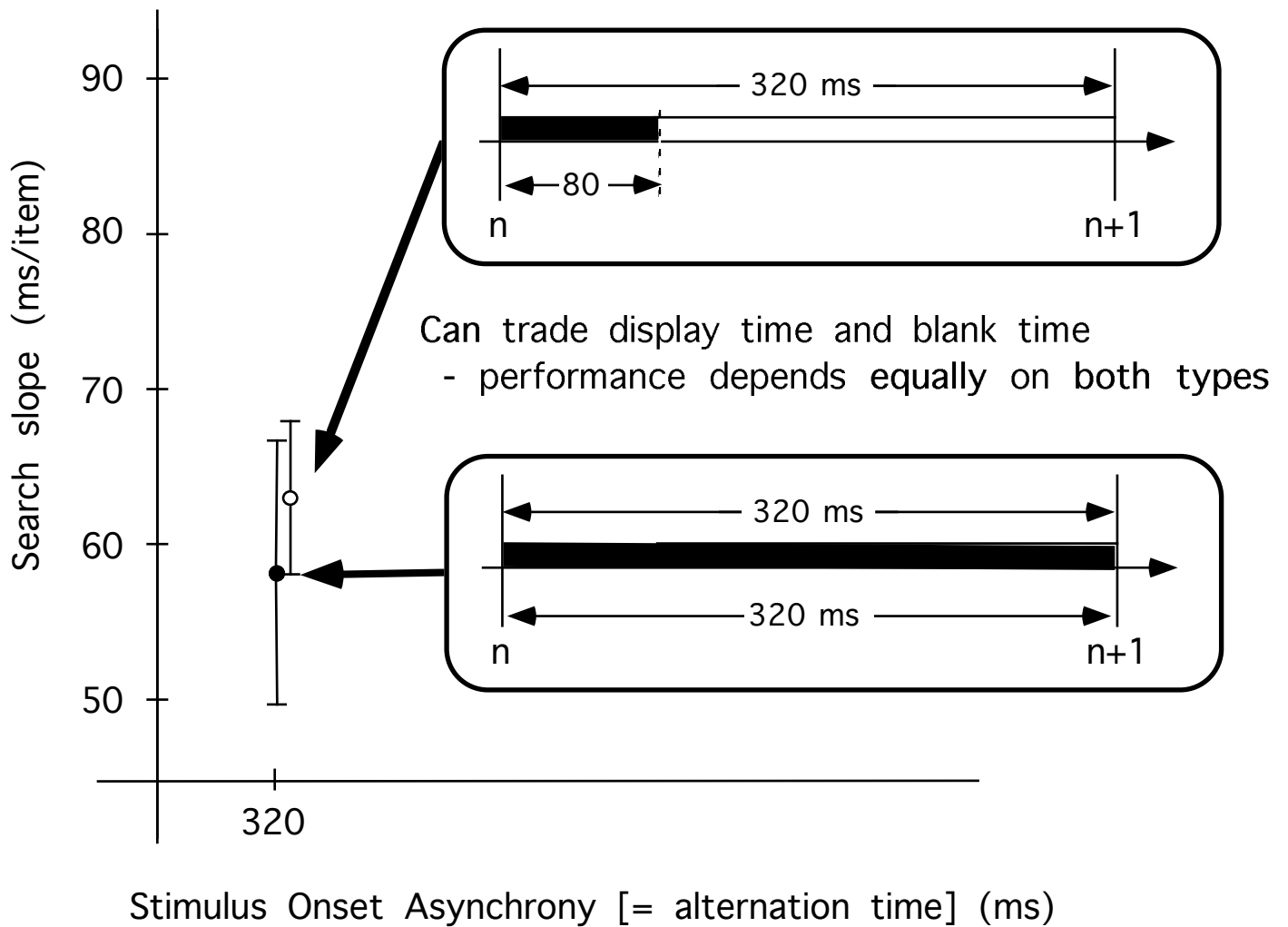


Stimulus Onset Asynchrony [= alternation time] (ms)

Does failure to use **blank** time mean iconic store is unavailable?

Carry out "standard" search (i.e., search for a fixed target) while display is flickering

Orientation search - vertical bar among tilted bars



Thus, two very different behaviors for slightly different tasks:

1. Search for fixed target:

- operates when there is a signal in the incoming light.
- operates for c. 300 ms after signal offset.
- **can** trade display time for (\leq c. 300 ms) blank time

2. Search for changing target:

- only when there is a signal in the incoming light.
- **cannot** trade display time for blank time
- when signal is no longer present, operation halts.
 - halt occurs even in absence of mask

-> Process is **photoraic** ("photo" + "orasi" = "seeing/using light")

An Interesting New Issue:

What is the critical difference between the two tasks?

What does the photoraic/nonphotoraic divide correspond to?

- **why is a particular process photoraic (or why is it not)?**