

## PSI 428

### Attentional Processes

Divided Attention

### Learning Objectives

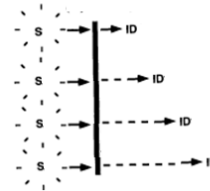
- What is divided attention
- Serial vs. Parallel Processing
- Taking in Information from Brief Visual Displays
- Simultaneous vs. Sequential Presentations
- Article Presentation
- **Speeded Visual Search**
- Article Presentation

### Speeded Visual Search

- In these tasks display remain present until response is made
- Reaction time is the primary dependent variable
- The focus is how long it takes to detect targets as a function of display set size

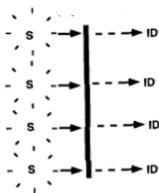
### Capacity Limitations in Serial Processing

Attend to More than One Object:



### Capacity Limitations in Parallel Processing

Attend to More than One Object:



Treisman, A. (1988). Features and objects: The fourteenth Bartlett memorial lecture. *The quarterly journal of experimental psychology*, 40(2), 201-237.

### Speeded Visual Search

- Certain aspects of visual processing is accomplished in parallel manner
- Other aspects of visual processing depend on serial processing.

Treisman, A. (1988). Features and objects: The fourteenth Bartlett memorial lecture. *The quarterly journal of experimental psychology*, 40(2), 201-237.

### Speeded Visual Search

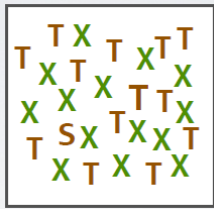
- “When the distractors were all identical and the target differs substantially from these distractors in a perceptual property (color, size, orientation, or brightness) the search is parallel.”
- “If target is defined as the conjunction of properties (red O among red N’s and green O’s) the search is parallel.”

Treisman, A. M., & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive psychology*, 12(1), 97-136.

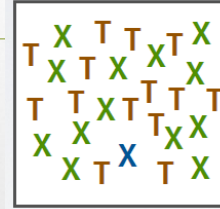
### Treisman & Glade (1980)

- **Method:** Four different display sizes, consisting of 1, 5, 15, and 30 items were used
- In the feature condition: target was either a blue letter or an S
- In the conjunction condition target was T\_green
- In both conditions distractors were T\_brown and X\_green

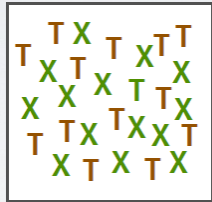
### Treisman & Glade (1980)



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MIRIAH MEYER

<https://www.cs.utah.edu/~miriah/uncertainty/FeatureIntegrationTheoryOfAttention.pdf>

pdf

### Experiment 1

Distractors: X, T

Target: "S or blue: T"

Feature

S

blue

Conjunction

T

X

T

X

T

X

T

X

T

X

T

X

T

X

T

X

T

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X

T

X

Treisman, A. M., & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive psychology*, 12(1), 97-136.

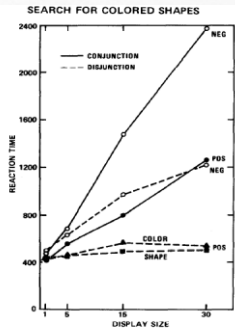


FIG. 1. Search times in Experiment 1.

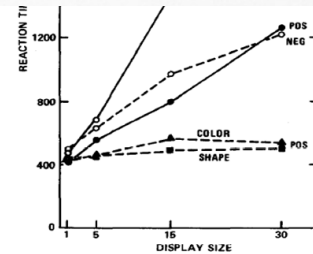


FIG. 1. Search times in Experiment 1.

Treisman, A. M., & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive psychology*, 12(1), 97-136.

### Treisman & Glade (1980)

- **Conclusion:** “attention must be directed serially to each stimulus in a display whenever conjunctions of more than one separable feature are needed to characterize or distinguish the possible objects presented.”

### Asymmetry in Searching the Existence and Absence of the Target Feature

- “When the target is distinguished by the fact that a feature exists with the target, and it does not exist in all of the distractors, the search was parallel.”
- “When the target is distinguished by the fact that it lacks a feature that is present in all distractors, the search is serial.”

Treisman, A. (1988). Features and objects: The fourteenth Bartlett memorial lecture. *The quarterly journal of experimental psychology*, 40(2), 201-237.

### An Asymmetry in Search

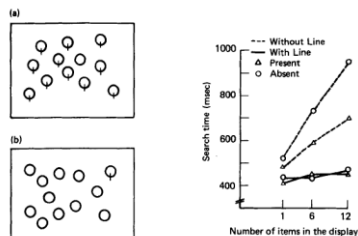


FIG. 3. Examples of displays and mean search times for a target circle with and without an intersecting line.

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### An Asymmetry in Search

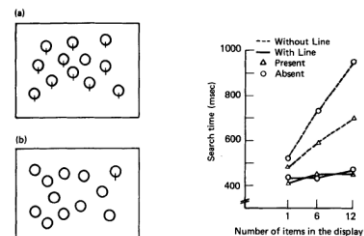
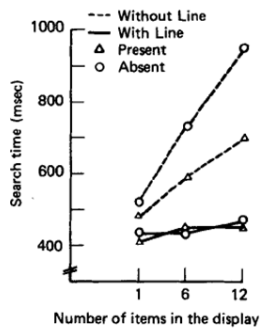


FIG. 3. Examples of displays and mean search times for a target circle with and without an intersecting line.

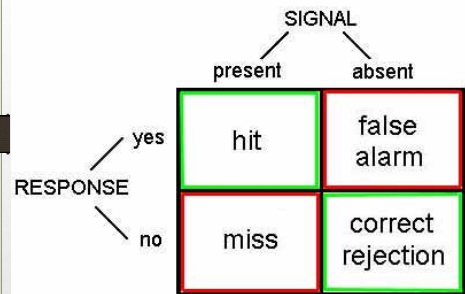


### Criticism 1

- There is little criticism for the results that flat slopes entail parallel search.
- But slopes are not that flat
  - 10-30 msec per item?
- The search might be serial but very very fast!!!

### Criticism 2

- The problem of decision noise:
  - The number of false alarms increases with the number of distractors in the display

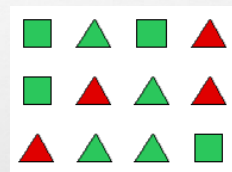


### Decision Noise Increases Reaction Times

- The problem of decision noise:
  - Each element has a nonzero probability of being confused with the target (p)
  - Probability of a false alarm is p
  - If each channel in the display processed in parallel

### Parallel Search

Is there a red square in the display?

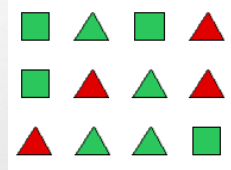


### Decision Noise Increases Reaction Times

- If each channel in the display processed in parallel
- The probability of correctly detecting that the channel does not contain a target  $(1-p)$
- The probability of correctly detecting that there is **no target** in the display of  $n$  elements  $(1-p)^n$

### Parallel Search

Is there a red square in the display?

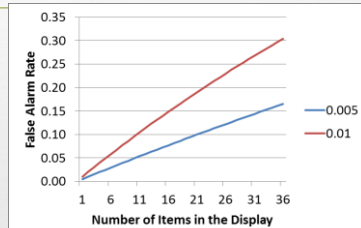


### Decision Noise Increases Reaction Times

- The probability of correctly reporting that there is **no target** in the display of  $n$  elements  $(1-p)^n$
- The probability of **detecting a target** when there is **no target** (false alarm rate) in the display of  $n$  elements  $1-(1-p)^n$

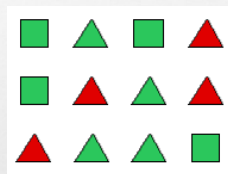
### Decision Noise Increases Reaction Times

- $1-(1-p)^n$
- $p = 0.01$
- $p = 0.005$



### Parallel Search

Is there a red square in the display?



### Decision Noise Increases Reaction Times

- Since the target displays were presented until the response was made
- “To achieve approximately equal accuracy with both small and large display sets, subjects must acquire more information to compensate the accumulation of the decision noise.”

### Decision Noise Increases Reaction Times

- “Therefore, an increase in RTs with display size might arise even if an unlimited-capacity parallel search is made.”

### Criticism 3

- How do we know that increase in the number of distractors is a results of perceptual processing of the items, but not reflect subsequent decision or memory comparison processes?

### Criticism 4

- Eye movements might be important in visual search tasks
- It may be the case that subjects are making more eye movements in difficult search tasks
- Therefore the observed results are coming from mechanical differences between conditions.