PSI 428
Attentional Processes

Divided Attention

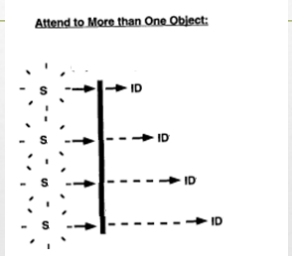
Learning Objectives

- 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

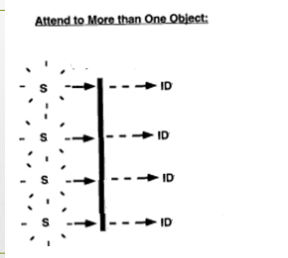
Speeded Visual Search

- 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



Capacity Limitations in Parallel Processing

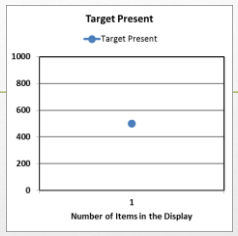


The Relation Between Capacity and Processing Type

	LIMITED	UNLIMITED
SERIAL	POSSIBLE	IMPOSSIBLE
PARALLEL	?	POSSIBLE

Serial Search

Is there a red square in the display?



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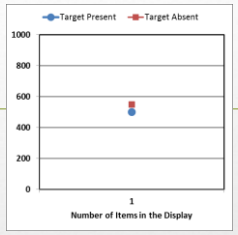

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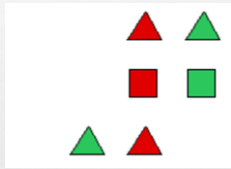

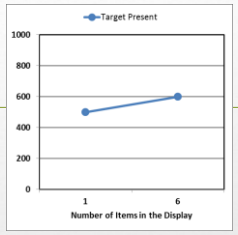

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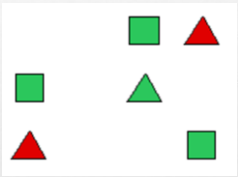

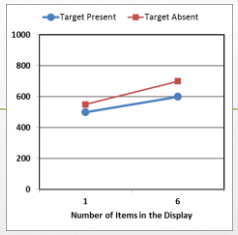

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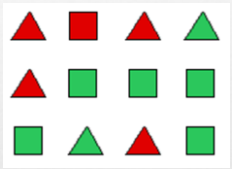

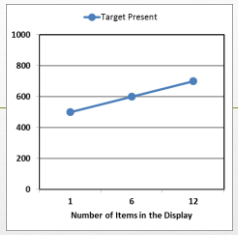

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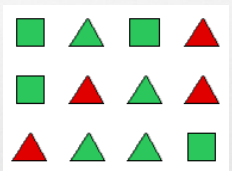
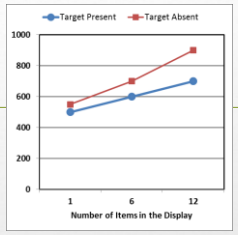


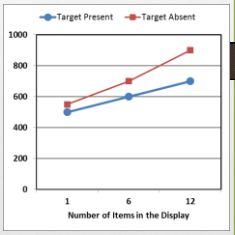


Speeded Visual Search

- The focus is how long it takes to detect targets as a function of display set size
- **If the search is serial** the search time in target present (positive trials) increases at a half the rate of the search in target absent (negative trials).

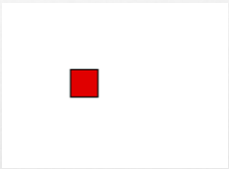
Serial Search

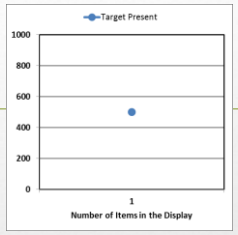
What is the search rate per item in this Hypothetical experiment?



Parallel Search

Is there a red square in the display?





Parallel Search

Is there a red square in the display?

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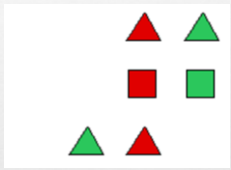

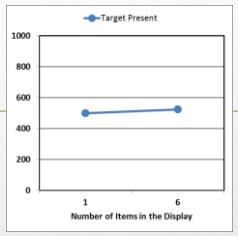

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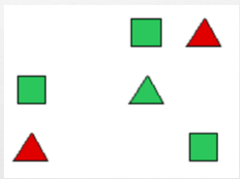

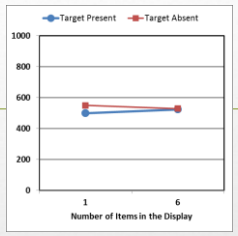

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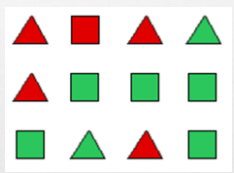

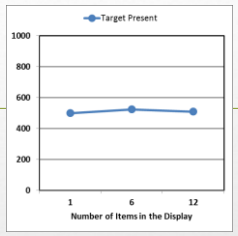

Parallel Search

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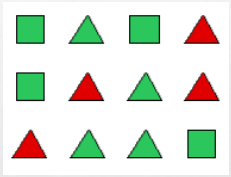
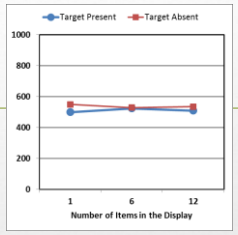




Treisman, A. (1988). Features and objects: The fourteenth Bartlett memorial lecture. *The quarterly journal of experimental psychology*, *40*(2), 201-237.

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

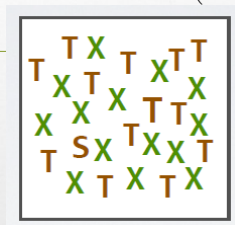
- "When the distractors were all identical and the target differs substantially from these distractors in a perceptual property (color, size, orientation, or brightness) the search is parallel."
- "If target is defined as the conjunction of properties (red O among red N's and green O's) the search is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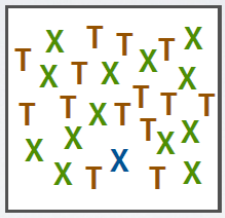

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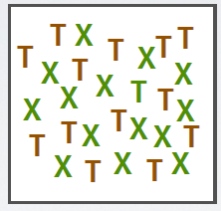
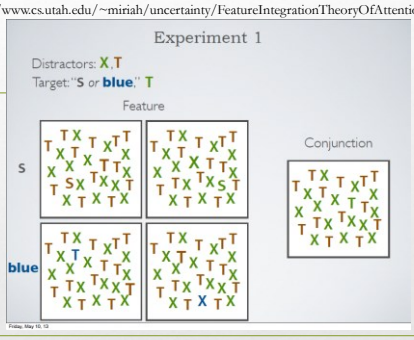


MIRIAH MEYER
https://www.cs.utah.edu/~miriah/uncertainty/FeatureIntegrationTheoryOfAttention.pdf



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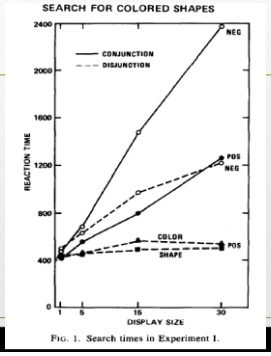

FIG. 1. Search times in Experiment 1.

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."

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

Treisman & Glade (1980)

- When the search is serial, slowing the decision about the features changes (increases) the slope relating search time to display size"

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

Treisman & Glade (1980) Experiment 2 Method

Condition: easy
Distractors: O , N
Target: O

O	N	N	O	O	N
N	O	O	N	N	O
N	O	N	N	O	N
O	N	O	N	O	O
N	O	O	O	N	O
N	N	O	O	N	N

Condition: difficult
Distractors: X , T
Target: T

T	X	X	T	T	X
X	T	T	X	X	T
X	T	X	X	T	X
T	X	T	X	T	T
X	T	T	T	X	T
X	X	T	T	X	X

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

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

Treisman & Glade (1980) Experiment 2 Results

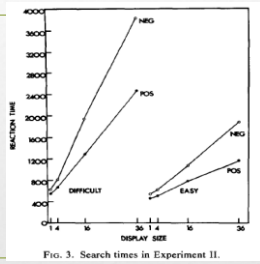

FIG. 3. Search times in Experiment II.

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

Treisman & Glade (1980) Experiment 2 Results

- **Conclusion:** When the search is serial, slowing the decision about the features changes (increases) the slope relating search time to display size"
- How much the search rate per item was decreased by making the task more difficult?

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

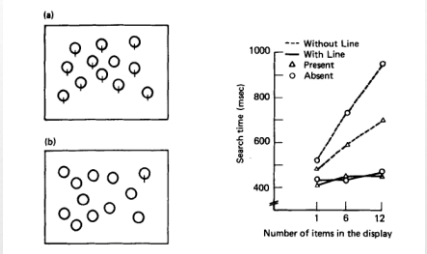

FIG. 3. Examples of displays and mean search times for a target circle with and without an intersecting line.

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

- Why the presence of a feature is detected in parallel but the absence of a feature is detected in serial manner?
  - The neural signal in early visual processing conveys the presence but not the absence of a distinctive feature.

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

The Pop-out of Visual Features

- Pre-attentive processing of visual scenes occurs in parallel (automatically and without capacity limitation)
- A target that is distinct from its neighbors in its pre-attentive presentation pops-out of the display.
  - Pop-out: the time it takes to find the target is independent of the number of distractors.

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

The Pop-out of Visual Features

- Which features pop-out?
  - Which features are analyzed pre-attentively (parallel and without capacity limitation) in the brain?
- Color, size, contrast, tilt, curvature, line ends, movement, stereoscopic depth.