

# A Feature-Integration Theory of Attention

A. Treisman and G. Gelade (1980)

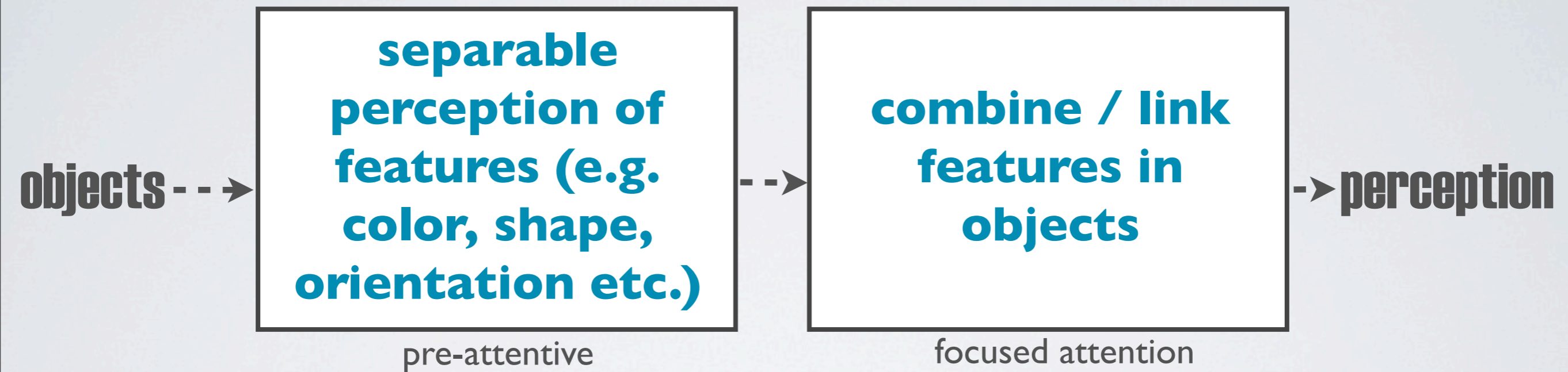
A word cloud centered on the word "attention". The word "attention" is the largest and most prominent. Other words of varying sizes and orientations surround it, including "selective", "divided", "alternating", "covert", "bottom-up", "overt", "sustained", "top-down", and "focused".

**attention**  
selective divided alternating  
covert bottom-up overt sustained focused  
top-down

A word cloud centered on the word "attention". The word "attention" is the largest and most prominent, written in black. Surrounding it are several other terms in different sizes and orientations, including "selective" (orange), "top-down" (orange), "divided" (black, vertical), "alternating" (black), "focused" (black, vertical), "sustained" (black), "overt" (black, vertical), "bottom-up" (black, vertical), and "covert" (black). The words are arranged in a roughly circular pattern around the central "attention".

**attention**  
selective  
top-down  
divided  
alternating  
focused  
sustained  
overt  
bottom-up  
covert

# Feature Integration Theory



# Feature Integration Theory

support

9 experiments testing predictions based on the theory

## 5 Areas

Visual Search

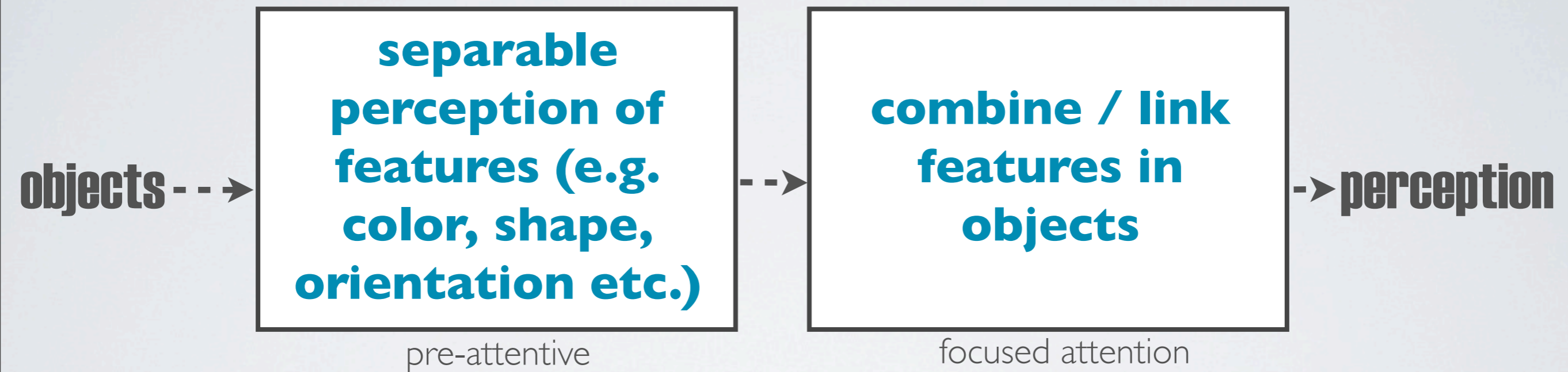
Texture Segregation

Illusory Conjunctions

Identity and Location

Interference from Unattended Stimuli

# Feature Integration Theory



# Feature Integration Theory

single features **can be detected in parallel** *without attention limits*

pre-attentive

conjunctions **require focal attention of each object, resulting in serial search**

focused attention

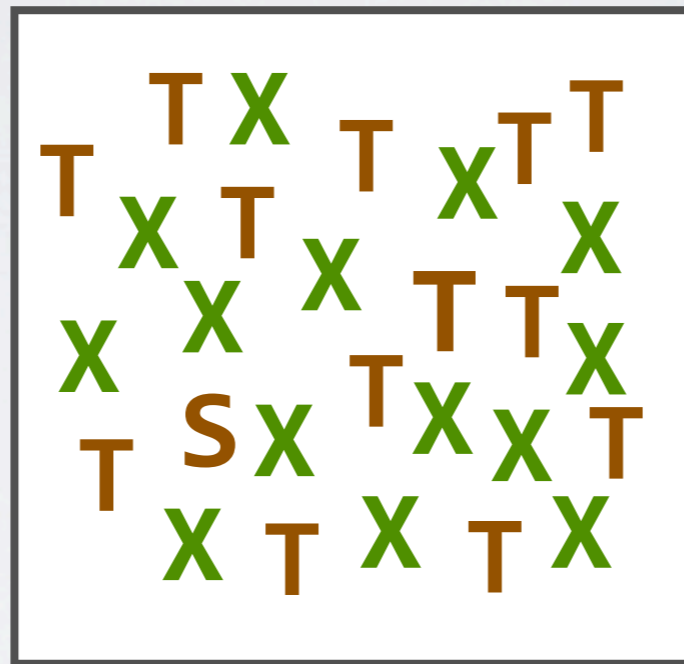
# Visual Search feature

find the **S** or **blue**



# Visual Search

feature

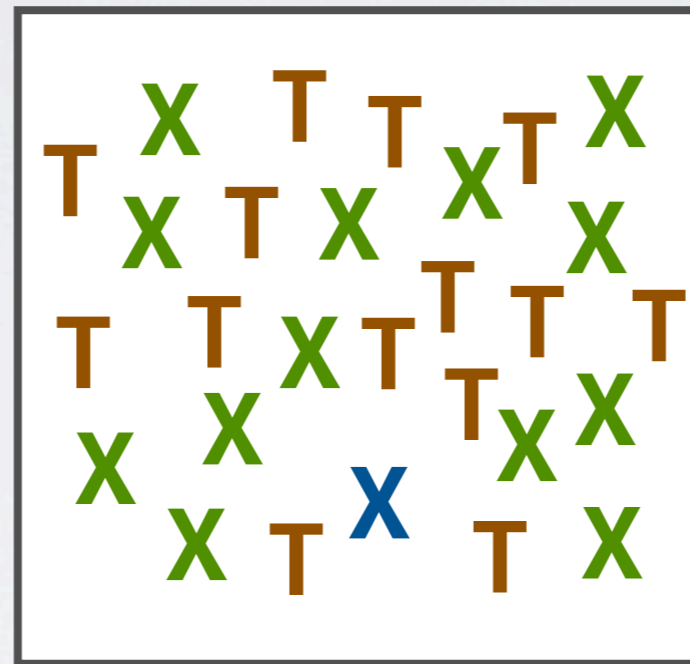


# Visual Search feature

find the **S** or **blue**

# Visual Search

feature



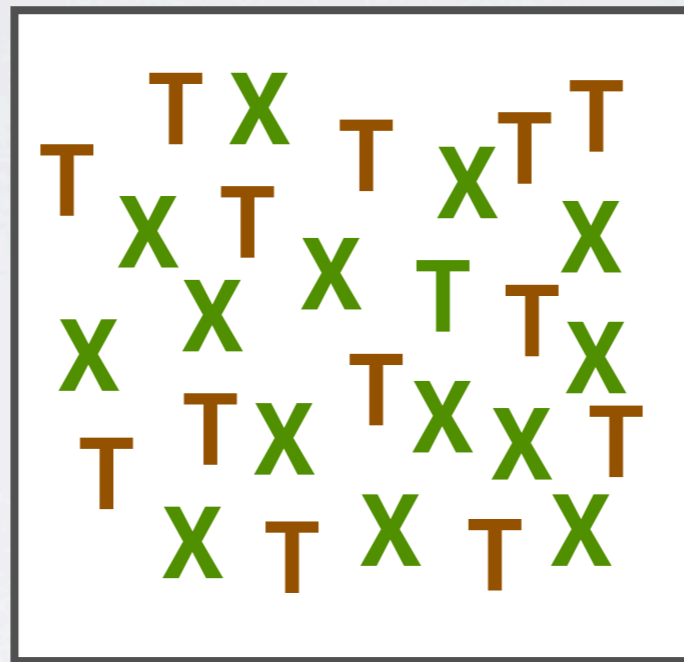
# Visual Search

conjunction

find the **T**

# Visual Search

conjunction



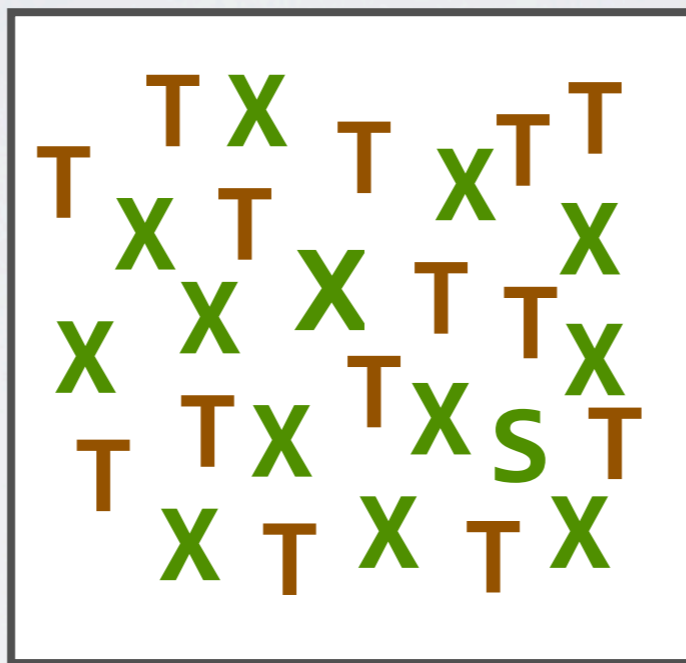
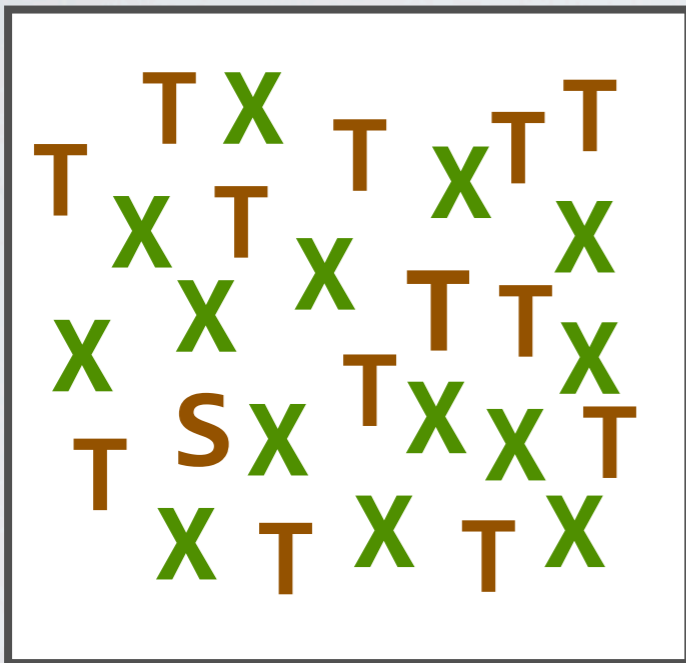
# Experiment 1

Distractors: **X**, **T**

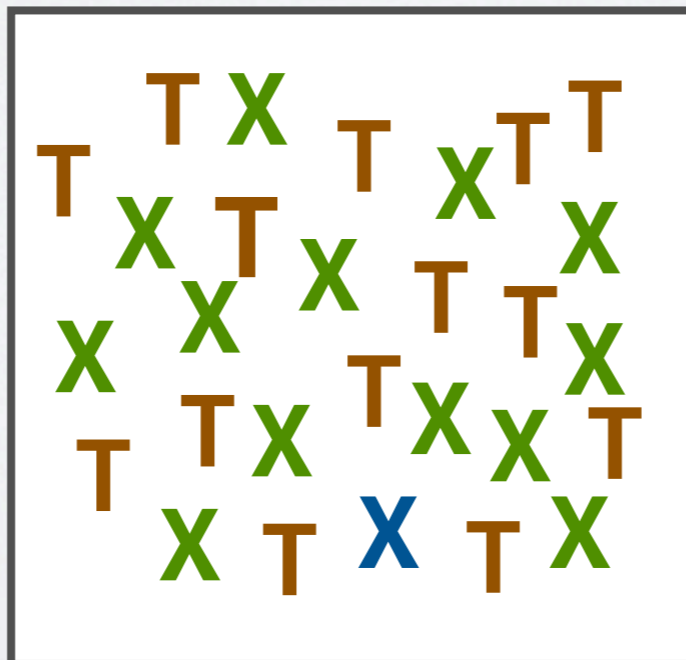
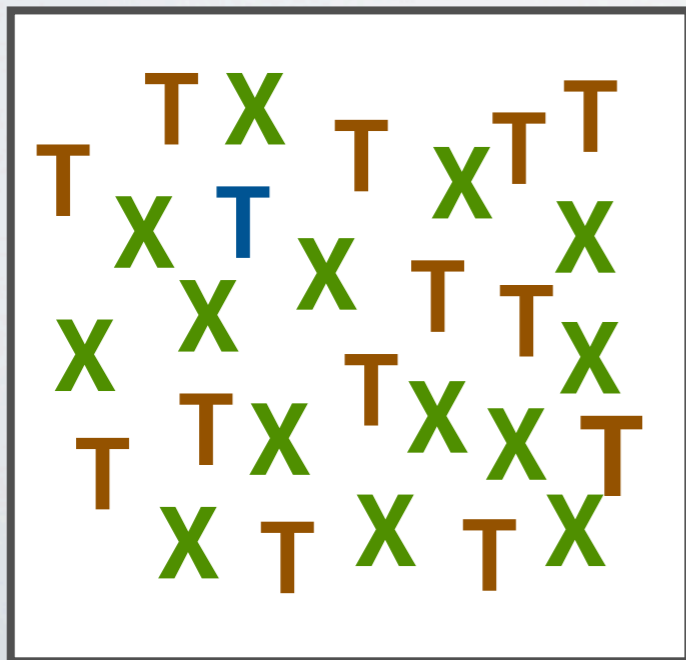
Target: "S or **blue**," **T**

Feature

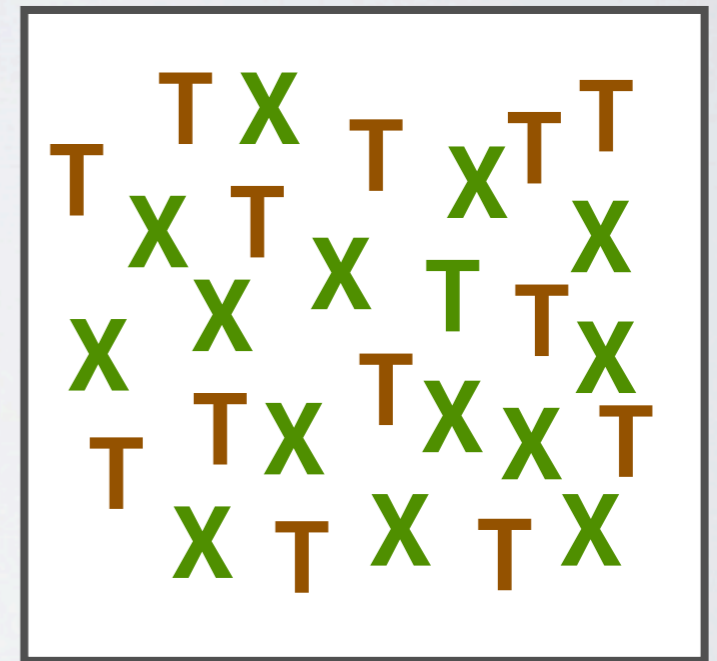
S



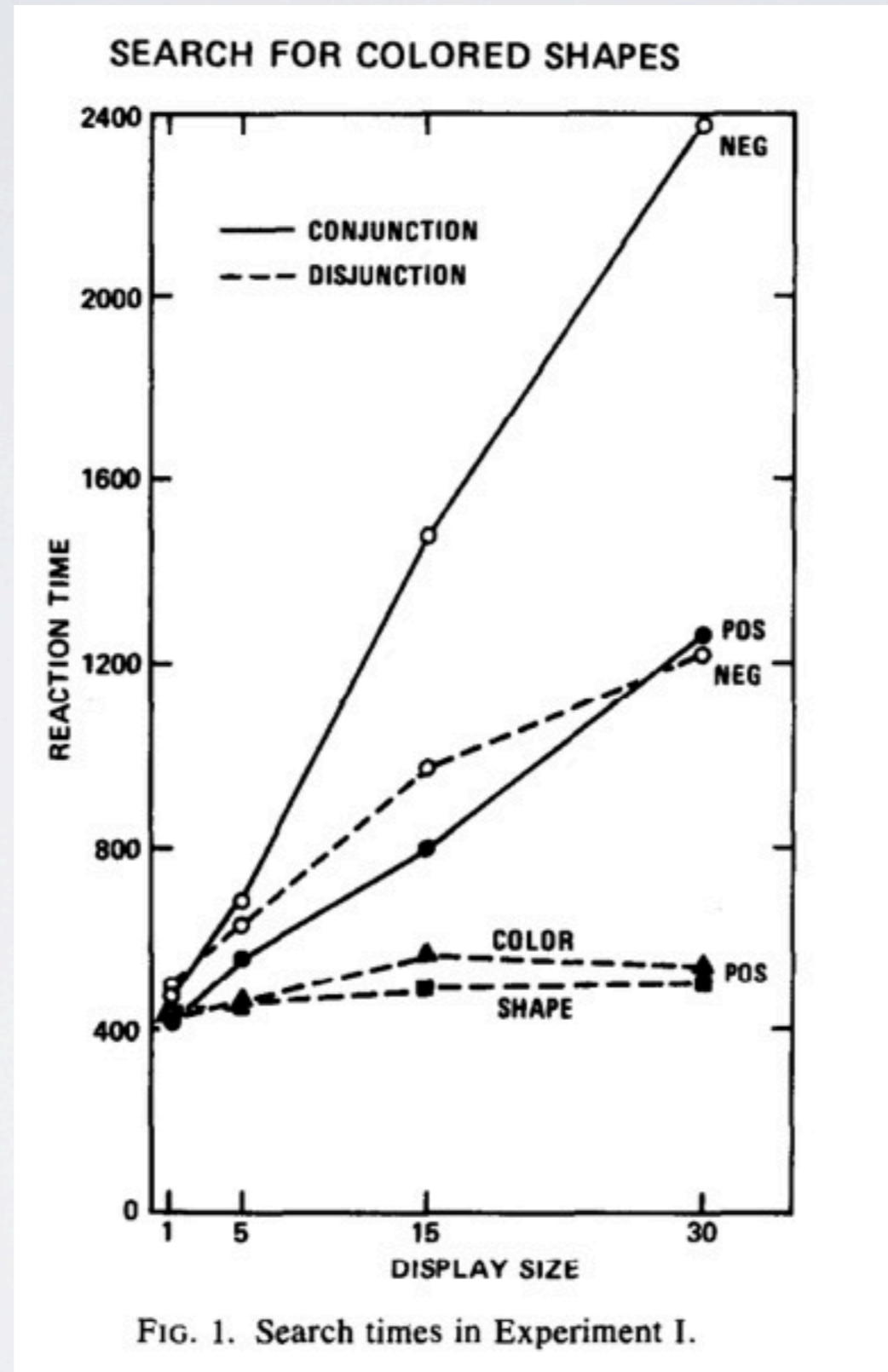
blue



Conjunction



# Visual Search results



# Experiment 2

Condition: easy

Distractors: **O**, **N**

Target: **O**

<b>O</b>	<b>N</b>	<b>N</b>	<b>O</b>	<b>O</b>	<b>N</b>
<b>N</b>	<b>O</b>	<b>O</b>	<b>N</b>	<b>N</b>	<b>O</b>
<b>N</b>	<b>O</b>	<b>N</b>	<b>N</b>	<b>O</b>	<b>N</b>
<b>O</b>	<b>N</b>	<b>O</b>	<b>N</b>	<b>O</b>	<b>O</b>
<b>N</b>	<b>O</b>	<b>O</b>	<b>O</b>	<b>N</b>	<b>O</b>
<b>N</b>	<b>N</b>	<b>O</b>	<b>O</b>	<b>N</b>	<b>N</b>

Condition: difficult

Distractors: **X**, **T**

Target: **T**

<b>T</b>	<b>X</b>	<b>X</b>	<b>T</b>	<b>T</b>	<b>X</b>
<b>X</b>	<b>T</b>	<b>T</b>	<b>X</b>	<b>X</b>	<b>T</b>
<b>X</b>	<b>T</b>	<b>X</b>	<b>X</b>	<b>T</b>	<b>X</b>
<b>T</b>	<b>X</b>	<b>T</b>	<b>X</b>	<b>T</b>	<b>T</b>
<b>X</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>X</b>	<b>T</b>
<b>X</b>	<b>X</b>	<b>T</b>	<b>T</b>	<b>X</b>	<b>X</b>



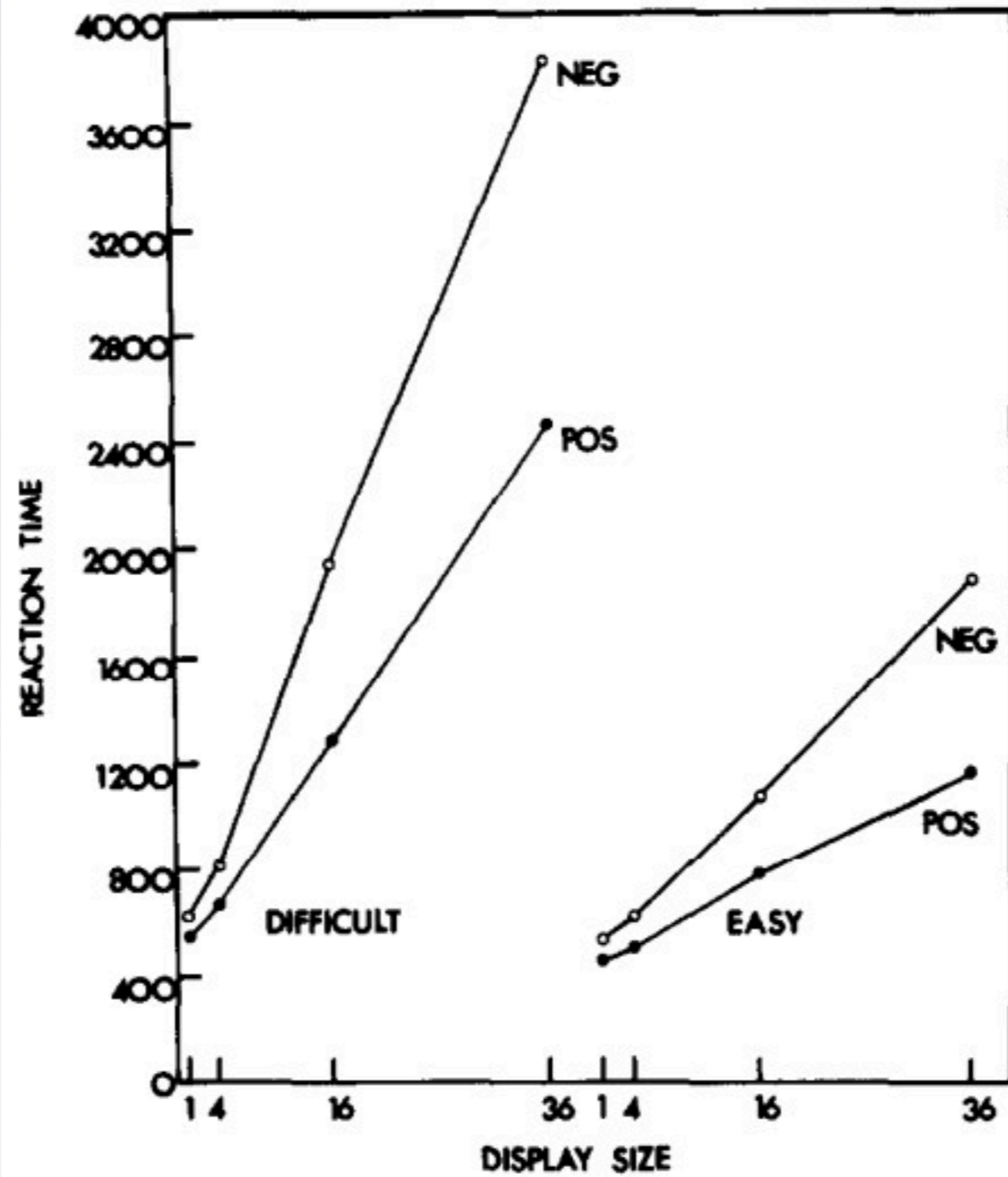
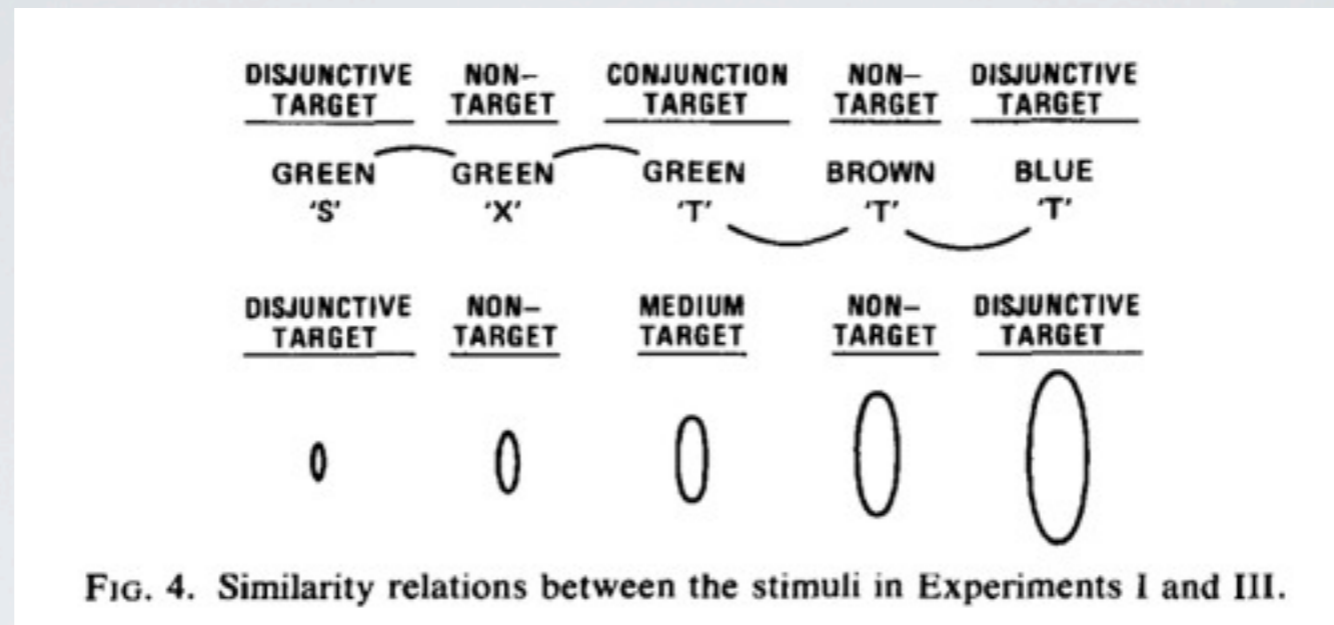


FIG. 3. Search times in Experiment II.

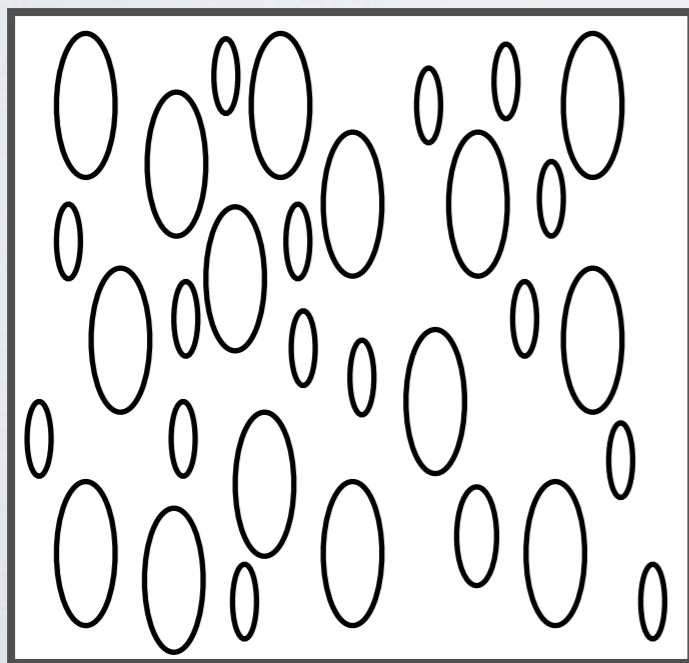
# Experiment 3



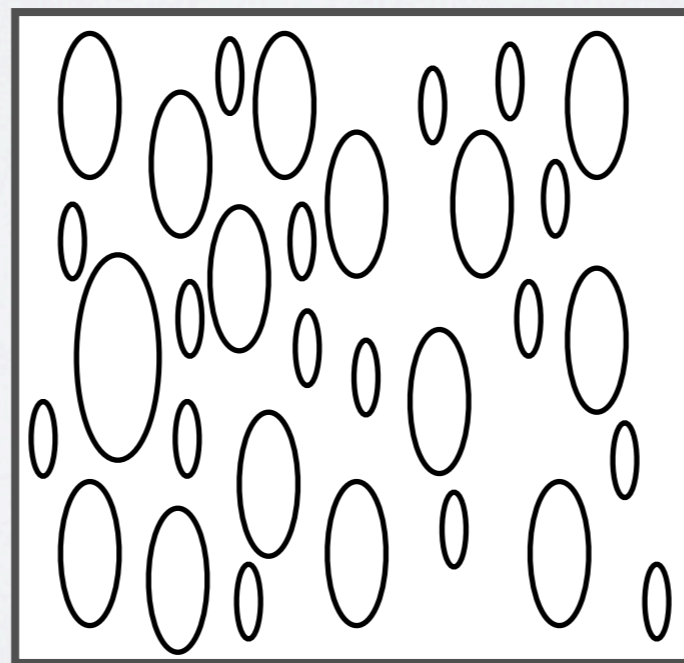
Distractors: ○, ○  
Target: ○

Distractors: ○, ○  
Target: ○

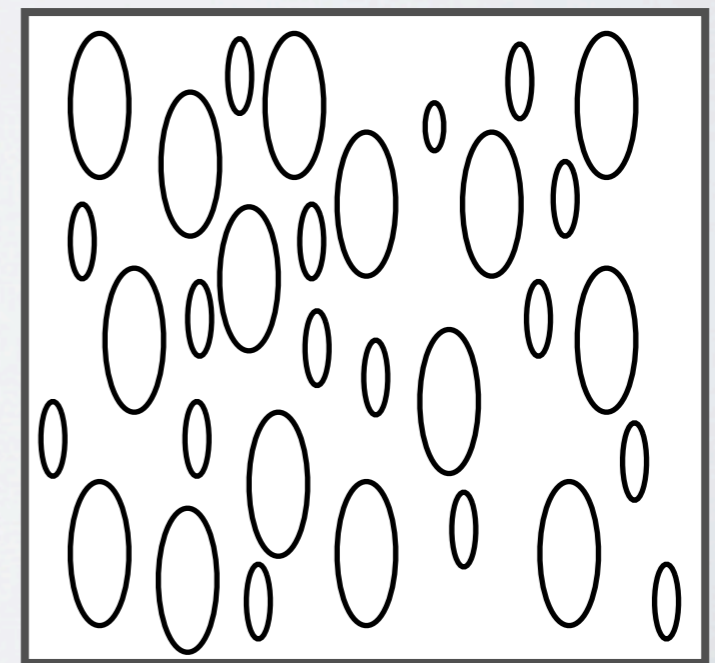
Distractors: ○, ○  
Target: ○



conjunction



feature



feature

# Experiment 4

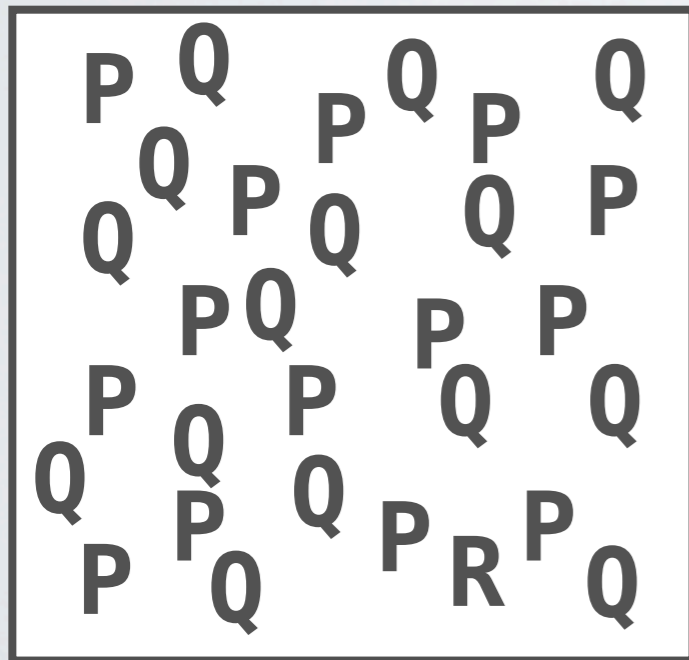
$$P+Q=\theta=R$$

illusory "R"

$$(I+Z=I=T)$$

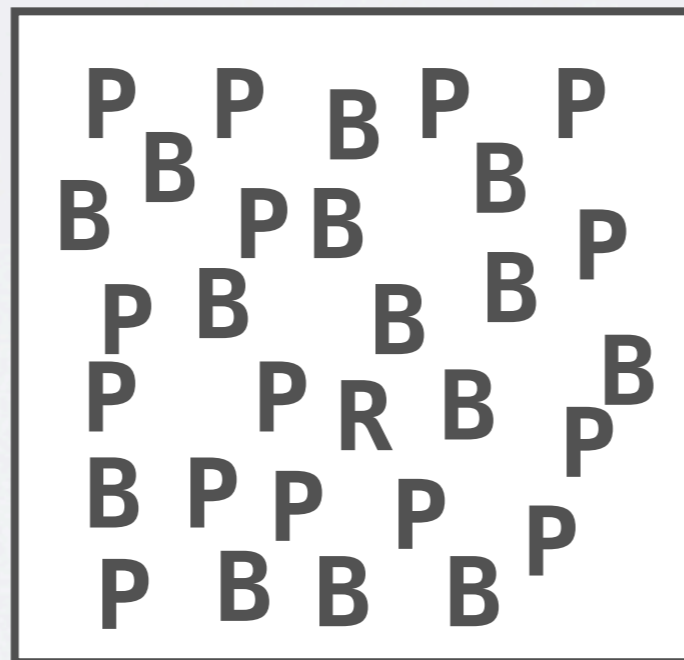
illusory "T"

Distractors: **P**, **Q**  
Target: **R**



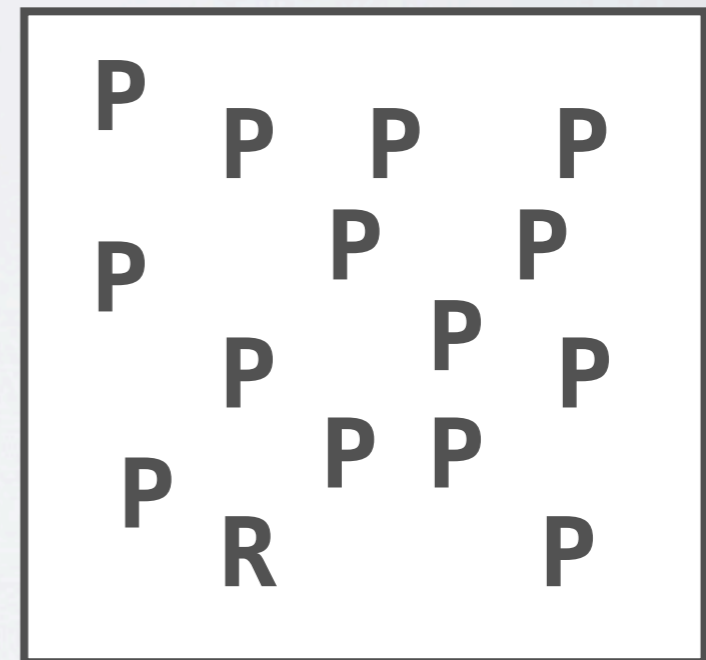
illusory conjunction

Distractors: **P**, **B**  
Target: **R**



non-illusory conjunction

Distractors: **P(Q,B)**  
Target: **R**



single feature

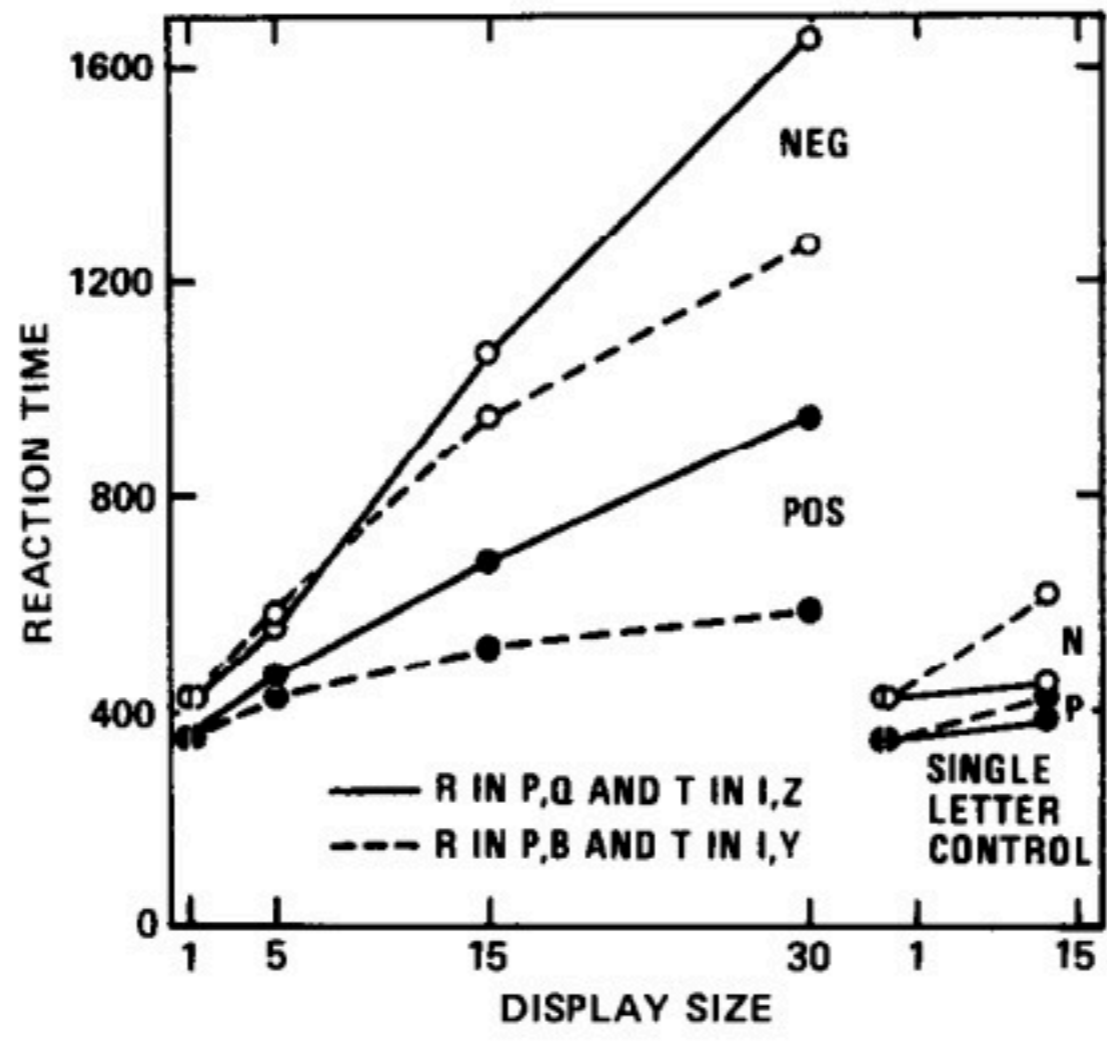
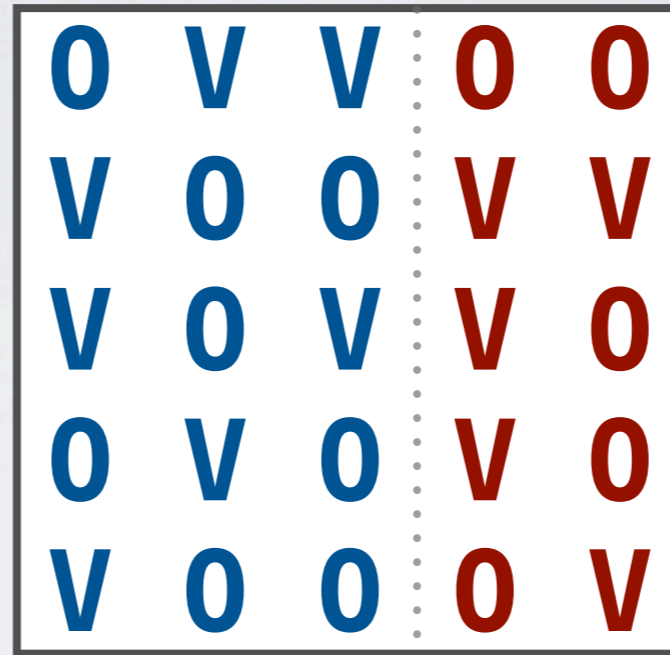


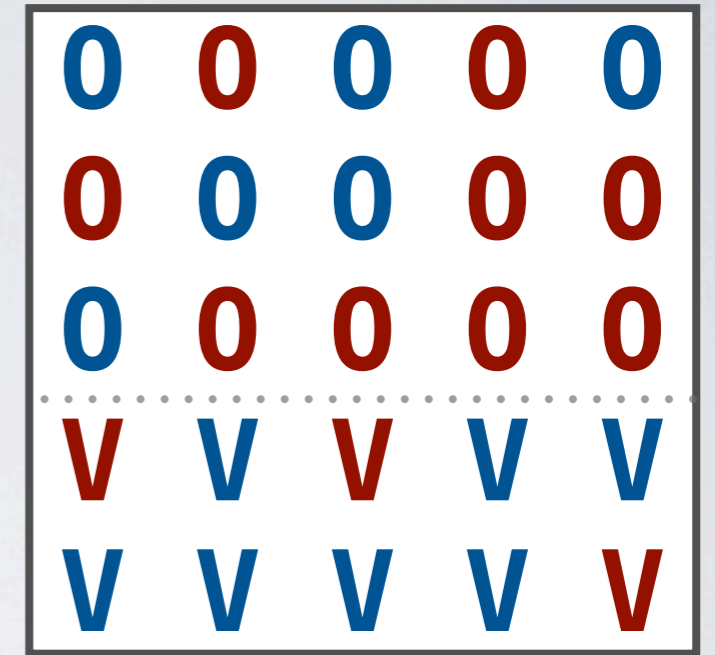
FIG. 6. Search times in Experiment IV.

# Experiment 5

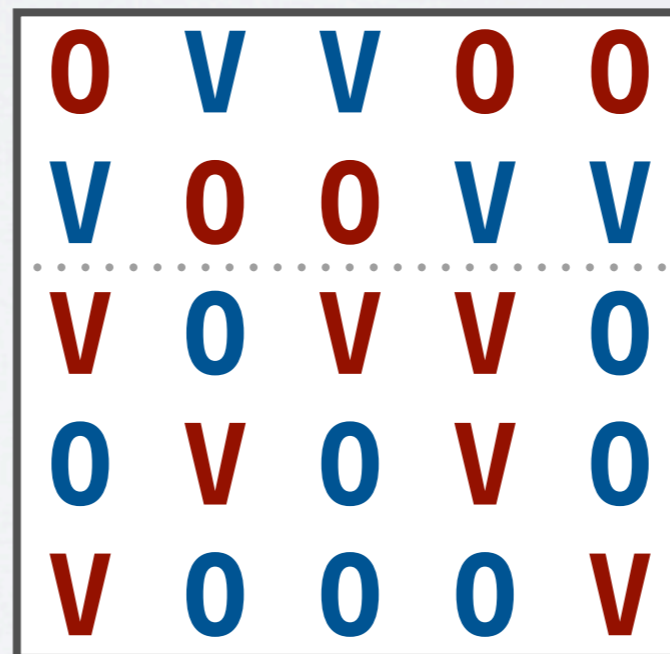
Task: sort by boundary  
(horizontal vs vertical)



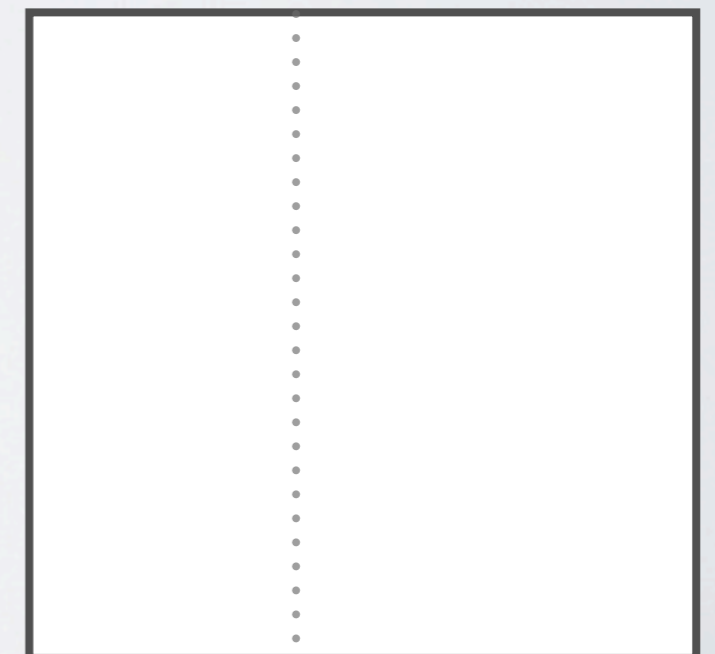
color



shape



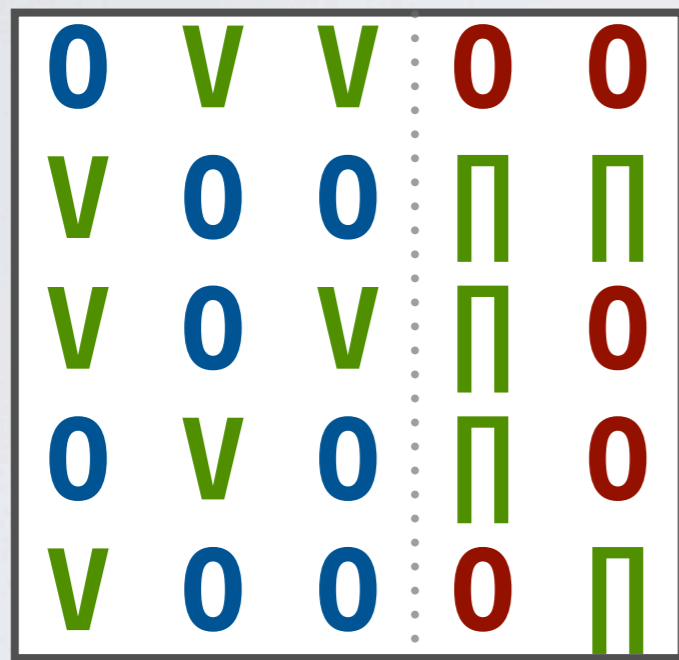
conjunction



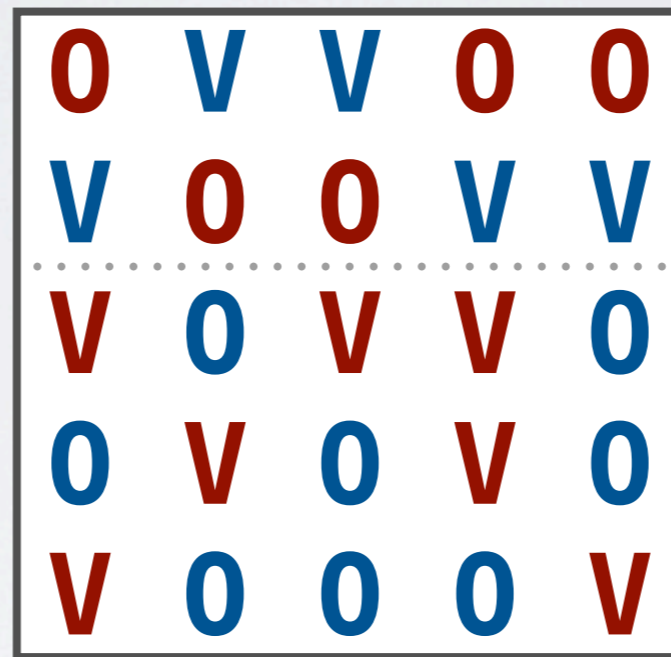
control

# Experiment 6

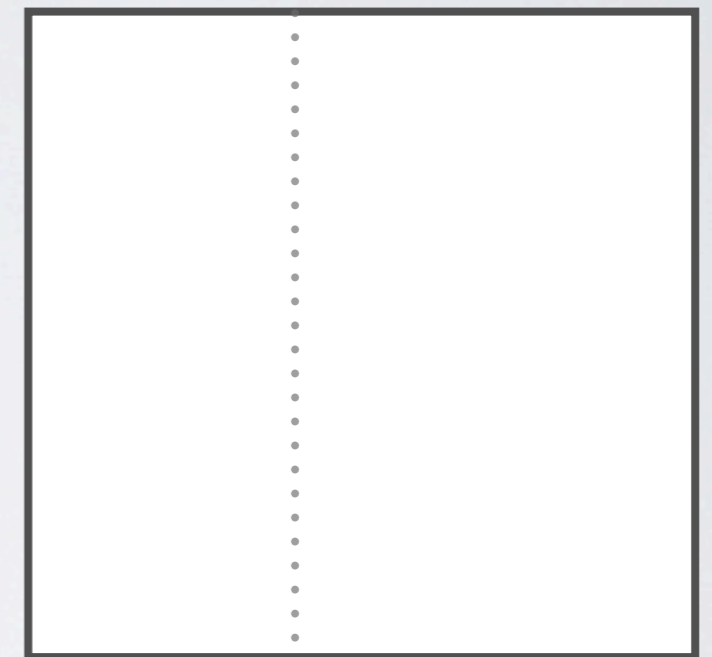
Task: sort by boundary  
(horizontal vs vertical)



disjunctive feature



conjunction



control

# Experiment 7

boundary determined by non-intersecting pairs of  
[P, R, E, F, O, Q, X, K]

interesting cases

<b>O</b>	<b>R</b>	<b>R</b>	<b>Q</b>	<b>Q</b>
<b>R</b>	<b>O</b>	<b>O</b>	<b>P</b>	<b>P</b>
<b>R</b>	<b>O</b>	<b>R</b>	<b>P</b>	<b>Q</b>
<b>O</b>	<b>R</b>	<b>O</b>	<b>P</b>	<b>Q</b>
<b>R</b>	<b>O</b>	<b>O</b>	<b>Q</b>	<b>P</b>

“single feature”:(PO/RQ), (EO/FQ)

“conjunction”:(PQ/RO),(FK/EX)

# Experiments 8/9

Distractors: **0**, **X**  
Target: **H** (**H**, **X**, **0**)

<b>0</b>	<b>X</b>	<b>0</b>	<b>0</b>	<b>H</b>	<b>X</b>
<b>X</b>	<b>X</b>	<b>0</b>	<b>X</b>	<b>0</b>	<b>0</b>

disjunctive feature

Distractors: **0**, **X**  
Target: **X**, **0**

<b>0</b>	<b>X</b>	<b>0</b>	<b>0</b>	<b>X</b>	<b>X</b>
<b>X</b>	<b>X</b>	<b>0</b>	<b>X</b>	<b>0</b>	<b>0</b>

conjunction



# Applications to Graphics

encoding variables that represent **individual features** (e.g. color, orientation, intensity, movement) are *good for search tasks*

**unique combinations** of features do not create *pop-out effects* in the same way as **unique features**

