

# Experimental Design Project

## 1- Goal of the experiment

The goal of this experiment is first to determine whether two specific visual variables (VV) are preattentive when presented in isolation, and second, to assess whether they become less preattentive when combined.

## 2- Hypothesis

The following research hypotheses were tested:

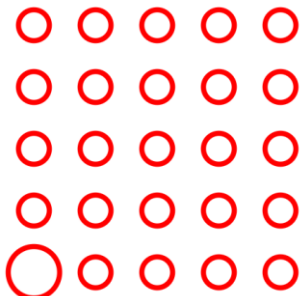
- **H1:** VV1 is preattentive.
- **H2:** VV2 is preattentive.
- **H3:** The combination of VV1 and VV2 is less preattentive than either VV1 or VV2 in isolation.

## 3- Operationalization

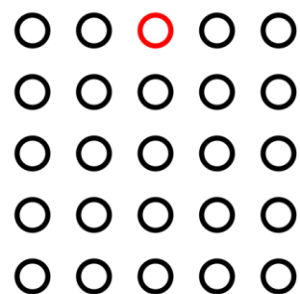
For this experiment, we selected color and size as the visual variables:

- **VV1:** Size
- **VV2:** Color
- **VV1 & VV2:** Combination of size and color

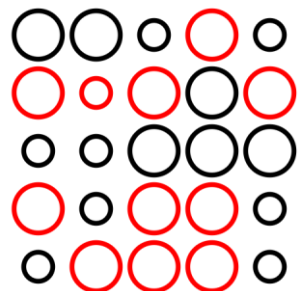
Example for size (VV1) :



Example for color (VV2):



Example for the combination of color and size (VV1 & VV2):



### **Measurement:**

- Spotting time (visual search time)

### **Factors:**

- Difference type (DT): Color, Size, Combination
- Number of elements in the scene: Low (9), Medium (25), High (49)

### **Task:**

Each trial required participants to identify the unique object in a scene. Pressing "Enter" initiated a stopwatch and displayed the scene on a computer. Once the participant spotted the target, they pressed the spacebar to stop the stopwatch, which then replaced the scene with a grid where they indicated the target's location by pressing the left click on the right cell.

## **4- Procedure**

We recruited six participants. Trials were blocked by Difference Type (DT) and by Object Count (OC), with block presentation order counterbalanced using a Latin square design across participants. Each participant completed five repetitions of each experimental condition, resulting in a total of 30 repetitions per condition.

## **5- Participants**

Six master's students from Paris-Saclay University participated in the experiment, aged between 21 and 27 years. The group consisted of four women and two men, with one participant wearing glasses.

## **6- Apparatus**

The experiment was conducted using an Asus Zenbook 13 laptop running Windows, equipped with a 13-inch OLED screen.

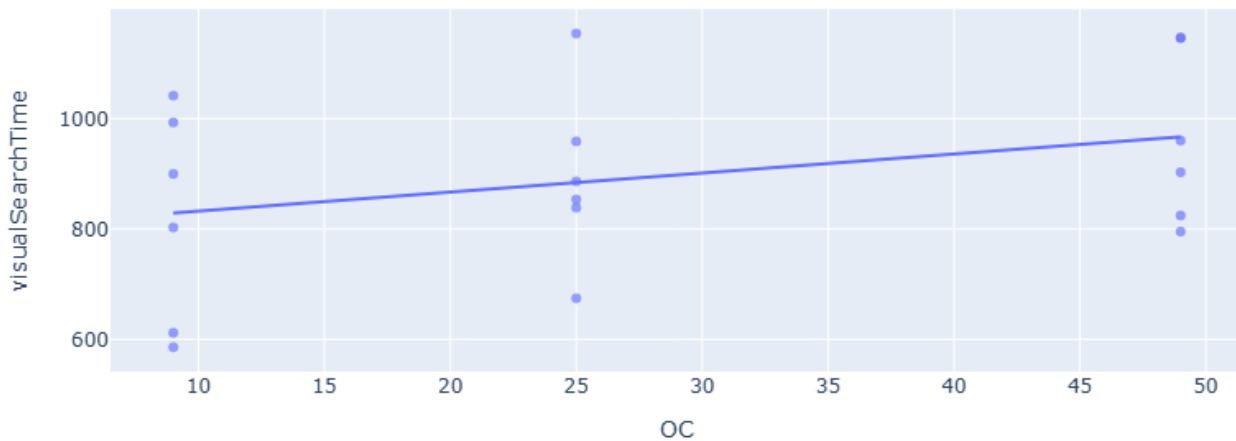
## **7- Results**

### **For H1 (VV1 is preattentive):**

To test the first hypothesis, we used a subset of the logs with only DT=Size.

#### *Correlation table*

After having aggregated observations per ParticipantID x DT x OC when DT = Size, we found  $r(18) = 0.35$  ( $r^2=0.12$ ,  $p>0.05$ ).  $r^2$  is close to 0 so we can't say that there is a correlation between variables visualSearchTime and ObjectCount.

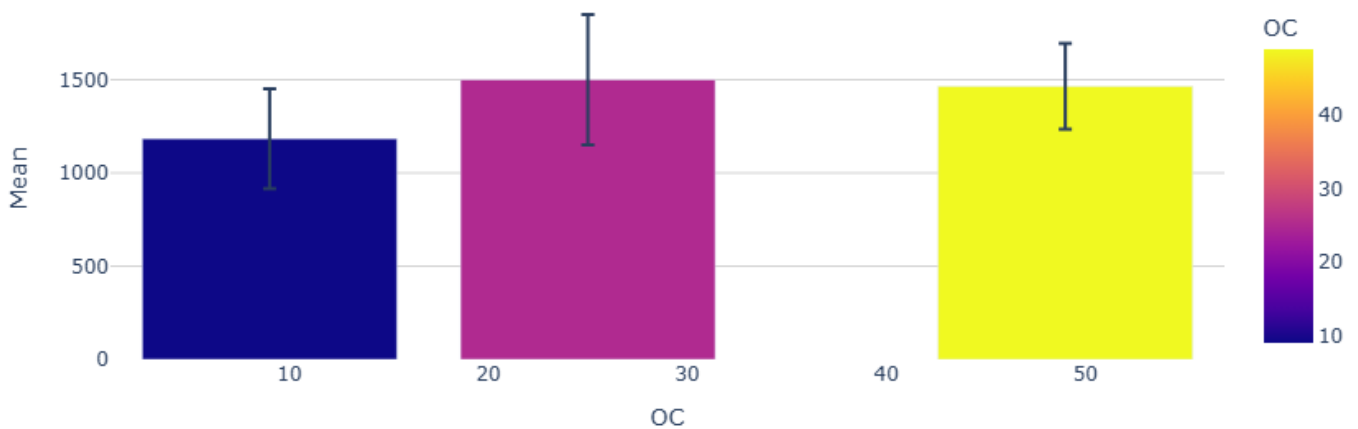


### One way anova

Hypothesis: visualSearchTime is the same regardless of OC.

Null hypothesis: visualSearchTime differs depending on the number of object (OC).

We found no significant effect of factor OC on visualSearchTime when DT = Size ( $F(2,10) = 2$ ,  $p > 0.05$ ,  $\eta^2 = 0.12$ ). p-value is above 0.05.



We can reject the null hypothesis and support the hypothesis. In fact, the one way anova test p-value is not enough high to show a significant effect of OC on visualSearchTime. So the visualSearchTime is the same regardless of OC.

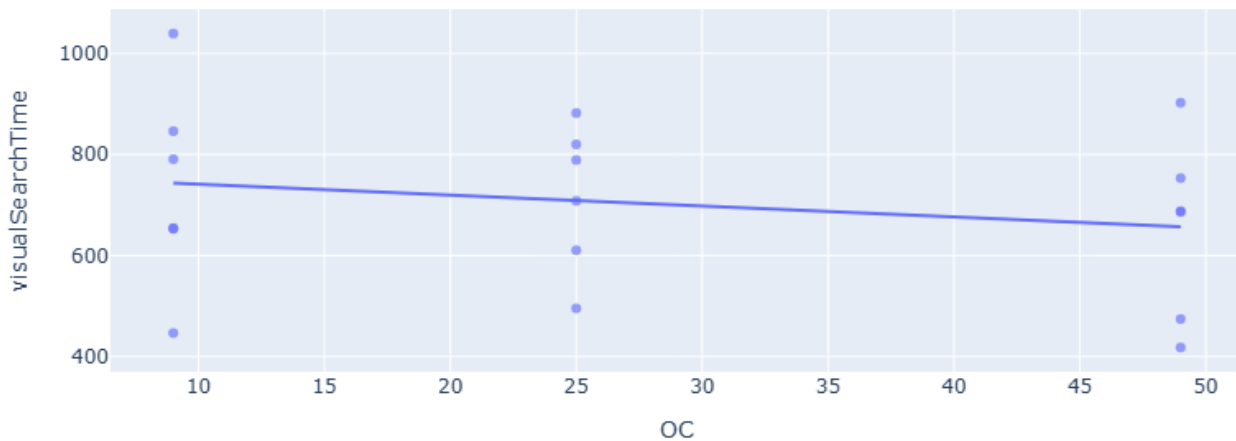
### For H2 (VV2 is preattentive):

To test the first hypothesis, we used a subset of the logs with only DT=Color.

### Correlation table

After having aggregated observations per ParticipantID x DT x OC when DT = Color, we found  $r(18) = -0.21$  ( $r^2=0.05$ ,  $p>0.05$ ).  $r^2$  is close to 0 so we can't say that there is a correlation between variables visualSearchTime and ObjectCount.

Gadet Martin  
Hatem Sandra

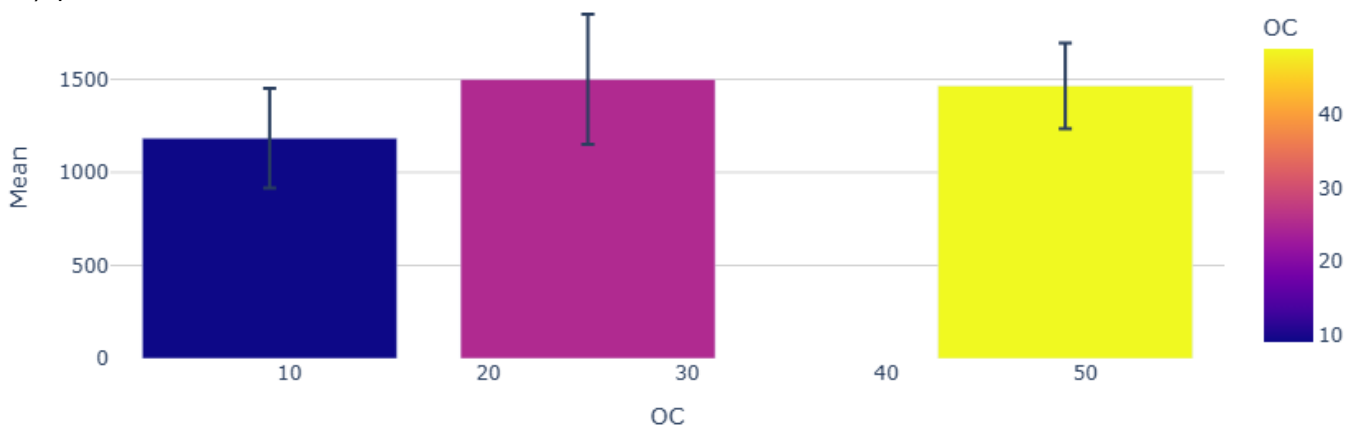


1 way anova

Hypothesis: visualSearchTime is the same regardless of OC.

Null hypothesis: visualSearchTime differs depending on the number of object (OC).

We found no significant effect of factor OC on visualSearchTime when DT = Color ( $F(2,10) = 0.5$ ,  $p > 0.05$ ,  $\eta^2 = 0.05$ ). p-value is above 0.05.

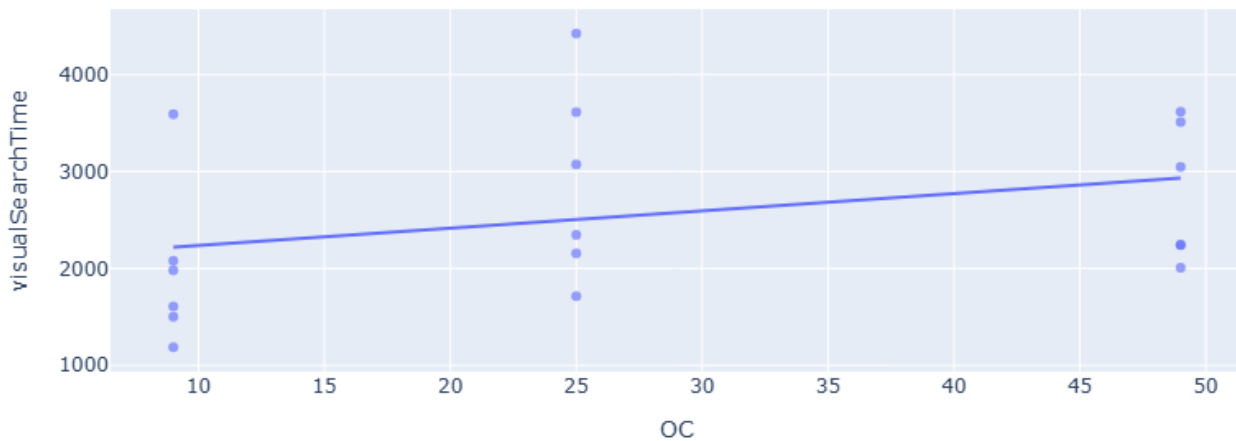


We can reject the null hypothesis and support the hypothesis. In fact, the one way anova test p-value is not enough high to show a significant effect of OC on visualSearchTime. So the visualSearchTime is the same regardless of OC.

**For H3 (Size (VV1) and Color (VV2) combined are less preattentive than Size (VV1) or Color (VV2) in isolation):**

*Correlation table*

After having aggregated observations per ParticipantID x DT x OC when DT = ColorSize, we found  $r(18) = 0.33$  ( $r^2=0.11$ ,  $p>0.05$ ).  $r^2$  is close to 0 so we can't say that there is a correlation between variables visualSearchTime and ObjectCount.

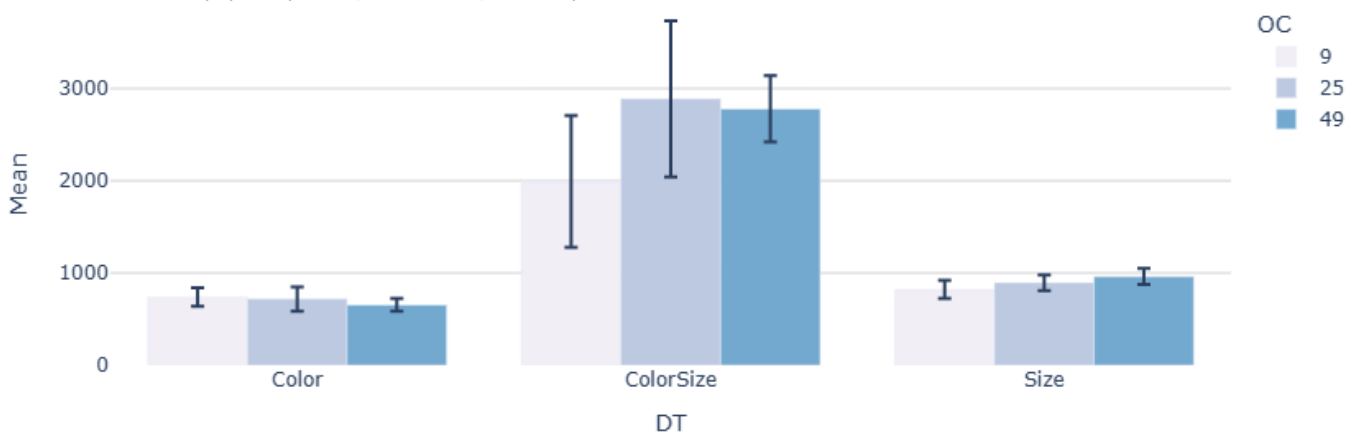


### Two way anova

Hypothesis: visualSearchTime differs depending on the difference type (DT).

Null hypothesis: visualSearchTime is the same regardless of DT.

An ANOVA test revealed a significant effect of DT on visualSearchTime ( $F(2,10) = 48, p < 0.001, \eta^2=0.75$ ), no significant effect of OC on visualSearchTime ( $F(2,10) = 2, p > 0.05, \eta^2=0.08$ ), as well as no significant DT x OC interaction effect ( $F(4,20) = 2, p > 0.05, \eta^2=0.13$ ).



According to the 2-way anova test, DT has a significant effect on visualSearchTime. The DT that differs is ColorSize. ColorSize has a higher visualSearchTime comparing to Color and Size in isolation. Thus we can support our hypothesis.

Based on these findings, our hypotheses are supported:

- **H1 & H2**: VV1 (Size) and VV2 (Color) are preattentive since visual search time changes minimally with increasing object count. There is no correlation between OC and visualSearchTime according to  $r^2$ .
- **H3**: The combination of VV1 and VV2 is less preattentive than when presented in isolation, as indicated by a significantly higher visual search time on every OC when DT=ColorSize.

## 8- Conclusion

A key challenge was interpreting the results. Typically, as object count (OC) increases, visual search time also increases due to additional elements. However, this increase is minimal, supporting the preattentiveness of VV1 and VV2.

One limitation of the study is how we define "minimal" change. The slight correlation between visual search time and OC could either lead to rejecting the hypothesis or considering the increase insignificant. Future research should refine this threshold to ensure clearer interpretation of preattentiveness in visual search tasks.