Background Information for the Visual Search Experiment

Why is it difficult to find a needle in a haystack? One of the reasons is the visual similarity between the shape of the hay stalks and the shape of a needle. This Experiment Project investigates the process of *visual search* – identifying a target (such as a needle) among distractor objects (such as a pile of hay stalks).

Before you begin working on your Lab Report, please read this background document, and then read the following material to strengthen your understanding about the cognitive process that make visual search possible:
- The sections in your textbook on *dual processing* (conscious vs. unconscious and serial vs. parallel processing), *selective attention* (and the *pop-out phenomenon*, if covered), and *gender similarities and differences* (in cognitive abilities)
- "Visual search" (2012) containing Wikipedia's clear and helpful introduction to this topic.

Your instructor may also ask you to read portions of these two journal articles describing some of the early research on the characteristics of visual search:
- Treisman and Gelade (1980) – the original (long) research article on which our experiment is based
- Nakayama and Silverman (1986) – a much shorter article describing a follow-up experiment on visual search

One goal of this experiment project is to help you understand what is going on in your brain while you are looking for a visual target. A second goal is to help you understand how psychologists test hypotheses about the impact of one variable (the *independent variable*) on another variable (the *dependent variable*).

Serial vs. Parallel Processing

This experiment is based on a theory of visual search proposed by researcher Anne Treisman (Treisman & Gelade, 1980). This theory proposes that the visual system takes in all of the objects in view on a computer screen and begins processing their details or "features" in parallel (simultaneously). So one component ("neural network") of the visual system processes the color of the objects at the same time that another component processes the shape of the objects.

Treisman argued that the difficulty of searching for a target (and therefore the amount of time that the search requires) depends on the visual similarity of the target to the other distractor objects on the screen. If a single feature (such as color) distinguishes the target from the distractors, the viewer can perform a "single-feature search" (sometimes called a "feature search") in parallel across all the objects on the screen. Because this feature search process simultaneously examines all the objects, adding more objects shouldn't slow the process.

On the other hand, if the target is so similar to the distractors that it can only be distinguished by a combination of features (such as color combined with shape), the viewer must perform a "conjunctive search", looking for the conjunction of the two features. Treisman argued that a conjunctive search cannot process all the objects simultaneously (using *parallel processing*).

Instead, the viewer must use *serial processing*, which examines the objects one at a time to see if they contain the correct combination of features. This means that adding more objects to the screen would require more processing time to find the target.

Independent vs. Dependent Variables

This experiment measured how quickly and accurately you could identify the target (an orange square) among distractor objects (blue and orange squares and triangles). Your performance scores varied from trial to trial, so we call these scores "variables". The performance variables or outcome variables in our experiment were <u>speed of response</u>, called *reaction time* (RT), and <u>accuracy of response</u>, measured in terms of *percent correct* (PC). These performance variables are considered *dependent variables,* because their values depend on the influence from other factors, called *independent variables*.

The experiment "manipulates" the independent variables by causing them to take different values, then measures the dependent variables to see if the manipulation of the independent variables had any effect or impact on the dependent variables. In this experiment, the main independent variable was **Search Type** (feature search or conjunctive search). This variable was manipulated by having some trials in which the target (an orange square) was surrounded by blue squares and blue triangles (allowing a "feature search" on color only), and other trials in which the target was surrounded by blue squares, blue triangles, and orange triangles (requiring a "conjunctive search" on both color and shape). The second independent variable was **Number of Objects** (4 objects or 16 objects) displayed on the screen.

Even without understanding Treisman's theory, we probably would expect that, on average, participants would respond slower (have longer RTs) on trials with 16 objects than on trials with 4 objects. We might also expect that participants would be slower on trials that required the more complicated conjunctive search rather than the simpler feature search. But if Treisman's theory is correct, we would predict a surprising result: *on trials allowing feature search, there should be no real difference in RT between 4 and 16 objects!* Why? Because all the objects could be processed in parallel (simultaneously).

Statistical Analyses

The analyses focus on the effect of each of the independent variables on the dependent variable of RT, using t-tests to test for a difference in mean RT scores between the two levels of the independent variable.

References

Myers, D. G., & DeWall, C. N. (2021). *Psychology: Thirteenth edition in modules.* New York: Worth Publishers.
Nakayama, K., & Silverman, G. H. (1986). Serial and parallel processing of visual feature conjunctions. *Nature, 320,* 264–265.
Treisman, A. M., & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive Psychology, 12,* 97-136.
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