Stroop Experiment

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The famous Stroop experiment is named after John Ridley Stroop who first demonstrated the difference in reaction times between automatic and non-automatic cognitive processing.

How hard did you have to think to read the sentence above?

If you're like most literate adults, reading is a skill so familiar and well-practiced that it may have felt like second nature to you. You may have barely noticed the cognitive effort your brain made to read and comprehend the words.

But what would happen if your brain was asked to do a task that it wasn't as familiar with? This question is behind the elegant design of the Stroop experiment.

A participant is presented with three different kinds of stimuli. The first is "neutral" and consists of printed words much like what you're reading right now. In this case, the words are for colors.

Green Blue Red Yellow

The second kind of stimulus is to again present words for colors, but this time, the color of the word varies. These words are "incongruent", meaning the word "green" may be printed in yellow, or the word "blue" may be printed in red etc.

Green Blue Red Yellow

The third kind is merely to present blocks of color.

As you can see, there are two kinds of information here: the stimulus of color, and the stimulus of the word for a color. Color can be presented alone, words can be presented alone, or they can be presented together.

The Experiment

Stroop conducted two main experiments. The first was to have people read the neutral stimulus – the words printed in black ink – and then read the words printed in colored ink. The challenge was that they were asked to say aloud the words they saw and not state the color they were printed in.

The second experiment was similar. Participants were first asked to state the color of the color blocks they saw and then later, when shown the incongruent words, they had to say the color of the word, regardless of what the word was.

Stroop experiments like this are some of the most frequently replicated studies in cognitive psychology. In fact, you can try it out yourself right now.

The Results

You most likely found that you were quicker to read the neutral stimuli (words in black ink) than the incongruent stimuli (“red” written in blue ink for example). Stroop called this effect semantic interference. Because reading is so automatic, the brain immediately leaps in to think of the color red when presented with the word “red.”

It then has to quickly correct itself and deliberately focus attention on the color instead, a task much less automated. The interference between these two tasks – one automatic and the other more deliberate – is what makes your reaction times for the incongruent stimuli just a little longer.

Though this is the effect most people are familiar with when they think of the Stroop effect, there were other results. Stroop discovered that naming congruent stimuli (when the ink and word match) was faster than when presented with the colored square alone. He called this effect semantic facilitation, as it again suggested that our familiarity with written words was behind the fast reaction times. After all, it’s not very often that we’re asked to name the colors we see!

The Explanation

Question: Now that you've tried the experiment for yourself, imagine that you are presented with the results and have to explain the discrepancy in reaction times. What do you think is behind the Stroop effect?

1. The brain reads faster than it can recognize colors. In a race between the two, the word information "wins" with the color information lagging behind.
2. It simply takes more attention from your brain to recognize a color than it takes to read a word, and this takes more time.
3. Recognizing colors is not something that most people have done enough to have it become automatic. We are in the habit of jumping in to do the familiar task even when told to do a less familiar one. This interferes with us doing the task well.
4. The neural pathway in the brain that recognizes words is stronger than the pathway that recognizes colors. It's not that we recognize words more quickly, only that this function is *stronger* in us than less familiar functions.

Answer:

In fact, all of the above explanations have been offered to explain the effects we see in Stroop tests.

What's Happening in the Brain?

When you did the test, did you find yourself thinking, "don't read the words, just look at the colors" and force yourself to ignore the word in front of you? If so, you were likely using your posterior dorsolateral prefrontal cortex to do so!

In brain scans, this part of the brain has been shown to be active during Stroop tests, and is loosely understood as helping us create heuristics or "rules" for processing what's in front of us. You may have experienced this as you deliberately shut off the parts of your brain that wanted to perceive the written word and refocused your attention on color recognition.

The anterior cingulate cortex is also involved in the Stroop task, and comes into play with memory, executive function, problem solving and making decisions on how to allocate mental resources.

The Stroop Test in Everyday Life

The Stroop test allowed researchers to not only theorize about what went on inside the brain and how, but to test it experimentally. Today, this test can be used to measure selective attention capacity and processing speed – which is useful in the diagnosis of a range of disorders such as ADHD, schizophrenia, dementia and brain damage.

The test can also be modified to measure the effect that a third variable (such as tiredness or intoxication) can have on processing times. The logic behind the test has undoubtedly inspired other research in cognitive psychology. Measuring the very small differences in processing times gives us some insight into the way the brain orders multiple tasks. Observing how we deal with tasks that are difficult or unusual gives insight into how the brain works in ideal situations.

Lastly, the Stroop test needn't involve only words and colors. Experimenters can use numerical information, words that are more or less emotive ("chair" versus "murder" for example), or even manipulate the location or font of words.
