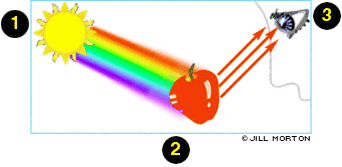
Introduction

Color is a part of everyday life. We see it everywhere we go. From our very own bedrooms, to the classroom; from the environment to our clothes and accessories. Everywhere we go, color goes with us. The human eye can see at least 7 million colors. The colors we see can affect our perceptions of the world. We all know that color can affect our moods and our personalities, but can it also affect our memory? Does it really matter what color of paper we take our notes on? Why do we highlight notes and vocabulary definitions when we are studying for a big Biology or History exam? Why? Well, before we get into color, let’s go over some background information first. What exactly is memory? Memory is the retention of, and ability to recall, information, personal experiences, procedures, skills and habits (Skeptics Dictionary). There are three distinguished types of memory, and those are sematic, procedural, and episodic memories. Semantic memory contains conceptual and factual knowledge; it is word based memory: names, facts, figures, and traditional book learning. It requires strong motivation on the part of the learner. We use our sematic memory when we are studying for exams or quizzes, or some other situation where we need to memorize definitions or facts. Procedural memory, on the other hand, allows us to learn new skills and acquire habits; it is motor memory or body learning. Many students often remember hands-on learning best. Some skills, such as driving a car, can only be learned by doing. Episodicmemory however, allows us to recall personal incidents that uniquely define our lives, such as the first time we drove a car, our first boyfriend or girlfriend, the first kiss or even the most embarrassing moment of our life**.** It has unlimited capacity, forms quickly and requires no practice. It is enhanced by sensory input: sights, sounds, smells, and movement. Episodic recall is often triggered by contextual cues such as location and emotions. Reflexive Memory is also a key component of memory. It is full of automatic, instant associations. It has been referred to as the hot stove effect. Reflexive learning is the goal when using flashcards to teach oneself math facts, vocabulary words or definitions.

One of the critical factors of an enriched environment is one which is mostly taken for granted, the visual climate. How does our brain recognize and work in this visual climate? Beginning around 1970, researchers began to seriously study the visual brain. Among the chief discoveries was the discovery of the V1 system. VI, in brief, acts much like a post office, distributing different signals to different destinations; it is an essential stage in an elaborate machine designed to extract the important information from the visual world. Our eyes are capable of registering 36,000 visual messages per hour–a huge number when you stop to think about it. Imagine 36,000 words laid out on the floor and your brain has the capacity to register each one. “Between 80 and 90 percent of all information that is absorbed by our brain is visual” (Walker, Morton). In fact, the retina accounts for 40 percent of all nerve fibers connected to the brain. With this enormous capacity, “it is important to be aware of the environmental factors that influence how we see and process information. The essential elements enabling our eyes to actually compose meaning from our visual field are contrast, tilt, curvature, line ends, color, and size” (Walker, Morton). These elements, are perceived even before the learner consciously understands what they’ve seen; they can inform teaching practice and provide a framework for attracting learner attention. While optimal learning involves far more than getting and keeping students’ attention, the principles of brain-based attention-getting are useful. How does color come into this? Color is a truly powerful medium; and one that is generally underestimated. Color originates in light. Sunlight, as we perceive it, is colorless. In reality, a rainbow proves that all the colors of the spectrum are present in white light. As illustrated in the diagram below by Jill Morton, the light goes from the source (the sun) to the object (the apple), and finally to the detector (the eye and brain).



1. All the invisible colors of sunlight shine on the apple.  
  
2. The surface of a red apple absorbs all the colored light rays, except for those corresponding to red, and reflects this color to the human eye.  
  
3. The eye receives the reflected red light and sends a message to the brain.

Color is a property of objects that our minds create -- an interpretation -- and this property is unique to humans and higher primates. How is color determined? The signal from the retina is analyzed by nerve cells (retinal ganglion cells) which compare the stimulation of neighboring cones, and calculate whether the light reaching an area of the cones is more blue-or-yellow, and reddish-or-greenish. Next, the signal travels to the brain where it is divided into several pathways -- like fiber optics branching throughout the cortex. For example, visual signals from the photo receptors pass to retinal ganglion cells which code color information, to the parvocellular cell layers of the dorsal lateral geniculate nucleus (LGN) in the thalamus, onwards to the retinotopic mapped layers of the LGN.

You might wonder, "Why does color have such an impact on our brain?" Consider this: “Color is part of the spectrum of electromagnetic radiation. Other electromagnetic radiation forms include x-rays, infrared, heat, and microwaves–pretty powerful mediums” (Walker, Morton). Color is no different. Let me ask you a question. How many times in your life have you used a highlighter to highlight your History notes? I am more than willing to say numerous times. Well, have you ever you stopped to think why you did that? No? Well, I did! The brain will always remember colors before content, hence why we highlight our notes and vocabulary words. Here’s another question. When you highlight your notes, what color of highlighter do you use? Yellow, green, blue, or even orange? Well, have you ever thought about why manufacturers produce those colors of highlighters? It has actually been scientifically proven that each one of those colors promotes memory. Here is a table which shows the “Power of Color” on our emotions, and memory and learning abilities. It was constructed by Morton Walker and can be seen in his book “The Power of Color”.

**The Power of Color**

**Red** is an engaging and emotive color. Best for restaurants. It is considered more disturbing by anxious subjects, and more exciting to calm subjects. Triggers the pituitary and adrenal glands and releases adrenaline. May increase blood pressure and breathing, and stimulate appetite and sense of smell.

**Yellow** is the first color a person distinguishes in the brain. Associated with stress, caution, and apprehension, yet it stimulates an overall sense of optimism, hope, and balance. Excellent for use in classrooms.

**Orange** has the characteristics halfway between red and yellow. It is one the best colors for stimulating learning.

**Blue** is the most tranquilizing color. When you see blue, your brain releases eleven neurotransmitters that relax the body and increases willingness to read by 89%.

**Green** is also a calming color. In response blood histamine levels may rise resulting in reduced sensitivity to food allergies. Antigens may be stimulated for overall better immune system healing. It increases retention and recall by 78%/

**Dark Colors** lower stress and increase feelings of peacefulness.

**Brown** promotes a sense of security, relaxation, and reduces fatigue.

**Bright Colors** such as red, orange, and yellow spark energy and creativity. They can also increase aggressive and nervous behavior.

**Gray** is the most neutral color.

When color is introduced into the learning enviroment, memory and learning capabilities are increased. The purpose of my experiment is to see which color has the greatest impact upon the short term memory of humans. Based on my research, I firmly believe that different colors have different impacts on memory. I predicted that orange would enhance memory the greatest,which would then be closely followed by yellow. Green would be next and blue would come last as it would enhance memory capablities the least. To begin my experiment, I had to decide upon how I would test my hypothesis. After much consideration, I decided to test the effects of which yellow, orange, blue and green would have upon the short term memories of humans. In order to test this, I decided to put twenty, commonly used words onto twenty flashcards of each color. For example, I put the following words on orange flashcards, I then put the same words on the green, blue and yellow flashcards.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Apple | Table | Penny | Car | Shirt |
| Glass | House | Cake | Money | Leg |
| Cheese | Tent | Motor | Flower | Stamp |
| Cup | King | Forest | Horse | Menu |

After preparation of the flashcards, I now had to decide how to collect the data. After much thought, I decided to get 64 volunteers (32 male and 32 female) from the Junior class (class of 2003). I made this decision as I wanted all the participants to be in the same grade level to avoid a bias with age level. In an effort to eliminate a bias concerning intelligence level, I only recruited volunteers who had been in or were currently in at least one Honors or Advanced Placement course. I would liked to have used a random sampling of students, however, after much consideration, I realised that this would not only create several biases, but it would also be diffilcult to notify everyone of their scheduled date and time to take part in the experiment. I decided to conduct the experiment during lunch, with two experiments being conducted each day. I did this by scheduling an experiement for 12:20 pm and scheduling another for 12:40 pm. This enabled me to test 16 volunteers each day. I also decided to test volunteers with a different color each day. This enabled me to collect an equal amount of data for each color, which is key to any experiment. After I completed a great amount of research, decided on how, when, and where to do my research, and did what I could to eliminate biases, I was ready to start my experiment.