

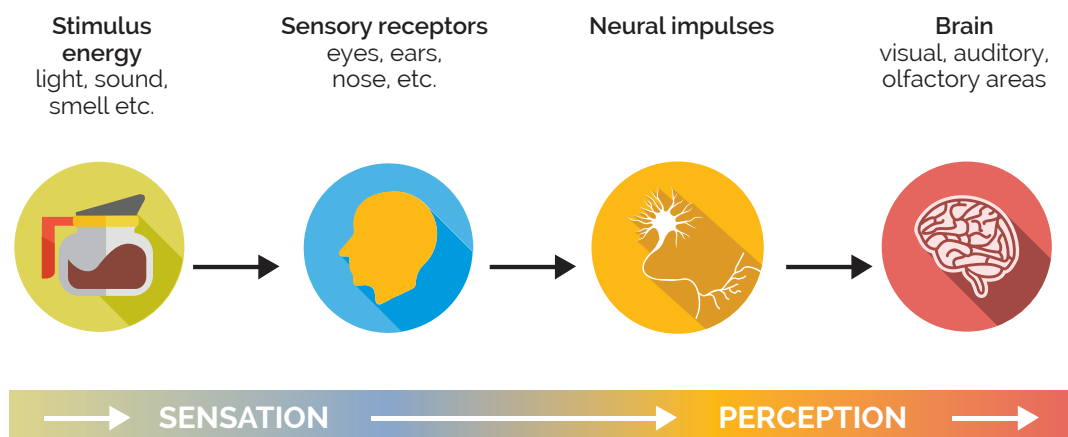
# Neuroscience and Design



You may not realize this about yourself, but **you are a highly trained, perceptual genius**. Go ahead and pat yourself on the back. Since your earliest moments of life, your brain forged advanced connections across a realm of cognitive processes, even without your awareness of this undertaking. Every sound, feeling, sight and beyond has been seamlessly integrated into our understanding of daily experience, and provided the foundation for each decision we make. Our sensation of the world around us provides the information to establish perception, enabling every person to experience a subjective reality through which we navigate our lives.

## The Science

Upon opening your eyes on a warm summer morning, the first rays of sunlight (the stimulus) pass through your pupils and land on the back of your retina (sensory receptors). Once these cells receive the stimulation, they fire signals (neural impulses) to the brain – in this case, the area responsible for visual information, the primary visual cortex (processing area). From this point forward, higher areas of the brain can then receive activation, providing higher-level processing and feedback opportunities. This pathway extends to all of our sensory modalities, whether auditory, olfactory, or tactile, and helps us understand the process that leads to cognition. Stimuli yield binary impulses that yield brain activation. Simple enough?



*Fig. 1. Pathway through which sensation becomes perception.*<sup>1</sup>

## Visual

As visual cues are the most influential for web and graphic design decisions, this sensory pathway is critical for understanding what we appreciate about "good design". Every step of the mechanism contributes to the next, and throughout the visual process, we gain improved information about what we are seeing. What begins as binary processing of a photon gradually progresses to include edges detection, boundaries completion, and surface filling.

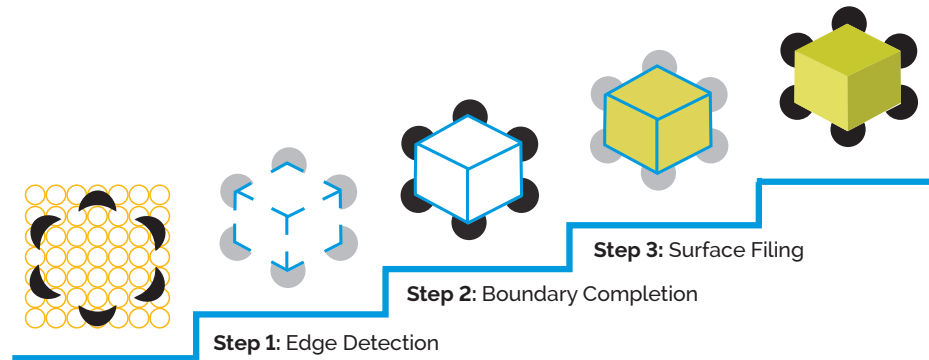


Fig. 2. Visual identification hierarchy. <sup>ii</sup>

## Recognition

Later, we can start to actually recognize objects. At this point in the pathway, we require feedback from other areas (like the inferotemporal cortex), because recognition requires memory of previous experience or extrapolation based upon similarity. Many models attempt to understand this ability (see Biederman's Geon theory of components or naïve template theory), but what is most important is that we are able to identify visual stimuli as familiar. As the object achieves greater recognition in the brain, the processing level rises and the level of cortical interaction grows (note: the figure below is oversimplified, but beneficial in understanding the progression of perception).

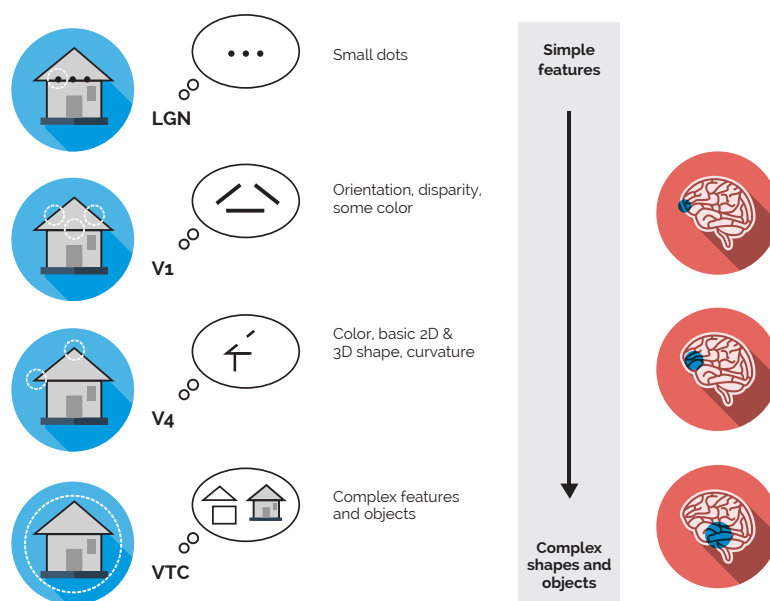


Fig. 3. Visual pathway leading to recognition. <sup>ii</sup>

## Response

When we see an object in front of us, a variety of cortical regions contribute to how we perceive it after the visual cortices have helped provide the relevant data. The hippocampus consolidates the new sensory information. Areas like the prefrontal cortex and amygdala call upon previous experience and extrapolation of similarity to guide our emotional response, offering semantic attributes to the object. Before we (think we) are fully cognizant of what we are looking at, our brain has made up its mind.

**Did you know?** Some of our neurons may actually recognize objects even in isolation. In a study by Quiroga et al. (2005), scientists found a specific neuron in the hippocampus to fire signals ONLY when the subject was shown a picture of Jennifer Aniston. No combination of objects, people, or other stimuli could elicit the same response. This finding prompted further investigation into the idea that we have cells devoted to single faces or objects.

## Implications for Design

Okay, enough with the science (for now), and onto design. If neuroscience is the study of the brain and nervous system, then "intelligent design" utilizes the careful understanding of our perception and implements devices that ultimately cause our brains to respond in a targeted manner. Successful design does not merely reflect the immediate aesthetic of a piece, but also includes the critical thinking and research components. The most prominent division, especially for understanding the relationship between neuroscience and design, is the division between subconscious and conscious appreciation for composition.

**Did you know?** *Koinophilia* is the evolutionary theory that postulates that humans prefer faces with minimal unusual features, meaning that the average face is likely the most attractive to you. However, a study from DeBruine et al. (2007) found increased perceived attractiveness upon caricaturing highly attractive faces. Implications for design? We like the average, and also far from it...just not the in-between.

## Visual Attention

Highly important in the conception of design is visual attention. Consider a "Where's Waldo?" graphic in front of you. You have a target, Waldo, distractors, all other characters and features of the scene, and a set size, the number of items within your viewpoint. The game has entertainment value because of its difficulty in isolating a seemingly profound object.

In the majority of cases, intelligent design depends upon achieving the opposite effect. Through minimizing the distractors, and lessening the set size, the target of our design achieves greater efficiency in visual search and salience in impact. How can we take advantage of this understanding?



Fig 4. We are always looking for our “Waldos” in a sea of distractions.<sup>iv</sup>

### Graphic design

We believe that “less is more” and strong, arresting visuals help achieve robustness of influence. We want to direct the viewers’ attention to specific features, and minimize outside distractors.

### Website development

We can utilize known visual search strategies to construct accessible content. As much of our vision depends upon guided search, we employ roles to standardize placement of content, as with a header and footer, to ensure ease of use.



Fig. 5. Comparing the clutter of Yahoo’s homepage with the successful Google style.<sup>v</sup>

Despite comprising only 2% of the body’s mass, the brain consumes 20% of the energy produced during the resting state. The implications for design are that we rely on selective attention to create our perceptions, and the quicker we can achieve a desired emotional reaction, the better our design will succeed. *Design needs to be salient and lack surrounding chaos.*

**Did you know?** Consulting firm Added Value Cheskin performed a study to identify why CB brandy company, which previously dominated in sales over E&J brandy, began losing market share despite similar price, marketing, and availability. Blind tests yielded fairly equal preference for the drinks, informing the subject of the brand being consumed yielded greater preference for Christian Brothers, and seeing the bottle shape for each in the background yielded preference for E&J. However, serving Christian Brothers brandy in a E&J bottle produced the highest margin of preference. What happened? The right bottle was a critical component of taste. Visual appeal impacts our other sensory perceptions (*sensation transference*).

## Patterns and Shapes

Human beings maintain incredible abilities to form patterns, and as a result, we look for these relationships in everything we see in order to propagate comprehension. First introduced in 1890 by Christian von Ehrenfels, Gestalt psychology defines the principles by which the mind forms meaningful perceptions of otherwise chaotic elements of the world. We can utilize negative space, discontinued lines, and a variety of other fractured stimuli to create continuity. Design often exploits this ability of ours, crafting logos and graphics that go beyond a binary structure and call upon higher levels of processing.



Fig. 6-11. Examples of logos that use a combination of Gestalt rules (reification, multistability, and continuity, among others), to create memorable designs with negative space. vi vii ix x xi

For more information on Gestalt rules and the use in design, check out Michael Tuck's article on the subject for Six Revisions: "Gestalt Principles Applied in Design".

## Color

Light enters our visual system as electromagnetic energy of different wavelengths, and our visual system converts this energy to what we perceive as color, a purely psychological phenomenon. Even at early ages of learning, we were taught about the primary colors, likely without understanding the rationale behind these options. Humans have four types of photoreceptors, three of which are cones, which absorb light at specific wavelengths, one each for red, green, and blue. Using the three primaries and applying von Helmholtz's 1859 Trichromatic theory, any color can be matched from a combination of RGB. Here we make the transition from the initially limited palette, to the complexity of color availability.

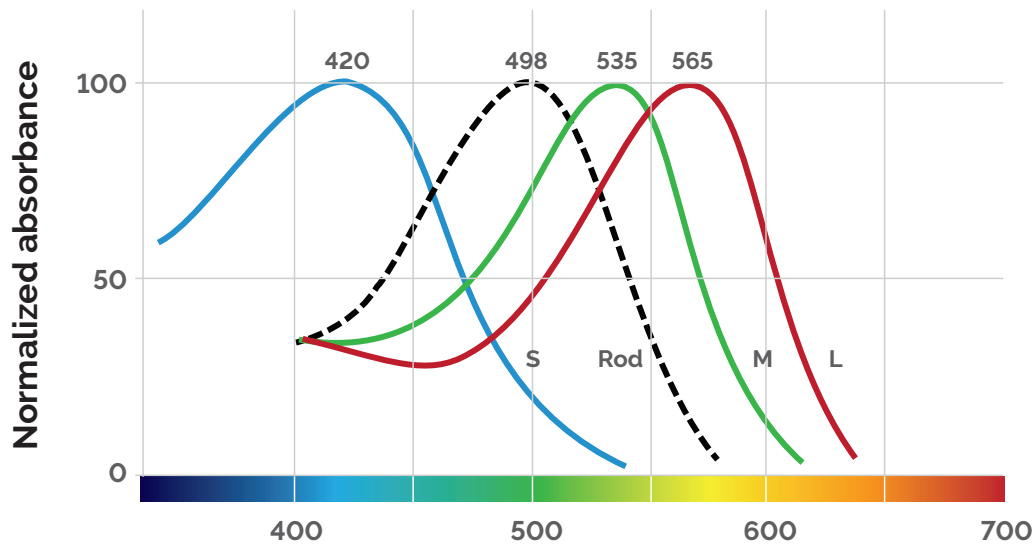


Fig. 12. Graph showing the wavelengths of color absorption of the three cones and one rod of the human eye. These lines represent average absorption values across tested populations.<sup>xiii</sup>

When choosing a color scheme for a project, designers consider a variety of factors, including harmony, context, and symbology of their color choices. Pursuant to the design choices of a brand's voice and message, the visual should adequately elicit the desired effect on the viewer. Across countries and cultures, many of the emotions we associate with specific colors are highly conserved. Bright red can mean passion and excitement, yellow can mean cowardice and illness, or green can mean growth and nature.

We can also look at what all of the competition uses, and choose instead to "own" a completely new color, or assimilate to a similar design. Palette choices do not merely reflect the aesthetic of a piece – equally important are the critical thinking and research that provide depth to design, and communicate the desired message. These decisions do not end at the color choices. Shape of lines, depth of surfaces, interactions amongst objects; all features of the final product are carefully implemented in generating the finished piece.



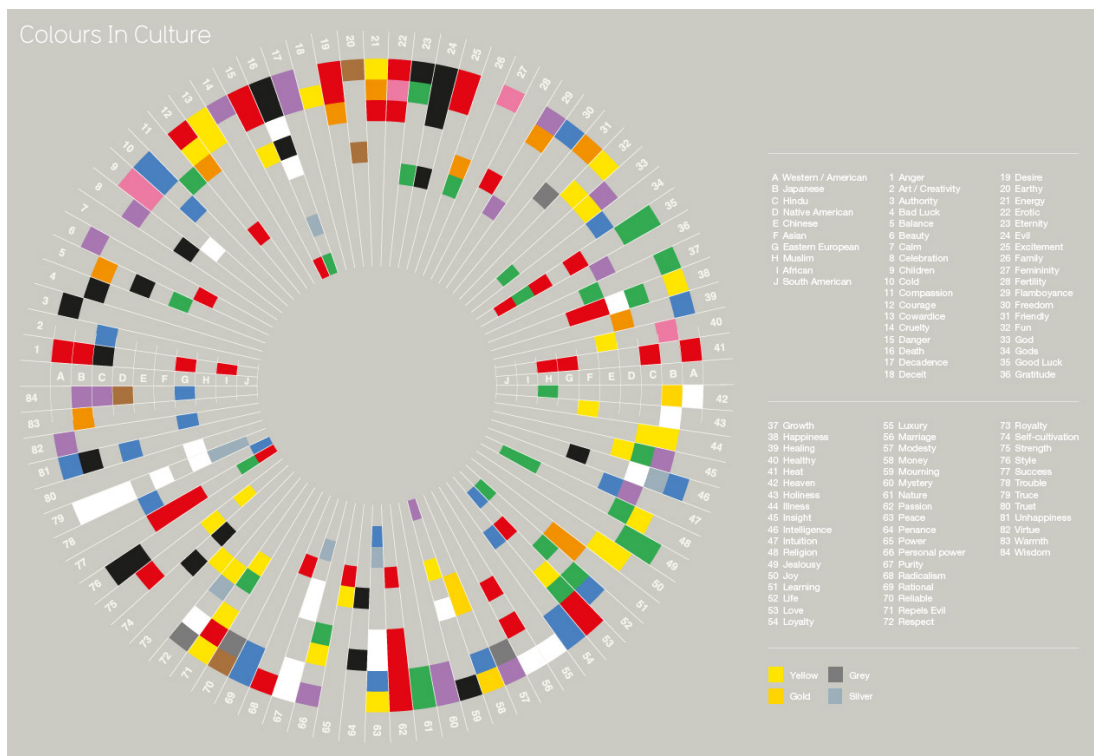


Fig. 13. Graphical representation of geographical origin, emotional, and color associated with each.<sup>xiii</sup>

## A Case Study in Logo Development: Effective Student Marketing

In pursuant to our goal of intelligent design, we want every project we work on to be smartly conceived, and not just aesthetically appealing. Successful and creative design depends wholly on critical thinking and research. To help our clients, Jackrabbit designers work to:

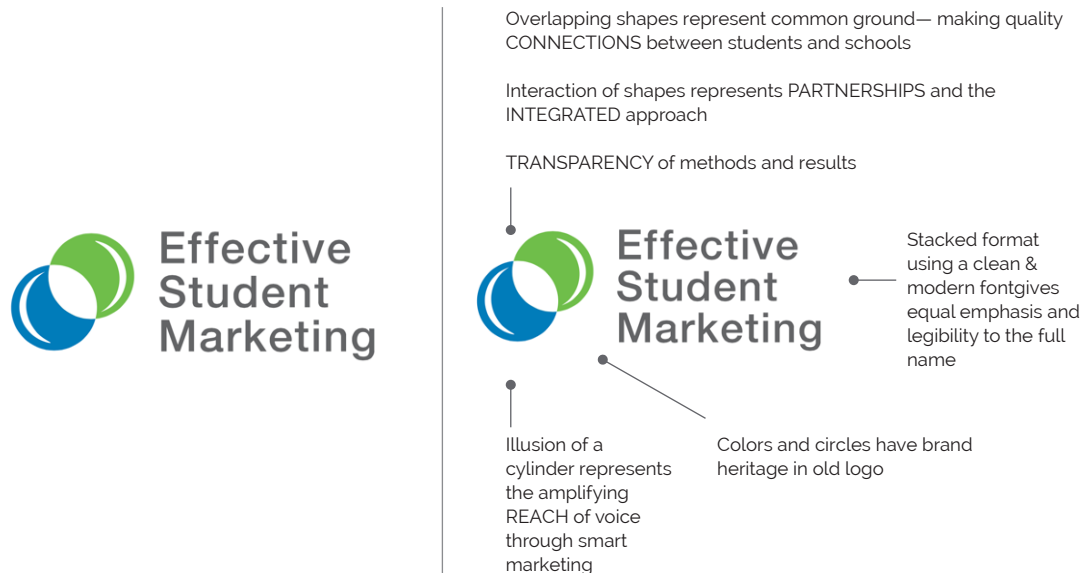
1. Find the brand voice
2. Define what makes them unique
3. Establish core message of the brand
4. Choose how best to visually communicate the message
5. Determine audience and what motivates them
6. Identify specific challenges, and define objectives to solve them

Throughout this process, we ensure that the design is visually appealing and that every decision has a reason, based upon our research.

Effective Student Marketing wanted to promote an image of trust, professionalism, and innovation, among other defining characteristics. Jackrabbit worked with them to generate the relevant adjectives: smart, techie, creative, professional, innovative, trust, integrity. Furthermore, as a basis for our design, we needed to include some logistical criteria, like inclusion of the entire company name and the ability to have a single color version. Based on these characteristics, we got to work.



Let's take a look at ESM's current logo, the chosen option amongst our presented selection. Every facet of the design is meaningful. The shapes and colors of the graphic portray brand heritage, connecting the previous identity to the new design. The marketing reach of ESM's voice can be seen in the cylinder illusion, with the overlapping shapes also establishing the connections the company fosters with its own clients. Key qualities of the brand, like partnership, integration, and transparency all come to fruition. On first glance, the logo may not appear remarkable, but the intention of the design and the emotional response of the viewer is far more exceptional, even if we are not fully cognizant of its effect.



## Conclusion

**Good design is smartly conceived.** What we view as previously successful and creative pieces reflect what our brains like to see. We want simple but striking images. Bite-sized content appeals to our attentional efficiency, and doesn't overwhelm our senses. Aesthetic appeal, albeit well-situated in our cognition, is not sufficient to guarantee intelligent design. Our lower levels of processing are blunt and activate upon the familiar and pleasant, but through critical thinking into the intricacies of design, we better access the higher areas of processing. The more we integrate meaning and emotional characteristics into our design, the better we can achieve lasting effects on our audience.

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<sup>ii</sup>(Ibid, 2012)

<sup>iii</sup>Baars, Bernard J.; & Gage, Nicole M. (eds.) (2007), *Cognition, Brain, and Consciousness: Introduction to Cognitive Neuroscience* (Amsterdam: Elsevier), Fig. 6.10

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<sup>v</sup>Hong, Sockyung. *Yahoo vs. Google Home Page Design Evolution*. Digital image. Flickr. Yahoo, 5 Nov 2007. Web. 2 Jun 2015.

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