Color

Color is used in design to attract attention, group elements, indicate meaning, and enhance aesthetics.

Color can make designs more visually interesting and aesthetic, and can reinforce the organization and meaning of elements in a design. If applied improperly, colors can seriously harm the form and function of a design. The following guidelines address common issues regarding the use of color.

Number of Colors
Use color conservatively. Limit the palette to what the eye can process at one glance (about five colors depending on the complexity of the design). Do not use color as the only means to impart information since a significant portion of the population has limited color vision.

Color Combinations
Achieve aesthetic color combinations by using adjacent colors on the color wheel (analogous), opposing colors on the color wheel (complementary), colors at the corners of a symmetrical polygon circumscribed in the color wheel (triadic and quadratic), or color combinations found in nature. Use warmer colors for foreground elements, and cooler colors for background elements. Light gray is a safe color to use for grouping elements without competing with other colors.

Saturation
Use saturated colors (pure hues) when attracting attention is the priority. Use desaturated colors when performance and efficiency are the priority. Generally, desaturated, bright colors are perceived as friendly and professional. Desaturated, dark colors are perceived as serious and professional, and saturated colors are perceived as more exciting and dynamic. Exercise caution when combining saturated colors, as they can visually interfere with one another and increase eye fatigue.

Symbolism
There is no substantive evidence supporting general effects of color on emotion or mood. Similarly, there is no universal symbolism for different colors—different cultures attach different meanings to colors. Therefore, verify the meaning of colors and color combinations for a particular target audience prior to use.

See also Expectation Effect, Highlighting, Interference Effects, Similarity, and Uniform Connectedness.

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It is reasonable to assume that dark colors will make people sleepy. Light colors will make people alert, and initiating colors will make people tired. Otherwise, the only observable influence of color on behavior is its ability to keep people to report the color unnecessarily. For those determined to try to color drinks and win football games through the application of color, see The Power of Color by Morten Walker, Avery Publishing, 1991.
Interference Effects

A phenomenon in which mental processing is made slower and less accurate by competing mental processes.

Interference effects occur when two or more perceptual or cognitive processes are in conflict. Human perception and cognition involve many different mental systems that operate on information independently of one another. The outputs of these systems are communicated to working memory, where they are interpreted. When the outputs are congruent, the process of interpretation occurs quickly and performance is optimal. When outputs are incongruent, interference occurs and additional processing is needed to resolve the conflict. The additional time required to resolve such conflicts has a negative impact on performance. A few examples of interference effects include: ¹

1. Stroop Interference—an irrelevant aspect of a stimulus triggers a mental process that interferes with processes involving a relevant aspect of the stimulus. For example, the time it takes to name the color of words is greater when the meaning and color of the words conflict.

2. Garner Interference—an irrelevant variation of a stimulus triggers a mental process that interferes with processes involving a relevant aspect of the stimulus. For example, the time it takes to name shapes is greater when they are presented next to shapes that change with each presentation.

3. Proactive interference—existing memories interfere with learning. For example, in learning a new language, errors are often made when people try to apply the grammar of their native language to the new language.

4. Retroactive interference—learning interferes with existing memories. For example, learning a new phone number can interfere with phone numbers already in memory.

Prevent interference by avoiding designs that create conflicting mental processes. Interference effects of perception (e.g., Stroop and Garner) generally result from conflicting coding combinations (e.g., a red go button, or green stop button) or from an interaction between closely positioned elements that visually interact with one another (e.g., two icons group or blend because of their shape and proximity).

Minimize interference effects of learning (i.e., proactive and retroactive) by mixing the presentation modes of instruction (e.g., lecture, video, computer, activities), employing advance organizers, and incorporating periods of rest away thirty to forty-five minutes.

See also Advance Organizer, Performance Load, Error, and Mapping.


In populations that have learned that green means go and red means stop, the incongruence between the color and the label-icon results in interference.

Naming the column of shapes that stands alone is easier than naming either of the columns located together. The close proximity of the columns results in the activation of mental processes for naming proximal shapes, creating interference.

Reading the words aloud is easier than naming their colors. This mental process for reading is more practiced and automatic and, therefore, interferes with the mental process for naming the colors.
Gutenberg Diagram

A diagram that describes the general pattern followed by the eyes when looking at evenly distributed, homogenous information.¹

The Gutenberg diagram divides a display medium into four quadrants: the primary optical area at the top left, the terminal area at the bottom right, the strong follow area at the top right, and the weak follow area at the bottom left. According to the diagram, Western readers naturally begin at the primary optical area and move across and down the display medium in a series of sweeps to the terminal area. Each sweep begins along an axis of orientation—a horizontal line created by aligned elements, text lines, or explicit segments—and proceeds in a left-to-right direction. The strong and weak follow areas lie outside this path and receive minimal attention unless visually emphasized. The tendency to follow this path is metaphorically attributed to reading gravity—the left-right, top-bottom habit formed from reading.²

Designs that follow the diagram work in harmony with reading gravity, and return readers to a logical axis of orientation, purportedly improving reading rhythm and comprehension. For example, a layout following the Gutenberg diagram would place key elements at the top left (e.g., headlines), middle (e.g., images), and bottom right (e.g., contact information). Though designs based directly or indirectly on the Gutenberg diagram are widespread, there is little empirical evidence that it contributes to improved reading rates or comprehension.

The Gutenberg diagram is likely only predictive of eye movement for heavy text information, evenly distributed and homogeneous, and blank pages or displays. In all other cases, the weight of the elements of the design in concert with their layout and composition will direct eye movements. For example, if a newspaper has a very heavy headline and photograph in its center, the center will be the primary optical area. Familiarity with the information and medium also influences eye movements. For example, a person who regularly views information presented in a consistent way is more likely to first look at areas that are often changing (e.g., new top stories) than areas that are the same (e.g., the title of a newspaper).

Consider the Gutenberg diagram to assist in layout and composition when the elements are evenly distributed and homogeneous, or the design contains heavy use of text. Otherwise, use the weight and composition of elements to lead the eye.

See also Alignment, Entry Point, Progressive Disclosure, and Serial Position Effects.

1 Also known as the Gutenberg rule and the Z pattern of processing.

2 The seminal work on the Gutenberg diagram is attributed to the typographer Edmund Arrows, who is said to have developed the concept in the 1950s. See, for example, Typo & Layout of the Typography and Design Can Get Your Message Across or Get in the Way, by Colin Woodson, Stonehouse Press, 1995.
Hierarchy

Hierarchical organization is the simplest structure for visualizing and understanding complexity.

Increasing the visibility of the hierarchical relationships within a system is one of the most effective ways to increase knowledge about the system. Examples of visible hierarchies are look outlines, multi-level software menus, and classification diagrams. Perception of hierarchical relationships among elements is primarily a function of their relative left-right and top-down positions, but is also influenced by their proximity, size, and the presence of connecting lines. Superordinate elements are commonly referred to as parent elements, and subordinate elements as child elements.

There are three basic ways to visualize hierarchy: trees, nests, and stairs.1

Trees structures illustrate hierarchical relationships by locating child elements below or to the right of parent elements, or through the use of other strategies indicating hierarchy (e.g., size, connecting lines). Tree structures are effective for representing hierarchies of moderate complexity, but can become cumbersome for large or complex hierarchies. Tree structures grow large quickly, and become tangled when multiple parents share common child elements. Tree structures are commonly used to represent overviews or high-level maps of system organization.

Most structures illustrate hierarchical relationships by visually containing child elements within parent elements, as in a Venn diagram. Nest structures are most effective when representing simple hierarchies. When the relationships between the different levels of the hierarchy become too dense and complex to be clearly distinguishable, nest structures become less effective. Nest structures are most commonly used to group information and functions, and to represent simple logical relationships.

Stair structures illustrate hierarchical relationships by stacking child elements below and to the right of parent elements, as in an outline. Stair structures are effective for representing complex hierarchies, but are not easily browsed, and falsely imply a sequential relationship between the stacked child elements. Interactive stair structures found in software often deal with the former problem by concealing child elements until a parent element is selected. Stair structures are commonly used to represent large system structures that change over time.1

Hierarchical representation is the simplest method of increasing knowledge about the structure of a system. Consider tree structures when representing high-level views of hierarchies of moderate complexity. Consider nest structures when representing natural systems, simple hierarchical relationships, and grouped information or functions. Consider stair structures when representing complex hierarchies, especially if the visibility and growth of the system represented is unpredictable. Explore ways to selectively reveal and conceal the complexity of hierarchical structures to maximize their clarity and effectiveness.1

See also: AAdvance Organizer, Alignment, Five Hat Racks, Layering, and Proximity.
Common Fate

Elements that move in the same direction are perceived to be more related than elements that move in different directions or are stationary.

The principle of common fate is one of a number of principles referred to as Gestalt principles of perception. It asserts that elements that move together in a common direction are perceived as a single group or chunk, and are interpreted as being more related than elements that move at different times or in different directions. For example, a row of randomly arranged Xs and Os that is stationary is naturally grouped by similarity, Xs with Xs, and Os with Os. However, if certain elements in the row move in one direction, and other elements move in the opposite direction, elements are grouped by their common motion and direction.

Perceived relatedness is strongest when the motion of elements occurs at the same time and velocity, and in the same direction. As any of these factors vary, the elements are decreasingly related. One exception is when the motion exhibits an obvious pattern or rhythm (e.g., wave patterns), in which case the elements are seen as related. Although common fate relationships usually refer to moving elements, they are also observed with static objects that flicker (i.e., elements that alternate between brighter and darker states). For flickering elements, perceived relatedness is strengthened when the elements flicker at the same time, frequency, and intensity, or when a recognizable pattern or rhythm is formed.

Common fate relationships influence whether elements are perceived as figure or ground elements. When certain elements are in motion and others are stationary, the moving objects will be perceived as figure elements, and stationary ones will be perceived as ground elements. When elements within a region move together with the bounding edge of the region, the elements and the region will be perceived as the figure. When elements within a region move together, but the bounding edge of the region remains stationary or moves opposite to the elements, the elements within the region will be perceived as the ground.

Consider common fate as a grouping strategy when displaying information with moving or flickering elements. Related elements should move at the same time, velocity, and direction, or flicker at the same time, frequency, and intensity. It is possible to group elements when these variables are dissimilar, but only if the motion or flicker forms a recognizable pattern. When moving elements within bounded regions, move the edges of the region in the same direction as the elements to achieve a figure relationship or in the opposite direction as the elements to achieve a ground relationship.

See also Figure-Ground Relationship and Similarity.


3 "Common Fates as a Determinant of Figure-Ground Organization" by Joseph Lloyd Brooks, Stanford University, May 2000.