Orientation Sensitivity

A phenomenon of visual processing in which certain line orientations are more quickly and easily processed and discriminated than other line orientations.

The efficiency with which people can perceive and make judgments about the orientation of lines is influenced by a number of factors. For example, the time displayed on a standard analog clock can be quickly interpreted because the numbers are positioned at 30-degree increments around the center. The 30-degree increment happens to correspond to the minimum recommended difference in line orientation required to be easily detectable; i.e., differences in line orientation of less than 30 degrees require more effort to detect. Orientation sensitivity is based on two phenomena that are observed in visual perception: oblique effect and pop-out effect.[1]

The *oblique* effect is the ability to more accurately perceive and judge line orientations that are close to vertical and horizontal, than line orientations that are oblique. For example, in tasks where people have to estimate the relative orientation of a line by any number of methods (e.g., redrawing from memory), the most accurate judgments are for horizontal and vertical lines, and the least accurate judgments are for oblique lines. The oblique effect is caused by a greater sensitivity of neurons to vertical and horizontal stimuli than to oblique stimuli. Additionally, people tend to make judgments about line orientation that are biased toward the nearest vertical or horizontal axis; lines oriented close to the vertical or horizontal axis will often be perceived or recalled as truly vertical or horizontal. Designs in which the primary elements are vertical or horizontal are also considered generally more aesthetic than designs in which primary elements are oblique.[2]

The *pop-out* effect is the tendency of certain elements in a display to pop out as figure elements, and as a result be quickly and easily detected. For example, in tasks where people have to identify a target line against a background of lines of a common orientation, the target line is easily detected when it differs from the background lines by 30 degrees or more. The pop-out effect is caused by a change in the visual stimuli sufficient to activate additional input neurons, which then help to detect differences in line orientation and patterns. The effect is strongest when combined with the oblique effect; it is easier to detect subtle differences in the orientation of a target line against a background of vertical and horizontal lines, than against a background of oblique lines.[3]

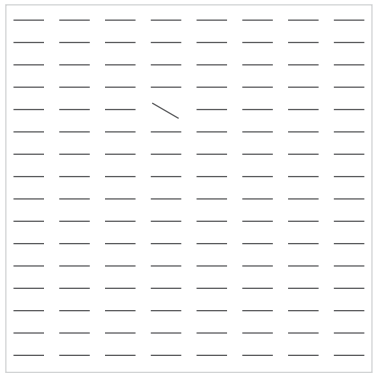
Consider orientation sensitivity in compositions requiring discrimination between different lines or textures, or decisions based on the relative position of elements. Facilitate discrimination between linear elements by making their orientation differ by more than 30 degrees. In displays requiring estimates of orientation or angle, provide visual indicators at 30-degree increments to improve accuracy in oblique regions. Use horizontal and vertical lines as visual anchors to enhance aesthetics and maximize discrimination with oblique elements.

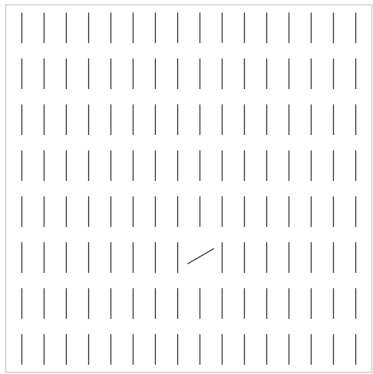
See also Closure, Constancy, Figure-Ground Relationship, and Good Continuation.

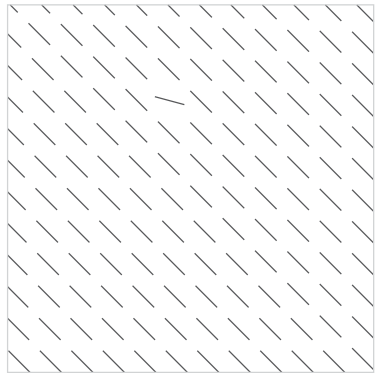
[1] The seminal works on orientation sensitivity include "On the Judgment of Angles and Positions of Lines" by Joseph Jastrow, *American Journal of Psychology*, 1893, vol. 5, p. 214–248; and "Perception and Discrimination As a Function of Stimulus Orientation: The "Oblique Effect" in Man and Animals" by Stuart Appelle, *Psychological Bulletin*, 1972, vol. 78, p. 266-278.

[2] "An Oblique Effect in Aesthetics: Homage to Mondrian (1872–1944)" by Richard Latto, Douglas Brain, and Brian Kelly, *Perception*, 2000, vol. 29(8), p. 981–987.

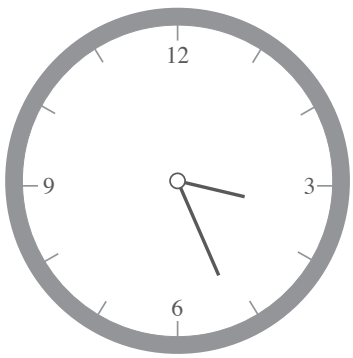
[3] See, for example, "Texture Segmentation and Pop-Out from Orientation Contrast" by Christoph Nothdurft, *Vision Research*, 1991, vol. 31, p. 1073–1078.

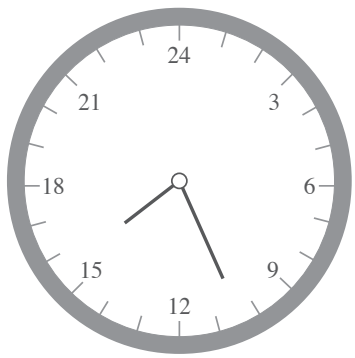




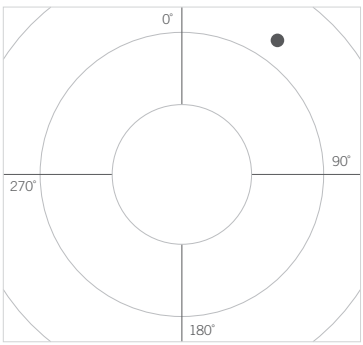


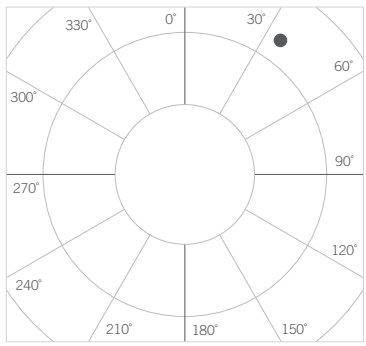
Differences in line orientation are most easily detected when set against vertical or horizontal lines.





Standard analog clocks are easily read because numbers are separated by 30 degrees. However, the same time on a twenty-four hour clock is more difficult to read because numbers are separated by only 15 degrees.





Systems that require precise estimation of orientation and position should be designed to accommodate orientation sensitivity. For example, radar-tracking displays should indicate orientation by providing markers in 30-degree increments or less. Without the markers, estimates in oblique regions of the display will be prone to error.