Three-Dimensional Projection

A tendency to see objects and patterns as three-dimensional when certain visual cues are present.

People have evolved to see things as three-dimensional whenever possible—even when the things are clearly not three-dimensional. The following visual cues are commonly used to encourage the perception of three-dimensional relationships:[1]

Interposition
When two overlapping objects are presented, the overlapped object is perceived to be farther away than the overlapping object.

Size
When two similar objects of different size are presented together, the smaller object is perceived to be farther away than the larger object. The size of familiar objects can also be used to indicate the size and depth of unfamiliar objects.

Elevation
When two objects are presented at different vertical locations, the object at the higher elevation is perceived to be farther away.[2]

Linear Perspective
When two vertical lines converge near their top ends, the converging ends of the lines are perceived to be farther away than the diverging ends.

Texture Gradient
When the texture of a surface varies in density, the areas of greater density are perceived to be farther away than areas of lesser density.

Shading
When an object has shading or shadows, the shaded areas are perceived to be the farthest away from the light source and the light areas are interpreted as being closest to the light source.

Atmospheric Perspective
When multiple objects are presented together, the objects that are bluer and blurrier are perceived to be farther away than the objects that are less blue and blurry.[3]

Consider these visual cues in the depiction of three-dimensional elements and environments. Strongest depth effects are achieved when the visual cues are used in combination; therefore, use as many of the cues as possible to achieve the strongest effect, making sure that the cues are appropriate for the context.

See also Figure-Ground Relationship and Top-Down Lighting Bias.

[1] Note that only static cues (as opposed to motion cues) are presented here. A nice review the various depth cues is found in *Sensation and Perception* by Margaret W. Matlin and Hugh J. Foley, Allyn & Bacon, 1997, p. *165–193*.

[2] An exception to this is when a strong horizontal element is present, which tends to be perceived as a *horizon line*. In this case, objects that are closer to the horizon line are perceived as farther away than objects that are distant from the horizon line.

[3] The relationship between the degree of blueness and blurriness to distance is a function of experience—i.e., people who live in a smoggy city will have a different sense of atmospheric perspective than people who live in less-polluted rural areas.

Video games make ample use of three-dimensional projection to represent three-dimensional environments on two-dimensional screens. For example, the game Black & White uses three-dimensional projection to create a believable and navigable three-dimensional world. All of the depth cues are demonstrated in these screen shots from the game.