Cast shadows and depth

The strength of a cast shadow as a cue for depth can be illustrated by moving a shadow without moving the object casting the shadow. In the demo below, the green square doesn't move in the image, but it appears to move in depth, and in the image:

See: Kersten, D., Knill, D., Mamassian, P. et al. Illusory motion from shadows. Nature 379, 31 (1996). local link. Nature site: (https://doi.org/10.1038/379031a0.).

In the next demonstration, the image size of the ball is unchanged, but the position of the ball changes. The ball follows a diagonal trajectory inside a box. The ball's shadow first moves diagonally in a trajectory parallel to the ball, then it moves horizontally.

The ball's trajectory is the same for both segments of the animation. The apparent motion in depth of the ball is strikingly different in the two cases. When the shadow is diagonal, the ball appears to slide along the floor to the back of the box. When the shadow trajectory is horizontal, the ball appears to rise above the floor of the box.

See: Kersten, D., Mamassian, P., & Knill, D. C. (1997). Moving cast shadows induce apparent motion in depth. Perception, 26(2), 171-192. link

Shadows and the bouncing ball

The next demo provides a simple demonstration of vision's preference to interpret motion of a ball and its shadow as consistent with a stationary light source.

12 minutes worth of assorted shadow demonstrations

Developed at the **Max Planck Institute for Biological Cybernetics** with Pascal Mamassian, Isabelle Bülthoff, David Knill and Heinrich Bülthoff in 1993. The video includes demonstrations of: how cast shadows can affect perceived size through depth; how motion of the light source are interpreted as changes in depth; apparent non-linear motion from cast shadows; how additional cues for light source motion don't help in interpreting ball motion as due to light source rather than depth changes; how cast shadows can reduce shape ambiguity; influence perceived rigidity; how the shape of an object doesn't need to match the shape or color of the "shadow" patch; and how the reversing the contrast of the "shadow"-i.e. a light rather than dark shadow--reduces the effect; and how illumination from below also can reduce the strength of the depth illusion.

Shadows and sterescopic depth

In this video, as in the above green square demo, the size of the green square doesn't change. But a stereoscopic cue is introduced that is in conflict with the shadow cue. The demonstration should be viewed with crossed-fusion--i.e. the left image to the right eye, and the right image to the left eye.

The shadows are still effective at conveying a change in depth, despite the stereo disparity cue consistent with a depth change in the opposite direction —at least initially. After a while, the disparity seems to win out and the green square move appears to move towards the checkerboard background and "squeeze" the dark shadow away, then recede from the background and "suck" the shadow under itself.