Ambiguous Cube

Strange things happen when your brain gets confused.

Figure 1

Some objects or figures are designed to be ambiguous—to provide visual input that your brain can interpret in more than one way. In this snack, you will construct a three-dimensional ambiguous, especially when you hinder your depth perception by viewing it with one eye.

Materials

- 12 drinking straws (a bright solid color works best; avoid transparent straws)
- 4 12-inch-long chenille stems (this is what they are called in craft stores; you may also know them as pipe cleaners)
- additional chenille stems and straws (optional)
- string (optional)

Figure 2

Assembly

1. Cut the chenille stems in half, so that you have eight 6-inch stems.
2. Form a 3-legged corner support out of each piece of chenille stem by bending it as shown in Figure 2. Bend the 3 legs so that they are all at right angles to each other.
3. Construct a cube by sliding each corner support into the ends of three straws.

To Do and Notice

Place the cube on the floor or on a table, and adjust your position so that you are standing two to three feet away from the cube, facing one of the cube's vertical edges (not a flat face). Now adjust your distance from the cube as necessary so that as you look down at the cube, your viewing angle is such that the top corner nearest you lines up with the center of the bottom of the cube.

Close one eye and stare at the cube. Try to look "past" the cube if possible. Alternatively, you might concentrate your gaze on the bottom back corner and "will" it to move toward you. Try to avoid focusing your attention on places where the straws cross each other. If all works well, the cube should suddenly appear to be standing along an edge or on a corner, rather than on a flat face.

If you experience this effect, hold the focus of your gaze and gently lean your head and body slightly to the left and then to the right. You should see the whole cube rotate in the direction you move.

Opening your other eye will normally destroy the illusion.

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What's Going On?

Just as a two-dimensional drawing of a cube can be ambiguous, the three-dimensional straw cube can be seen in two ways, one of which is "incorrect"—that is, an illusion. In the illusion, the bottom back corner seems closer to you than the top front corner. If you are successful in perceiving the illusion, it is because closing one eye has hindered your depth perception and made it easy for your brain to ignore the cues provided by the places where straws cross each other. Normally, your two-eyed stereo vision will give you enough information to interpret the cube correctly, which is why the illusion disappears when you open your other eye.

So why does the reversed cube appear to rotate as you change your viewing position? Try this: Close one eye and then hold one of your index fingers at arms length and line it up with some distant reference point, such as a picture on the wall of the room across from you. Move your head to the right and notice that your finger appears to move to the left relative to the distant object; move your head to the left, and your finger seems to move to the right. Relative to the distant object, your finger, which is the closer object, moves in a direction opposite to that of your head.

When you are seeing the straw cube in the "incorrect" way and you move your head to the **right**, your brain expects the parts of the cube that are **closest** to you to move to the **left**. But ***the parts of the cube that your brain perceives as closest are actually the more distant parts***. So they actually move to the **right** instead. Trying to make sense of the situation (as it always does) your brain interprets the visual input as best it can: it "sees" the object rotating to follow your gaze. (If this doesn't quite all fit together for you yet, consider a person who turns their head to follow your motion. Whichever way you move, **the front of the person's head moves that way also**, and the **back of their head moves the other way**. This is what the cube does when seen "incorrectly."

So What?

Visual illusions are fun to play with, but they are also the subject of serious study by neuroscientists. The "mistakes" our brains make provide insights about our process of perception.

Going Further

• More Figures

You can experience a similar illusion with a variety of other three-dimensional figures. A tetrahedron (Figure 3) is just one of the possibilities.

Try making your own figures from additional straws and chenille-stem corners. See what illusions you can generate. Use your creativity and curiosity!

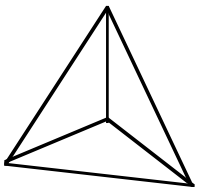

Figure 3

• Hang It Up

Try suspending your figures with string and looking at them as they gently rotate. Or tape them to a wall and look at them from different angles.

Etc.

Necker's 2-D Cube: The Ambiguous Cube is similar to a two-dimensional illusion first described in 1832 by L.A. Necker of Switzerland. In the Necker illusion, shown below in Figure 4, the shaded square may at one instant seem like the outside surface of the front side of the cube, and then an instant later it may seem to be the inside surface of the back side of the cube.

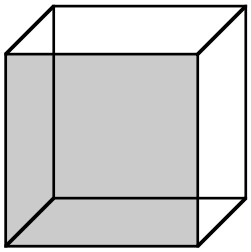

Figure 4

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