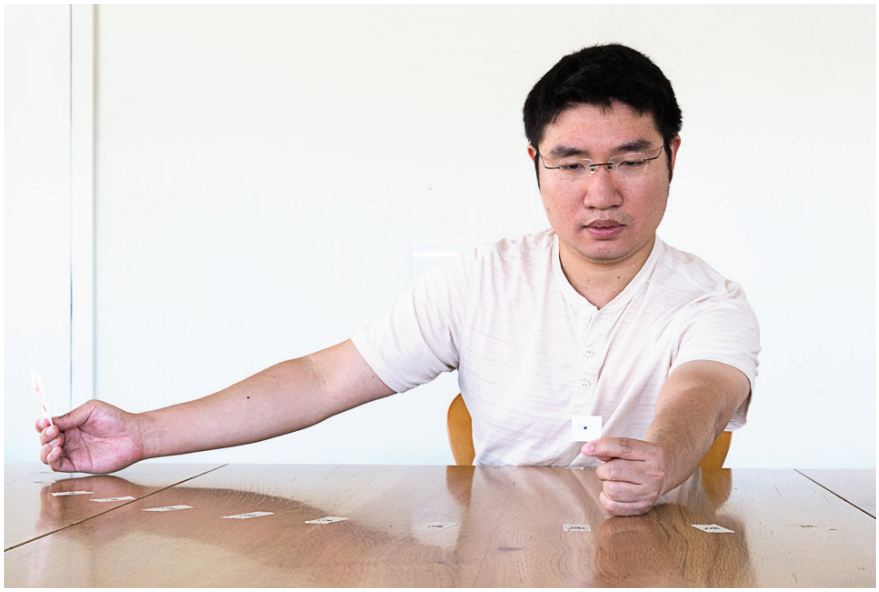

Peripheral Vision

Discover the outer limits of your eyes.

Test the limits of your peripheral vision with a homemade version of a protractor. With the help of a friend, you can measure how much you can see out of the corner of your eye. You'll find that you can detect motion, color, shape, and text at different angles.

Tools and Materials

- Protractor
- Piece of string about 3 feet (1 meter) long
- Large, rectangular table (at least 4 feet [1.3 meters] wide and 2 feet [2/3 meter] deep) with a chair
- Scissors
- Paper
- Marking pens in a range of colors
- Masking tape
- A partner

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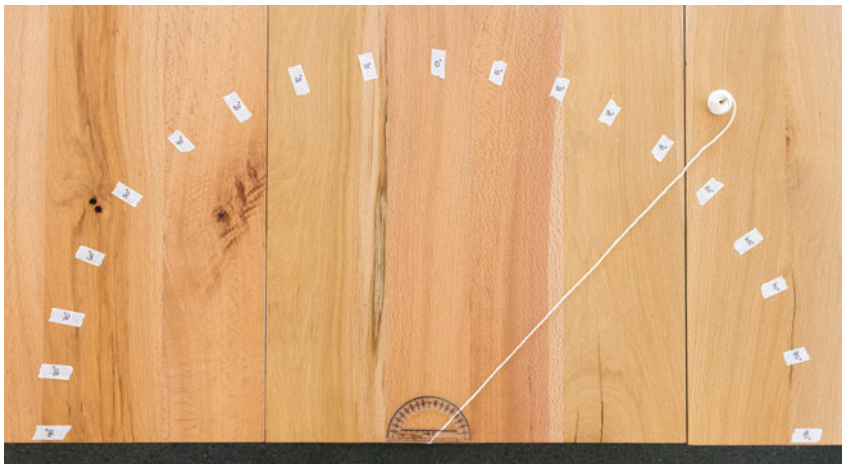
Assembly

Make a large tabletop protractor:

1. Position yourself so you are centered on the long (wide) side of a table. Mark a point with tape about 2 feet [2/3 meter] in front of you at the far edge of the table. This will be your tabletop protractor's vertex.

2. Using your outstretched arm, a piece of string, and your standard-sized protractor as a guide, create a large-scale tabletop protractor by marking the angles every 10 degrees with small pieces of tape. Label the piece of tape at the vertex "0 degrees" (on a standard protractor, this would be marked 90 degrees). On either side of this mark, label your tape in ascending 10-degree increments up to 90 degrees on both the left and right. (See image below for completed set-up.)



Make your focus object and test objects:

1. Cut out a small piece of paper and add a black dot somewhere on it. The dot is merely a visual target and will be what your partner will stare at during the experiment.

2. Use colored marking pens to draw simple shapes such as rectangles, squares, or triangles on small pieces of paper. Each shape should be slightly more than 1 inch (2.5 cm) in width and height.

3. In large capitals, in the middle of each shape, write a three- or four-letter word (such as DOG, CAT, or EYE). Important: Don't let your partner see any of these objects yet.

To Do and Notice

Have your partner sit at the table in the same spot you used to mark the protractor. Looking at your partner from across the table, make sure his/her head is aligned with the vertex of the tabletop protractor.

Start by testing the right eye. Have the person extend both arms directly in front at eye level, make fists with both hands, and point both thumbs up. Position the person's left arm so it is directly over the 0-degree mark, then swing the right arm out to the side, past the 90-degree mark, so it is a little behind the body.

Tape the focus object (the small piece of paper with the dot on it) on your partner's left thumbnail. Instruct your partner to stare straight ahead at the dot, while keeping the dot stationary.

Making sure your partner is staring straight ahead and can't see what you're doing, tape a randomly chosen test object (a colored shape with a word in it) on your partner's right thumb, oriented towards your partner's face.

While your partner continues to stare at the focus object without moving the head or left thumb, ask him/her to slowly bring the right arm toward the stationary hand in an arc. Pay close attention to your partner's eyes during this to make sure there is no sideways movement.

Ask your partner to pay attention to his/her peripheral vision without looking at the test object and tell you when he or she is first able to correctly discern the following visual information:

- Partner can detect motion of the test object
- Partner can correctly identity the test object's color
- Partner can correctly identify the test object's shape
- Partner can correctly read the text on the test object

Record the angles at which your partner correctly identifies the properties above. (It might be helpful for the person to briefly stop the motion of his/her arm at each point.) You'll likely find that your partner has to move the test object surprisingly close to the focus object to make out the various details.

Collect more data by switching arms or switching partners.

What's Going On?

Your retina—the light-sensitive lining at the back of your eye—is packed with light-receiving cells called *rods* and *cones*. Only the cones are sensitive to color. These cells are clustered mainly in the central region of the retina.

When you see something out of the corner of your eye, its image focuses on the periphery of your retina, where there are few cones. Thus, it isn't surprising that you can't distinguish the color of something you see out of the corner of your eye.

The rods are more evenly spread across the retina, but they also become less densely packed toward the outer regions of the retina. Because there are fewer rods, you have a limited ability to resolve the shapes of objects at the periphery of your vision.

In the center of your field of view is a region in which the cones are packed tightly together. This region is called the fovea. This region, which is surprisingly small, gives you the sharpest view of an object. The amount of your eyeball covered by the fovea is just a couple of square millimeters—similar to the fraction of the night sky that appears to be covered by the moon.

You can demonstrate this effect more simply by focusing on one of the words on this page while at the same time trying to make out other words to the right or left. You may be able to make out a word or two, depending on how far the page is from your eyes. But the area that you can see clearly is the area imaged on the fovea of your eye.

Generally, you are not aware of the limitations of your peripheral vision. You think that you have a clear view of the world because your eyes are always in motion. Wherever you look, you see a sharp, clear image.

Interestingly, your peripheral vision is very sensitive to motion—a characteristic that probably had strong adaptive value during the earlier stages of human evolution.

Going Further

This Snack is best with at least two people. As the colored shape approaches the center of your field of view, the temptation to cheat and move your eyes to look at the object becomes nearly irresistible. A partner can watch you and stop the experiment when you give in to temptation and move your eyes to look.