

activity 2.1

distribution of rods, cones, and color vision in the retina

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This simple activity illustrates the distribution of rods and cones in the retina and the differing ability of these photoreceptors to detect color. It can be used in classes in introductory psychology, sensation/perception, or cognition. This in-class activity takes as few as 10 minutes and can be done in any size class. It is a demonstration involving a single student but could involve greater numbers with additional time and materials.

CONCEPT

The demonstration shows that stimuli in the center of the visual field are detected mainly by color-sensitive cones concentrated in the fovea, whereas stimuli at the edges of the visual field are detected mainly by non-color-sensitive rods in the periphery of the retina.

MATERIALS

You will need a few pens, magic markers or other objects of various colors (e.g., red, blue, green, yellow, black), and a student volunteer with normal color vision.

INSTRUCTIONS

Ask your volunteer to sit or stand at the front of the room facing the class and, at your signal, to stare fixedly ahead at a spot or object at the back of the room. If the volunteer's eyes stray from the fixation point, the demonstration will probably not work very well. Emphasize the need for concentrated fixation. Instruct the class to not provide any feedback to the volunteer regarding the accuracy of his or her answers.

Now stand at the volunteer's side. Hold one of the colored objects 3 or 4 feet away from the volunteer's ear, at about eye level. (Keep the object concealed prior to this time.) Ask the volunteer to identify the color of the object in your hand. The volunteer is not likely to be able to do this. If the volunteer answers, you can determine the level of confidence by asking how much he or she would

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be willing to bet on the correctness of the answer. Move a step toward the class and slightly more in front of the volunteer (imagine you are moving on an arching track that would eventually place you directly in front of the volunteer) and ask the same question. Continue to move, one small step at a time, along the arc until the volunteer is certain of the object's color. You may want to pause before each step, briefly conceal the object, and give the volunteer a chance to relax the eyes. Make sure the volunteer is staring at the fixation point again before proceeding.

DISCUSSION

You will find that most participants have excellent peripheral vision, as reflected in their ability to recognize that the object is present even when it is far off to the side. However, for most people, it will take several small steps before they can recognize the object's color (most will first say it is black, because they are seeing it only with rods). The students will be surprised at how close to the center of the visual field the object must be before its color is clearly apparent. In real life, we perceive color in the periphery of the visual field because the brain remembers what color belongs there or makes an assumption about the likely color (e.g., the sky is usually blue). In this demonstration, however, there is no way for the brain to accurately guess the color of the object.

If the expected sequence of results does not occur, it is probably because the participant lost fixation or made a lucky guess about color. To confirm the distribution of rods and cones and their color sensitivity, you can run more trials using different colors.

You can make this demonstration an active learning experience by asking students to predict the results of this procedure and to justify their predictions on the basis of material presented in class or in the textbook. Another option is to divide the class into teams of three and have them conduct the procedure, perhaps using objects of different sizes and colors, held at differing distances. Team members can take turns acting as volunteer, experimenter, and data recorder (whose job is to note the point on each trial where the object is first detected, correctly named, and its color identified). Afterward, teams can be asked to report their results to the class, including the effect of object size and distance, and to suggest plausible explanations for the discrepant data (e.g., individual differences in retinal anatomy, restricted peripheral vision, or less fixation during a trial).

REFERENCES AND SUGGESTED READING

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