Out of the Corner of my Eye: Peripheral Vision Demonstration

Author: Maria Vita
Institution: Penn Manor High School; Penn Manor School District; Pennsylvania

Overview

When I met Dr. Jeremy Wolfe at the 2016 NETOP conference (New England Teachers of Psychology), he enthusiastically informed me that the "colored pencil" demo used by science and psychology teachers was problematic. Rather than using colored pencils, this demonstration uses small words printed on colored-shapes. The idea originates with the Exploratorium Teacher Institute and gets students to experience the acuity (or sharpness of vision) characteristic of the fovea. Students are often shocked by the lack of clarity in the periphery! After the demo, they are formatively assessed through a chart and short-answer responses.

Alignment with APA's Guidelines for the Undergraduate Psychology Major

Goal 1 Knowledge Base in Psychology

Goal 2 Scientific Inquiry and Critical Thinking

Goal 4 Communication

Outcomes

1.1 Describe key concepts, principles, and overarching themes in psychology
1.3 Describe applications of psychology
2.1 Use scientific reasoning to interpret psychological phenomena
4.1 Demonstrate effective writing for different purposes

Indicators

1.1a Use basic psychological terminology, concepts, and theories in psychology to explain behavior and mental processes

1.1c Interpret behavior and mental processes at an appropriate level of complexity

1.3a Describe examples of relevant and practical applications of psychological principles to everyday life

2.1c Use an appropriate level of complexity to interpret behavior and mental processes

4.1a Express ideas in written formats that reflect basic psychological concepts and principles

© 2018 American Psychological Association

Alignment with APA's National Standards for High School Psychology

Domain
Biopsychology

Content Standard Area
Sensation and Perception

Anticipated Time (*estimate of time needed)*
This could be a short demonstration in front of the class using 1-3 volunteers plus formative assessment (10-20 minutes) or could be extended into a laboratory activity where students conduct the study on classmates and then complete formative assessment (40 minutes)

Purpose
Formative Student *(teacher provides feedback to students for the purpose of revision)*

Students choose from statements provided and place into a T-chart to give evidence or support for peripheral vision or foveal/central vision. The demonstration allows students to make conclusions about each area of vision. The teacher can then discuss the correct responses to give students feedback on their understanding.

During class/outside of class
During class

Timing *(when should this assessment be used during the unit)*
To encourage critical thinking and allow students to make predictions about the structure and function of the eye, this lesson should be given before students have reading materials or lecture on the fovea or peripheral vision.

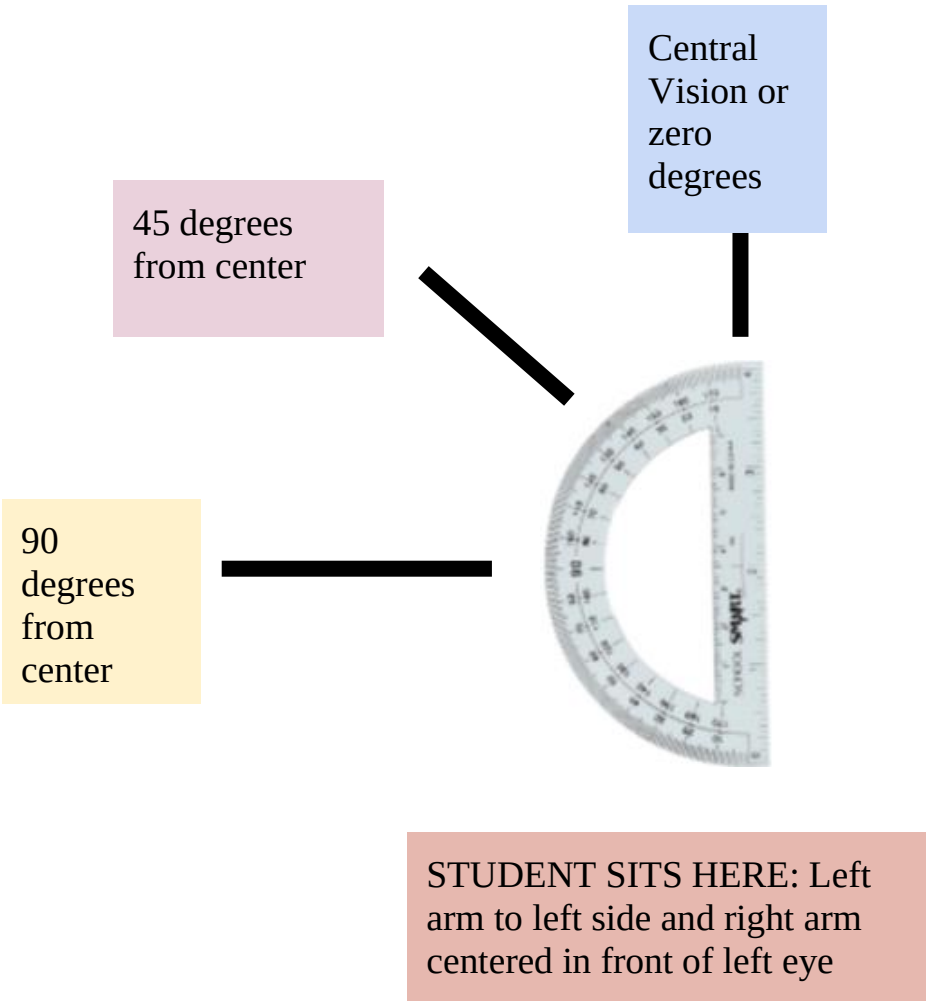
Instructions

Short Demo (10-20 minutes)
Watch the Exploratorium Teacher Institute explain the experiment:
https://www.exploratorium.edu/explore/videos/snacks/peripheral-vision-experiment

1. Ask for 1-3 volunteers to come up in front of the class one at a time.
2. Have subject place their RIGHT hand in front, but centered, in a line that matches up with LEFT EYE. Hold black dot with right hand as a focal point for subject. Subject looks at this central point throughout the demonstration.

© 2018 American Psychological Association

3. Have a protractor on the desk facing left. Use the inside numbers after the ninety-degree mark.



4. If teachers do not have a protractor - approximate the number of degrees and place post-it notes or masking tape on desk to mark estimates (do this on the left side of student). Explain to subject and class the number of degrees.
    a. When left hand of subject stretched out to left side of body, it is ninety degrees (90°) from central vision: THIS IS PERIPHERAL VISION -or outside of center.
    b. When left hand of subject in between ninety-degree mark (90°) and straight ahead, this is forty-five degrees (45°) from center: Still located in the periphery (outside of center)
    c. When left hand straight out in front of subject- in the line of left eye, zero degrees (0°) from center: This is furthest angle from periphery and is CENTRAL VISION or FOVEAL VISION.
5. Teacher places random object (see below) in subject's left hand. Do not let subject see the objects before the demo begins. Keep the subject looking straight at black dot - which

© 2018 American Psychological Association

should be in their RIGHT HAND (and over the protractor or tape/post-it note that matches 0° or central vision).

6. As the subject slowly moves random object in left hand toward center of face, subject should announce and stop arm motion when they:
    a. Detect **movement**
    b. Correctly identify the object's **color**
    c. Correctly identify the object's **shape**
    d. Correctly identify the object's **text**

    For each object, the teacher should record the number of degrees from periphery or have students document for each subject. The teacher could have the following table copied and pasted into a slide for record-keeping.

Object name	**Movement: degrees from periphery**	**Color: degrees from periphery**	**Shape: degrees from periphery**	**Text: degrees from periphery**
Sample 1				
Sample 2				
Sample 3				
Average/Mean				

7. This was a test to see how many degrees from the periphery can humans detect **movement, color, shape, and text.**
    - On average, how many degrees from the periphery did it take to **perceive movement**?
    - On average, how many degrees from the periphery did it take to **correctly identify color**?
    - On average, how many degrees from the periphery did it take to **correctly identify shape**?
    - On average, how many degrees from the periphery did it take to **correctly identify text**?

    We could do further testing to see how periphery reacts to other variables (bright light, dim light, big or small objects).

8. Formative assessment. Students complete on a handout or write a T-chart on a piece of paper listing the key characteristics of each visual area (can use list of statements to assist). Students can then review with a partner, and finally discuss.

Students can use the demo to determine which scientific explanations best describe characteristics of peripheral vision and foveal vision.

Write the scientific statements that are true for each area of the retina based on the demonstration.

- Weak at distinguishing color, shape or detail.

© 2018 American Psychological Association

- Sensitive to color.
- Sensitive to movement.
- Has the greatest visual acuity or sharpness of vision or high-resolution.

Predict which is true for each area based on the demonstration.

- Cones are highly concentrated in this area.
- Photoreceptors (rods and cones) less densely populated in this area.

Periphery of the retina	Foveal vision

9. Discuss T-chart.

Ask students to apply peripheral vision and foveal vision to their daily life. How do these processes assist individuals in their day-to-day activities? Or, conversely, one could ask students: What would it be like to be deficient in these areas; what day-to-day activities would become difficult?

Materials

1. Teachers can draw their own objects (see image below) or print out objects from the Appendix



Image from Exploratorium Teacher Institute

© 2018 American Psychological Association

2. Cut out objects by cutting a “square” shape around image.
3. Teacher keeps objects from subjects: place in envelope.
4. The “black dot” is used by each subject. Black dots can be cut (“square” shape) and provided to the subject as they come to the front of the classroom.
5. Tape or post-it notes and a protractor to measure approximate angles on left side of subject.
6. Projection of record-keeping or write on board:

Object name	**Movement: degrees from periphery**	**Color: degrees from periphery**	**Shape: degrees from periphery**	**Text: degrees from periphery**
Sample 1				
Sample 2				
Sample 3				
Average/Mean				

7. Handout or piece of paper for t-chart and formative assessment with potential list of statements that students can categorize as characteristic of peripheral or foveal/central vision

Scoring Criteria

Since this is formative assessment, there is no score for the discussion. Students get immediate feedback from pair share and discussion with teacher.

Model Student Answers

Discussion

Students can use the demo to determine which scientific explanations explain processes of peripheral vision and processes of foveal vision

Periphery of the retina	Foveal vision
Weak at distinguishing color, shape, or detail. Sensitive to movement.	Has the greatest visual acuity or sharpness of vision or high resolution. Sensitive to color.

© 2018 American Psychological Association

Statement predicted as true based on the demonstration: Photoreceptors (rods and cones) less densely populated in this area.	Statement predicted as true based on the demonstration: Cones are highly concentrated in this area.

Periphery use in day-to-day life: When driving, one needs peripheral vision to get an idea of the cars that are to the left and the right; athletes use peripheral vision to gauge movement and colors of uniform within vicinity; we use peripheral vision everyday to have an idea of our surroundings (e.g. who is near us in the hallways); etc.

Foveal vision or central vision in day-to-day use: Students need this to read text; students need this to make out details in their own face or someone else's face - the color of their eyes or whether or not they have freckles; students need this to see what they are writing; etc.

Accommodations/Modifications

Some students with additional needs may require modifications to this assessment. A student may need the chart documenting the degrees for each subject on a sheet of paper, so they can manually write each test down. They may also benefit from having the protractor image and T-chart graphic organizer printed on a sheet of paper.

Why is this Science?

In psychological science, students use scientific reasoning to interpret psychological phenomena. As part of the *Next Generation Science Standards* (NGSS Lead States, 2013), students should carry out investigations, which allow them to collect, record, analyze, and evaluate data. This short demo provides students with the opportunity to test acuity, color detection, shape detection, and motion perception in the periphery and fovea. Then, they use the data as evidence to support characteristics of peripheral vision and foveal/central vision. Teachers could extend the investigation and ask students to identify the independent variable(s) and dependent variables. Students could also make a directional hypothesis (e.g. the closer to the focea/center, the more detailed vision).

References

Exploratorium Teacher Institute. (n.d.). *Peripheral vision: Discover the outer limits of your eyes.* Retrieved from https://www.exploratorium.edu/snacks/peripheral-vision

Johnson, M.A. (1986). Color vision in the peripheral retina. *American Journal of Optometry Physiological Optics*, *63*(2), 97-103.

NGSS Lead States. 2013. *Next Generation Science Standards: For States, By State*s. Washington, DC: The National Academies Press.

© 2018 American Psychological Association

Science Buddies. (2017). *Now you see it, now you don't! Test your peripheral vision.* Retrieved from https://www.sciencebuddies.org/science-fair-projects/project-ideas/HumBio_p016/human-biology-health/test-your-peripheral-vision#procedure

Science Buddies. (2016, March 31). Put your peripheral vision to the test: An eye-catching science project from science buddies. *Scientific American.* Retrieved from https://www.scientificamerican.com/article/put-your-peripheral-vision-to-the-test/

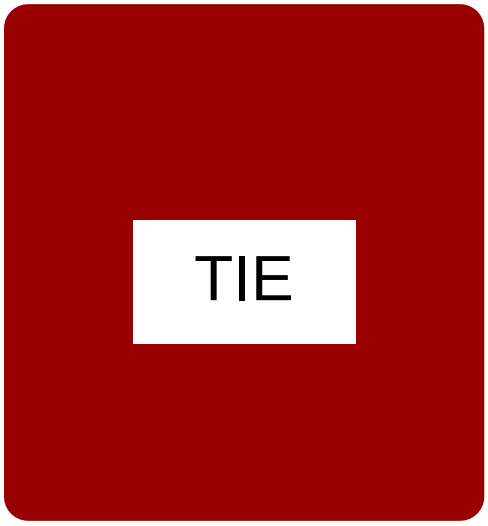
Attribution

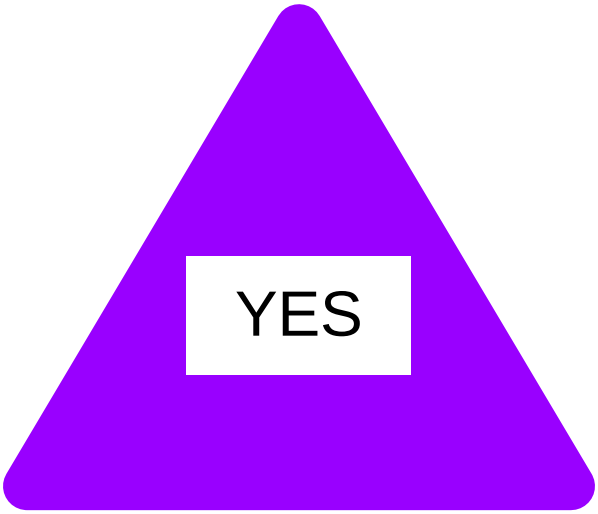
Exploratorium Teacher Institute. (n.d.). *Peripheral vision: Discover the outer limits of your eyes.* Retrieved from https://www.exploratorium.edu/snacks/peripheral-vision

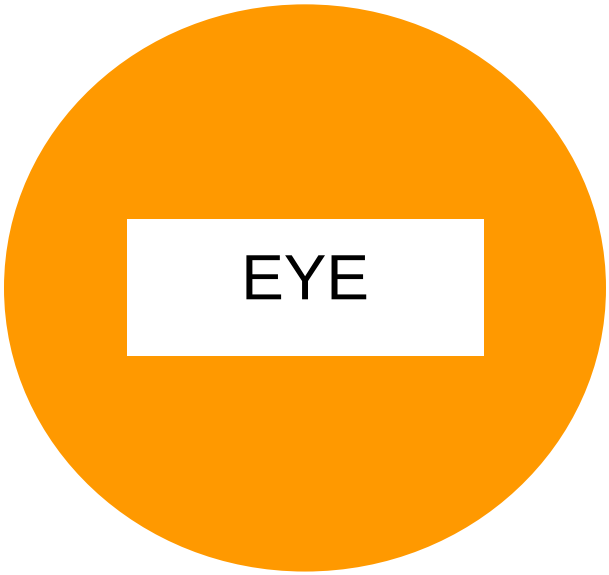
© 2018 American Psychological Association

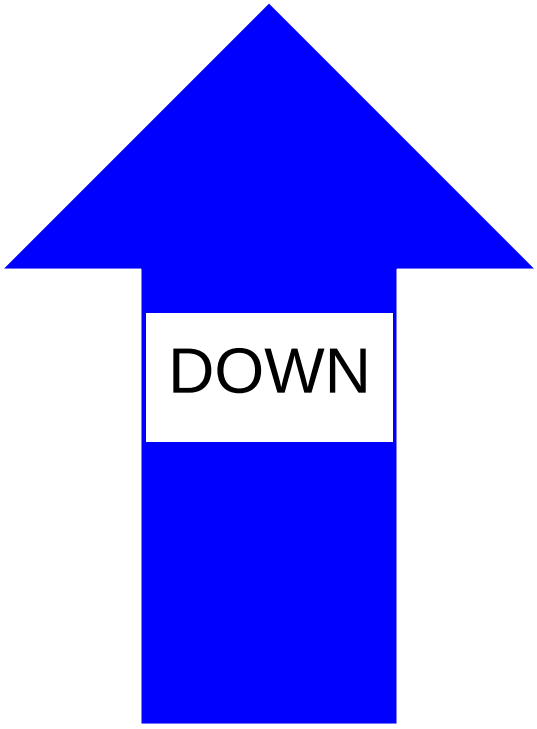
Appendix: Shapes for Activity

The following shapes could be cut out and used for this activity. You should print these out IN COLOR and cut out with WHITE SQUARE SHAPES AROUND. You can also split these shapes between student-pairs. You will need as many copies as you have student-pairs.



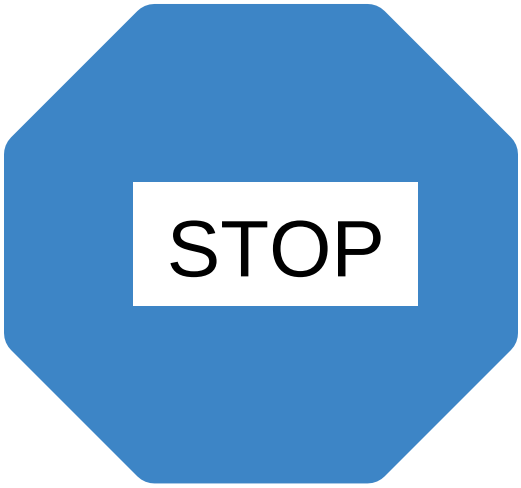




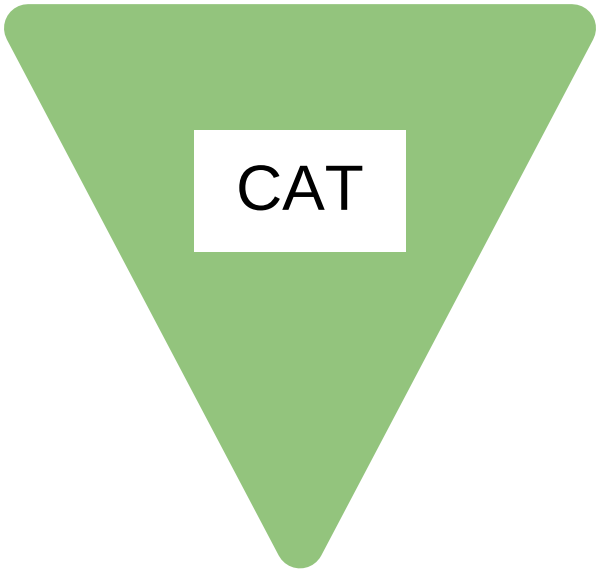


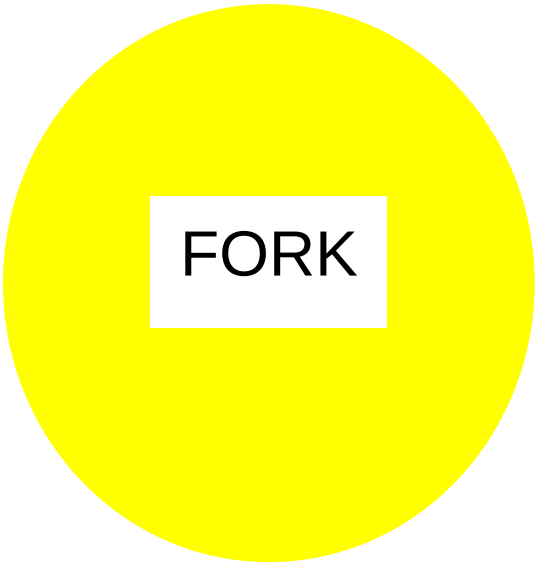
© 2018 American Psychological Association



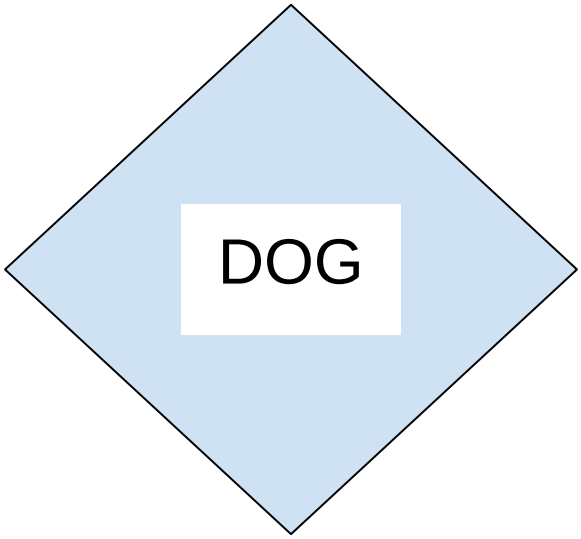


*hold with right hand as focus point



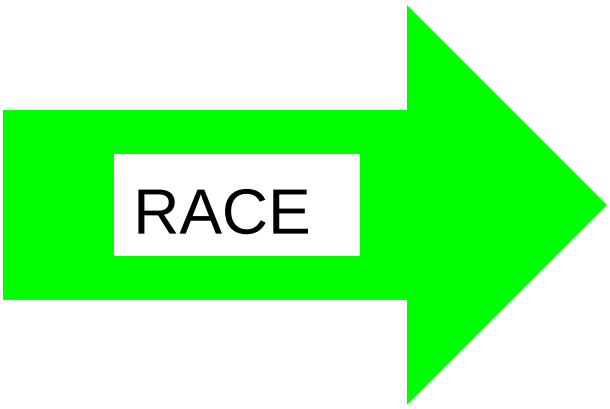


© 2018 American Psychological Association



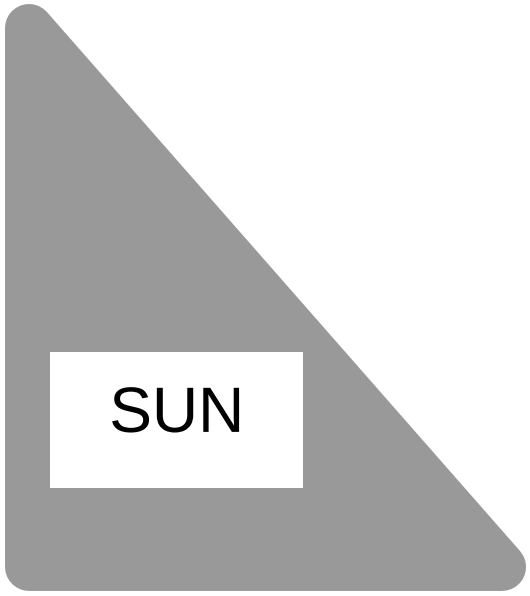


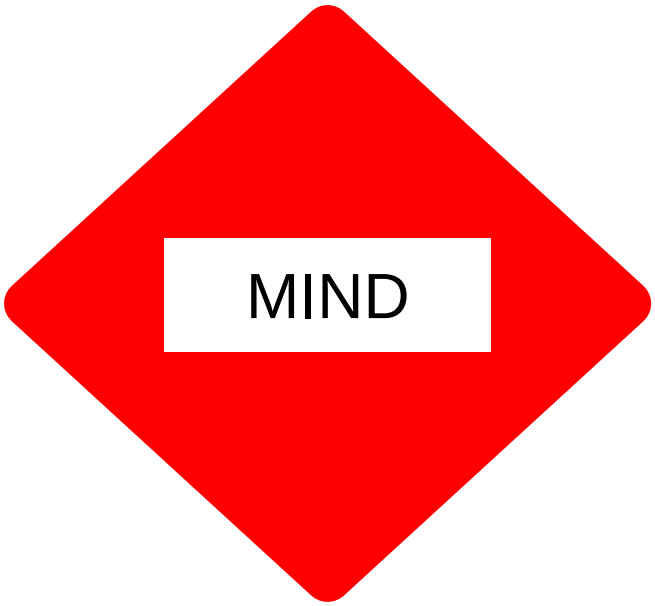


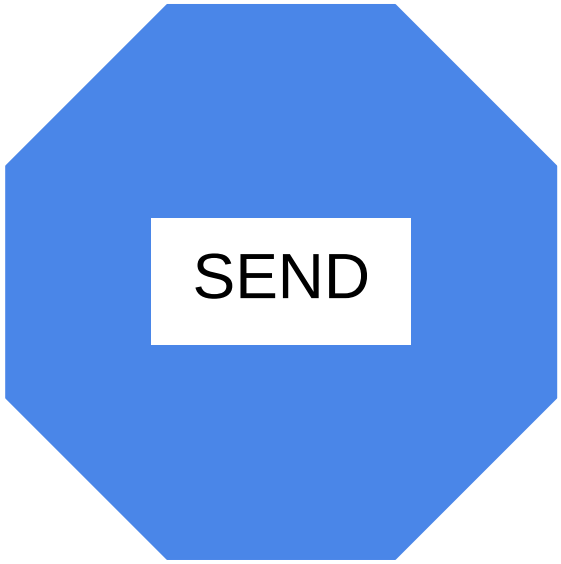


© 2018 American Psychological Association

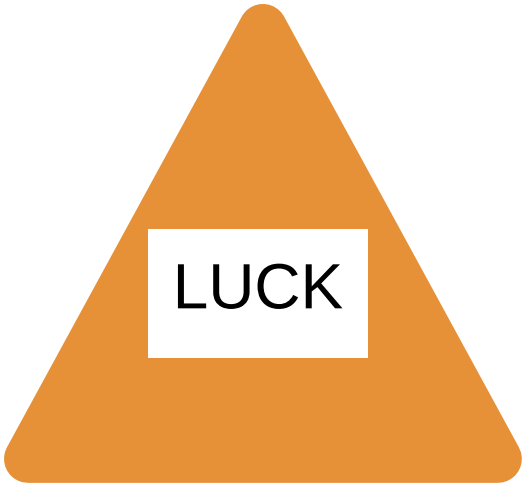


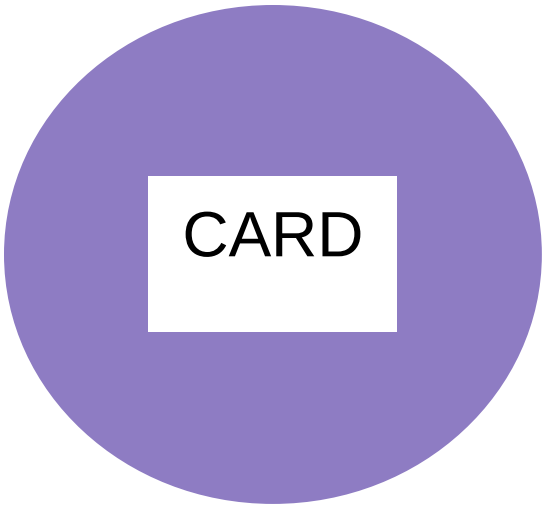




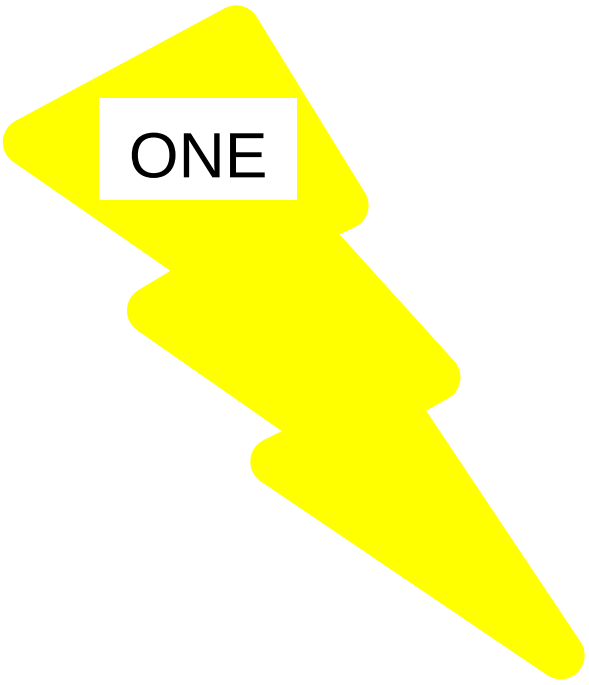


© 2018 American Psychological Association

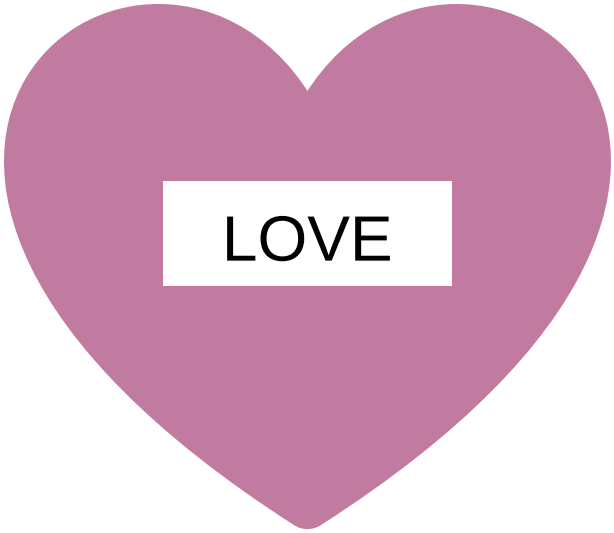




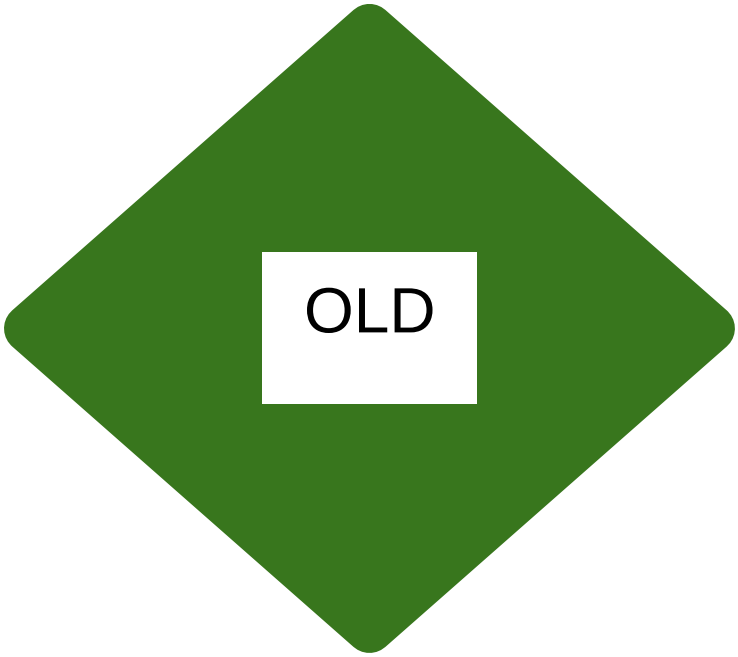


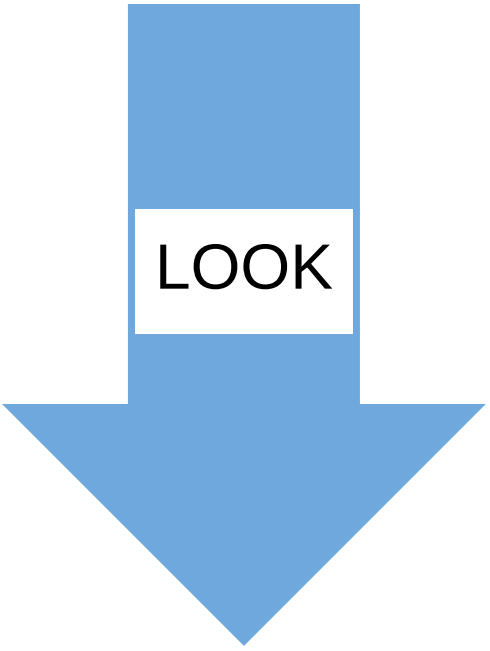


© 2018 American Psychological Association









© 2018 American Psychological Association



Developed by the APA Working Group on Assessing Student Knowledge and Skills in Psychology from the APA Summit on High School Psychology Education (July 2017): Dana S. Dunn, PhD, Alan Feldman, MA, Stephanie Franks, MS, Sayra González, PsyD, Regan A. R. Gurung, PhD (Co-Chair), Jane Halonen, PhD, Miriya Julian, MA, Rob McEntarffer, PhD (Co-Chair), and Maria Vita.

© 2018 American Psychological Association