**PRISM SHIFT GOGGLES**

**Topic: Neural plasticity and motor and visual system**

**Developed by:** CUNO graduate students, Michelle Stackmann

**Grades:** 8+ years old

**Vocabulary words:** motor system, visual system, perception, plasticity, adaptation, primary visual cortex, cerebellum

**Materials:** 2-3 pairs of vision shift goggles, bean bags, 2-3 targets for bean bags, and score sheets

**Time needed:** 10-15 min

**Summary:** This hands-on activity introduces the the visual and motor system and shows how our brains, especially our cerebellums, help us adapt quickly to different scenarios. It is suitable for adults and for kids 8 years or older. The lesson should emphasize the concepts of plasticity, which is the ability of neural pathways in the living brain and nervous system to change in response to experience or injury, and of adaptation, which is the ability to change in response to incoming signals or experience.

**Prerequisites for Students:** None.

**Learning Goals:**

* Demonstrate how sensory input and behavioral output can be modified over the course of a few trials
* Introduce plasticity as the brain’s ability to adapt to environmental changes or new experiences
* Learn that the cerebellum is important for short-term adaptation

**Background for instructor:**

* The brain’s ability to adapt rapidly to new experiences is called neuronal plasticity and is essential for learning new tasks and adapting to new environments.
* In this activity, students will throw a bean bag at a target while wearing vision-shift glasses, which change the visual input the participant receives. The goggles will cause the participant to throw the bean bag off-target, but they will get close to the target as their brain adapts to the shifted vision throughout repetition.
* The prism goggles bend the light coming in so that everything the wearer sees appears to be slightly shifted, even though it hasn’t moved. This means that what your brain perceiving was actually different from what was actually there.
* The parts of the brain involved in this task are the visual and motor systems. The visual system is responsible for detecting and interpreting information from visible light to build a representation of the environment, while the motor system is in charge of movement, and includes the primary motor cortex, basal ganglia, cerebellum, and spinal cord.
* The cerebellum, or “little brain,” is the part of the brain that helps recalibrate our maps of motor space within the visual world as our visual perception is shifted and then restored.
* In our brain, plasticity happens through the strengthening of some connections or pathways and weakening of others when we practice or learn something.

**Set-up:** Set up your targets on the floor and gather your prism shift goggles and bean bags. Bean bags can be made by cutting and sewing squares of fabric such as nylon hoses, old sheets, pillowcases, or t-shirts and filling them with beans.

**Lesson Outline:** Introduce yourself and ask the participants if they know what brain plasticity is. You can discuss with them that brain plasticity is the ability of our brains to adapt to new environments and incoming information, and that it is necessary for learning. Ask them if they want to participate in an activity where they will experience brain plasticity.

Ask for a first participant. The participant might want to adjust the goggles so that they fit properly around their heads, but don’t put them on yet! The first portion of the activity is called pre-adaptation and will test how well the participant can hit the target with the bean bag. Ask the participant to overhand toss bean bags at the target without the goggles on. Continue until the participant is able to hit the target regularly and adjust the distance from the target to increase success if necessary. Keep track of how many tosses it took for the participant to hit the target correctly.

Then, ask the participant to put on their prism goggles and throw the bean bags at the target. This is called the adaptation phase. The participant will have trouble hitting the target on the initial trials, since their vision will be shifted by some degrees. They should keep on throwing the bean bag at the target until they have successfully hit the target. Write down how many trials it took for the participants to hit the target correctly.

In the post-adaptation phase, you will next ask the participant to take off their goggles quickly and throw the bean bag at the target again. Because they have adapted to the vision shift, they should have trouble hitting the target accurately! They should keep trying to hit the target until they succeed. Take note of the number of trials it took for them to hit the target correctly.

Note: if there is a delay between taking off the goggles and the first toss, they will

return to baseline before the plasticity is demonstrated. After a couple of tosses they

will again be successful at hitting the target – more plasticity!

Be careful not to let the kids walk around with the goggles, since there is a very real risk of falling/bumping into things!

To extend the discussion, you can ask the participants what their thoughts are on why it was challenging to hit the target once they put the goggles on. Do they know what the goggles were doing? How did their brain adapt to the shifted field of view? Why might our brains be able to have plasticity?

**Wrap-up, final thoughts**: We just experienced plasticity, which is a brain property that allows us to adapt to new environments. Our visual system and motor system work together to make coordinated movements, and with the help of our cerebellum, we can correct movements pretty quickly when our visual fields are shifted.

**Bibliography:**

<http://students.washington.edu/nbout/LessonPlans/prismgoggles.pdf>

https://www.exploratorium.edu/snacks/distortion-goggles