VISUAL REACTION TIME

David B. Fankhauser, Ph.D.
Professor of Biology and Chemistry
Clermont College, Batavia, OH 45103

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http://biology.clc.uc.edu/fankhauser/Labs/Anatomy_&_Physiology/A&P202/Nervous_System_Physiology/Visual_Reaction.htm

Nervous responses to environmental stimuli are necessarily rapid events, taking a small fraction of a second to be completed. Considering the number of steps involved in the reaction, the time is very short. The physiological steps involved the response are:

(1) transduction of the environmental stimulus into a nervous impulse (rods and cones)
(2) processing in the neurons of the retina (bipolar and ganglion cells)
(3) transmission of the impulse to the thalamus
(4) relaying of impulse to the visual cortex via optic radiations
(5) visual association region recognizes the meaning of the visual impulses
(6) transmission of impulse from visual association region to precentral gyrus
(7) transmission of the motor impulse from precentral gyrus to muscles of hand
(8) effecting the movement through the contraction of muscles.

The length of time required for the entire response can be measured using an elegant test devised to measure the total time it takes to execute the physiological steps. The simple procedure measures the distance a dropped ruler falls before being caught, and converts it into the amount of time required for the drop according to the laws of the acceleration of gravity, .

EQUIPMENT:

meter stick (or a yard stick*)
card with horizontal line taped to wall at a convenient height

PROTOCOL:

1. Select a team of three with tasks to be rotated around: subject, experimenter and scribe.
   Create a 15 row table (one row per each of five trials per team member). Create columns:
   trial# ruler reading distance dropped msecs time average time
2. Experimenter holds meter stick with 50 cm mark on line of card, **zero end of stick down.**
3. Subject places thumb and forefinger on either side of ruler, near, but not touching it.
4. Experimenter asks to be certain that subject is ready, then within a few seconds releases ruler as cleanly as possible (no wiggling hints as to release time. Drop the ruler straight down).
5. Subject grasps ruler as soon as possible after its release, and holds it against the wall where caught (do not move it once it is caught). Experimenter reads the position of the line on the ruler to the nearest mm, the scriberecords the data in the notebook, then subtracts 50 cm to get the distance the ruler dropped (in cm). Repeat at least five times to determine an accurate average. (You may drop the fastest and slowest reactions to see how that affects it)
6. The distance dropped is converted into milliseconds by the following equation:

$$time\ of\ reflex\ (m\sec) = \sqrt{\frac{2\ x\ cm\ dropped}{980 cm/\sec 2}}\ x\ \frac{1000\ m\sec}{\sec}$$

Assignment at home: test the visual reaction time in triplicate at least five different times. Design an experiment to test the effects of time of day, fatigue, time of the month, or various agents on your friends and/or family members: Record the data and perform the calculations in your notebook.

For example: Determine effects of various agents (talking on the phone, caffeine, alcohol, sleeping aids, ephedrine, etc.) on reflex time. Repeat 10 or more times to look for learning and/or fatigue. Conduct population studies to look for effects on reflex time of age, sex, handedness, etc.

* Line up with 10 inch mark, 0 inch at bottom. Read to nearest 1/16th of an inch. Subtract 10 inches from reading. Convert the fraction to decimals of an inch. Substitute 385.8 inches/sec^2 for 980 cm/sec^2 for acceleration of gravity in the formula, and calculate the msec reaction time.

NYSTAGMUS DEMONSTRATION:
A VISUAL REFLEX MEDIATED BY SEMICIRCULAR CANALS

David B. Fankhauser, Professor of Biology and Chemistry
Clermont College, Batavia, OH 45103
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Tracking objects is a complex activity under normal circumstances, but the complexity is markedly increased during movement of the head. There is a system within the brain located in the superior colliculi which receives information on rotation of the head from the semicircular canals. The superior colliculi then directs eye movements via the extrinsic muscles of the eye to compensate for these head movements.

The effects of this system can be seen when it over compensates from prolonged rotation of the body. The semicircular canals become accommodated to the rotation, and when the rotation is halted, the endolymph continues to move, triggering impulses interpreted in the superior colliculi as strong rotational acceleration signals. It therefore directs the compensating jerking of the eyes called nystagmus (from the Greek, meaning to nod). Nystagmus may also be a sign of malfunction in one of the stages of the system responsible for this reflex.

NYSTAGMUS DEMONSTRATION

CAUTION:
Protect subject by performing away from all furniture, sharp corners, etc

1. Place student on rotating stool, away from all furniture, sharp corners, etc.

2. Rotate student a determined number of times (5, 10, 15, etc) Take care to stop *before* nausea is induced...

3. Stop rotation abruptly with subject's eyes facing observers so that the eyes may be observed at close range (about a foot away).

4. Observe the following:
   a) Is the movement large or small
   b) How frequent is the movement (jerks/second or second between jerks)
   c) How long do the movements persist.

Additional questions you could ask:

Does the strength or persistence relate to the length of time rotation was performed?

Is there a minimum length of time in order to accommodate to the rotation?

Use of a video camera with slow motion playback may allow this reflex to be quantified.