What is Eyetracking and How does it Work?

A mobile eyetracker (say, the mobile Eyelink II of SR research, Inc., Canada) uses video cameras to record the eye position of human subjects, and hence, record eye movements and pupil dilation. The eyetracker is like a bicycle helmet, which puts a video camera in front of each eye to record the position of each eye and the size of the pupils. Using the movements of one's pupil and cornea reflection, the eyetracker tracks the movement of one's eyes, which is then mapped into locations on the screen by calibration and adjustments for head movements.

With the eyetracker, we can measure **gaze locations**, the **time length** of fixations, and **pupil dilation**. Hence, using the eyetracker, we can investigate how fixations (looking at the same place for a while), saccades (scans across the screen) and pupil dilation responses (pupil size change) are related to the information on the screen and behavioral choices during an experiment in experimental economics. Understanding the relationship between these observables can help us understand how human behavior in the economy can be affected by what **information** people acquire, where their **attention** is focused on, and **emotions or brain activity**. This is because fixations and saccades (matched with information shown on screen) indicate how people acquire information (and what they see), time lengths of fixations indicate attention, and pupil dilation responses indicate arousal, stress, pain, or cognitive load.

The way the eyetracker works is the following: For pupil dilation, the eyetracker measures pupil sizes using the video images taken by the cameras. For gaze locations, the eyetracker uses a calibration process to map eye movements into locations subjects look on the computer screen. This process is performed by showing black dots at different locations and having the subject gaze at them. Typically, a nine point calibration is sufficient and further adjustments for head movements are automated by tracing sensors on the four edges of the screen. In this way, we may record gaze locations almost real time, and can infer the time length of these fixations. However, the accuracy of the length of the fixations depends on the sampling rate, or how frequent are gaze locations recorded. For example, the mobile Eyelink II eyetracker can typically sample both eyes at 250Hz (every 4ms). Hence, if the eyetracker records a subject looking at the same location 30 times in a row, we can infer the fixation was 120ms, with a maximum error margin of 4ms. High sampling rates can also enable us to run gaze contingent experiments, feeding back eyetracking data on the screen (e.g. look at a box to open it).