In the natural world, the brain must integrate visual and auditory signals arising from some single event, while also segregating signals that arise from independent events. Our laboratory has been studying multisensory integration and competition using variants of a video game called “Fish Police!!” The work we’ll describe here examined cortical oscillations while subjects played the game.

In the game, a series of fish swim rapidly across the gameplay window. Players must distinguish two “species” of fish solely based on the rate (6 or 8 Hz) at which a fish’s size oscillates. Each fish is accompanied by a task-irrelevant sound, amplitude modulated at either 6 or 8 Hz. The rates of the visual and auditory are either Congruent (matching) or Incongruent (mismatching). Additionally, EEG data are captured by a wireless four-channel EEG device.

Results. First, despite the nominal irrelevance of the auditory inputs, players learned to categorize fish more accurately when visual and auditory rates match than when they are mismatched. Second, power in the EEG alpha band from temporo-parietal electrodes declined rapidly when a fish swam into view. This decrease in alpha was greatest when auditory and visual signals were mismatched. This implicates suppression of task-irrelevant (auditory) information. Third, theta band EEG activity from frontal electrodes, a marker of demands on cognitive control, behaved quite differently: Incongruent auditory-visual signals evoked a transient increase in theta power during the first few hundred milliseconds of a fish’s lifetime.

Stress. Finally, in a separate experiment, the inter-trial interval (ITI) was progressively shortened, while other parameters were kept the same. This manipulation can be likened to the stress from a sped up assembly line. Subjects were profoundly affected, showing decreased behavioral performance (decreased accuracy and response time). Moreover, as ITI decreased, so too did alpha activity just before a fish would appear, suggesting increased preparatory attention. Interestingly, these changes were accompanied by increased pulse rate, and self-reported stress level. Overall, Fish Police!! provides a useful window not only on multisensory combination and learning, but also on decision-making, under conditions of stress.