



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

Name(s) Helen N. Gordan	Project Number S1304
Project Title Investigation of a Novel Saccade-Based Diagnostic for Rapid Concussion Detection	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals In the United States, athletes suffer roughly 3.8 million concussions per year. Unfortunately, many current concussion diagnostics are subjective or easily memorized, which can place athletes in potentially dangerous situations. This research addresses the need for a rapid and accurate method to quantify concussion symptoms by evaluating the ability of a custom-built, field-deployable electrooculogram to detect saccadic eye movements. This study takes the first step in validating the electrooculogram as a potential concussion screening tool by determining whether it has the capacity to accurately identify saccades during a previously validated concussion diagnostic, the King-Devick Test.</p> <p>Methods/Materials Based off a design from Matsuzaka et al., an electrooculogram was constructed with a bio-amplifier consisting of four stages: an input stage, a broad-band amplifier, a gain controller, and a final band pass amplifier. Electrodes placed on the subjects' temples fed impulses through the bio-amplifier and into an oscilloscope, which transferred the data to a computer for post-processing. Ten healthy adult subjects were asked to complete two trials of the King-Devick Test while monitored by the electrooculogram. Time to test completion and error rate were recorded during the test, and saccadic amplitude and total number of saccades were isolated post-processing in Matlab r2016b.</p> <p>Results The average number of oblique saccades (7.291 ± 0.622) and total saccades (41.958 ± 4.546) recorded among test subjects during each King-Devick Test card correlated with the expected number of oblique saccades and total saccades. The average voltage of the oblique saccades was 0.820 ± 0.318 V, while the average voltage of the horizontal saccades was -0.285 ± 1.117 V.</p> <p>Conclusions/Discussion The electrooculogram was able to sensitively detect both the directionality and differentiating amplitude of oblique and horizontal saccades. Additionally, the number of saccades recorded corresponded with the number of expected saccades. These results indicate that the electrooculogram is sensitive enough to accurately detect saccades, and therefore has the potential to act as a concussion diagnostic.</p>	
Summary Statement This study takes the first step in validating a novel concussion screening device, the electrooculogram, by examining the saccadic eye movement of individuals during the King-Devick Test.	
Help Received Lyndia Wu and Calvin Kuo provided supervision as I tested human subjects and advice as I tackled unfamiliar subject areas. Dr. David Camarillo allowed me to conduct trials in his lab.	