Results: Experiment 3 – EyeLink Parser

General Impressions

There are several general impressions that one has after reviewing the classification results from the EyeLink Parser. First, the EyeLink Parser does not classify PSOs, and there were many PSOs in these recordings. We understand that these PSOs are intended to be ignored by the EyeLink Parser. We also understand that, for certain real-time applications, the failure to detect PSOs may still allow some meaningful online calculations. Nonetheless, PSOs do occur in these recordings, and we consider the failure of this algorithm to detect them as a flaw in the parser, especially when used for offline analysis. The ONH found 1,051 PSOs and the MNH found 1,350 PSOs. Since our focus is on offline analysis, from our point of view, the failure to detect these PSOs are considered classification errors. Second, all blink periods (missing data) are both preceded and followed by "saccades", as shown in Figure 1 below. SR-Research refers to these events as "blink-saccades" and makes no judgement regarding if the saccades are true saccades or artifacts. In our sample, all such events were artifacts. SR-Research informs users in its user manual that these events should be removed, and so we will henceforth consider them removed. During online processing, there is not sufficient time to discriminate between the blink-saccades and regular saccades, and therefore these events remain classified as saccades. It is up to the user to remove them.

In general, the EyeLink Parser performs very well when determining saccade onset. However, there were a large number of saccades that end too early, as show in Figure 2 below. The EyeLink Parser does a reasonably good job determining the end of saccades in the absence of PSOs. But in the presence of PSOs we find many saccades that end too late and include a portion of the following PSO (see Figure 3 below).

Error Classification for the EyeLink Parser versus the ONH and the MNH

Table 10 presents the error numbers for errors of various types. Only comparisons with a total of more than 20 events between the two compared algorithms are included. These data are from the scoring by the first author only. Next to the error numbers are the p-values for the comparison between error rates. In the final column we present the estimated effect size (Cohen's d) for each comparison (absolute value). Blue highlighting indicates that error numbers were significantly higher for the comparison algorithm and yellow highlighting indicates that the error numbers were significantly higher for the EyeLink Parser algorithm. For the ONH-EyeLink Parser comparison, the ONH had higher numbers of errors than the EyeLink Parser for 2 error types and the EyeLink Parser had more errors than the ONH for 1 type of error. For the MNH-EyeLink Parser comparison, the MNH has significantly more errors than the EyeLink Parser for one error type and the EyeLink Parser had more errors than the MNH for 1 error type.

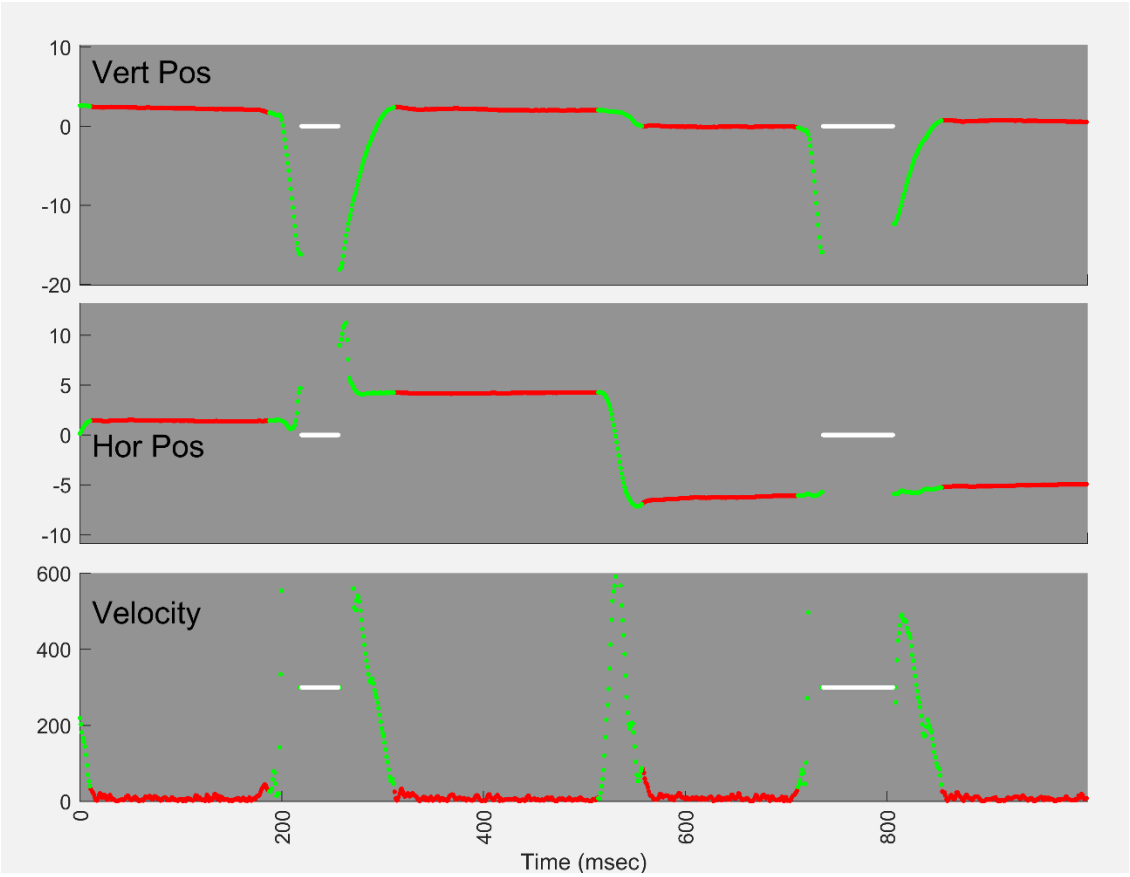

Figure 1: Illustration of 2 blink-saccades (and a saccade that ends too late between them). Fixation is red, saccades are green, and missing data is white. Data scored by EyeLink Parser. Subject number is 29, starting msec = 18001.

The EyeLink Parser scores a trivially small number of saccades that start too early (or those that start too late, data not shown). So, one would have to conclude that the EyeLink Parser performs very well in determining the onset of each saccade. The ONH finds many saccades that end too late – far more than the EyeLink Parser, whereas the MNH finds fewer (not significantly so) of these errors than the EyeLink Parser.

PSO Study

We also wanted to know what the EyeLink Parser does with PSOs, as defined by the MNH. There were 1083 MNH defined PSOs, consisting of a total of 17,125 samples (msec) of data, and only 2,093 samples were classified as saccade (12.2 %). For each PSO found by the MNH, we determined what percent of the PSO was classified as fixation by the EyeLink Parser. In Figure 4, below, we present a frequency histogram of these percentages. The percent of all MNH defined PSOs that were classified as 100% fixation was 56%. The percent of all MNH defined PSOs that were, in part, assigned to the saccade was 44%. We also looked, subject by subject, at

the the percent of all MNH defined PSOs that consisted of 20% or more saccade, as classified by the EyeLink Parser (Figure 5). For 3 subjects, roughly 50% of all MNH defined PSOs consisted of 20% or more saccade.

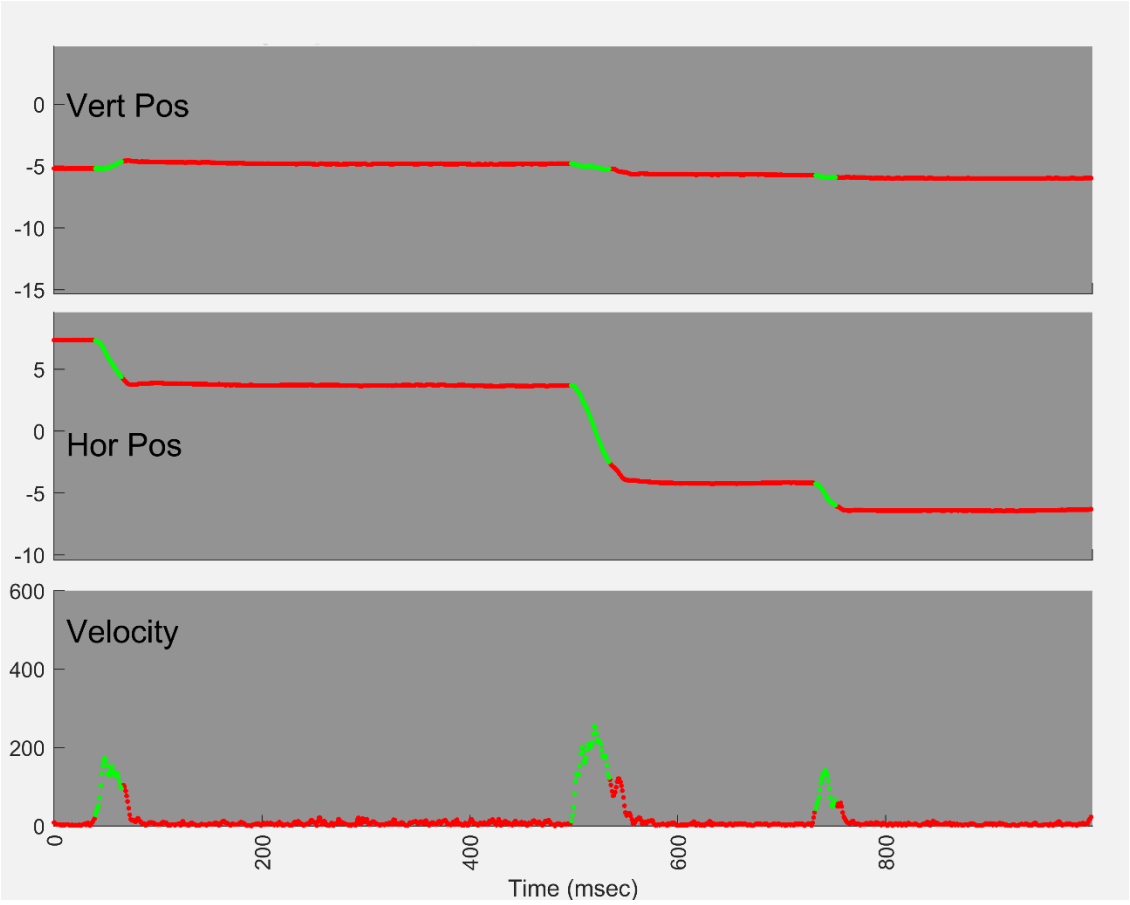

Figure 2: See caption for figure 2. Here we have 3 saccades that end too soon. Data scored by the EyeLink Parser. Subject number 37. Starting msec = 22001.

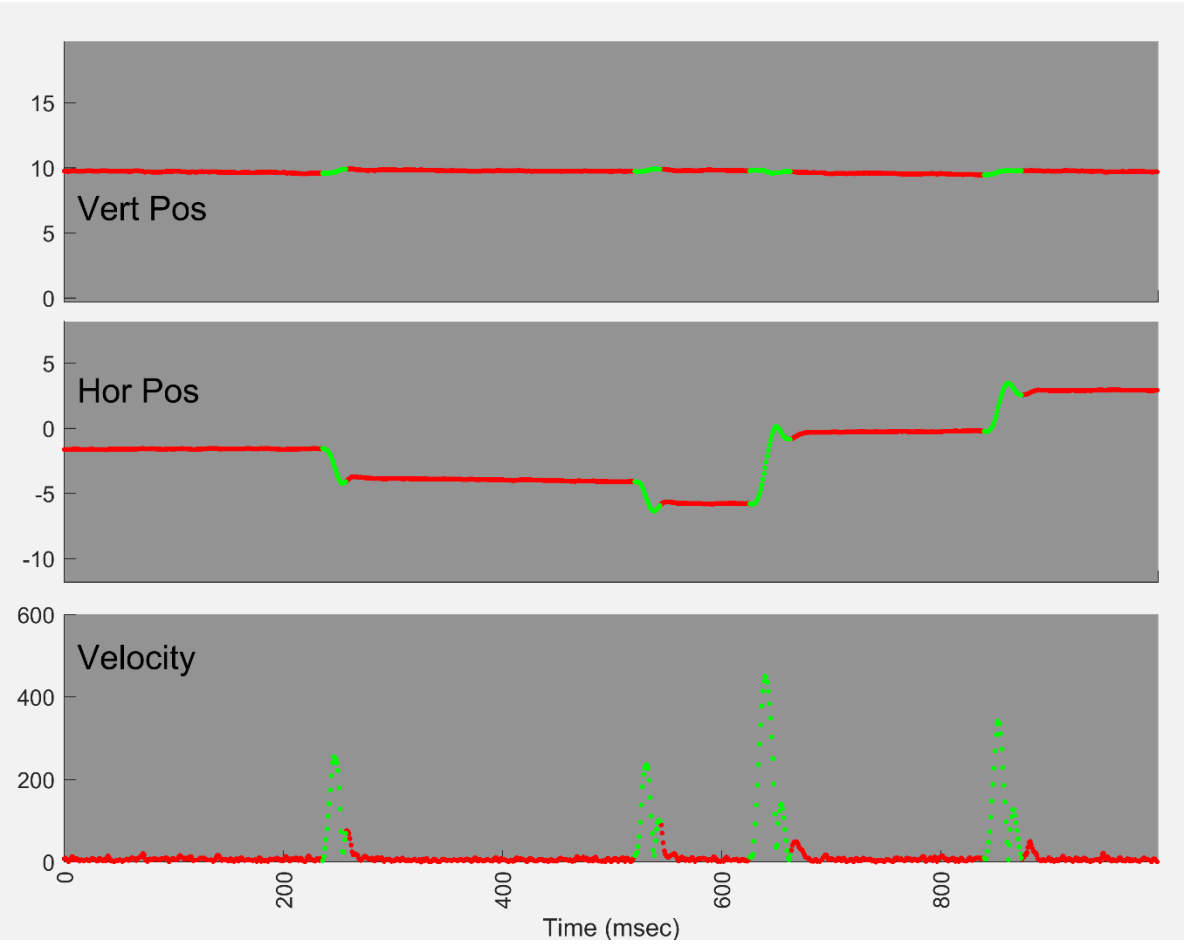

Figure 3: See caption for Figure 1. Illustration of 4 saccades that end too late and include a portion of the subsequent PSO in the saccades. Data scored by the EyeLink Parser. Subject number 3, starting msec = 2001.

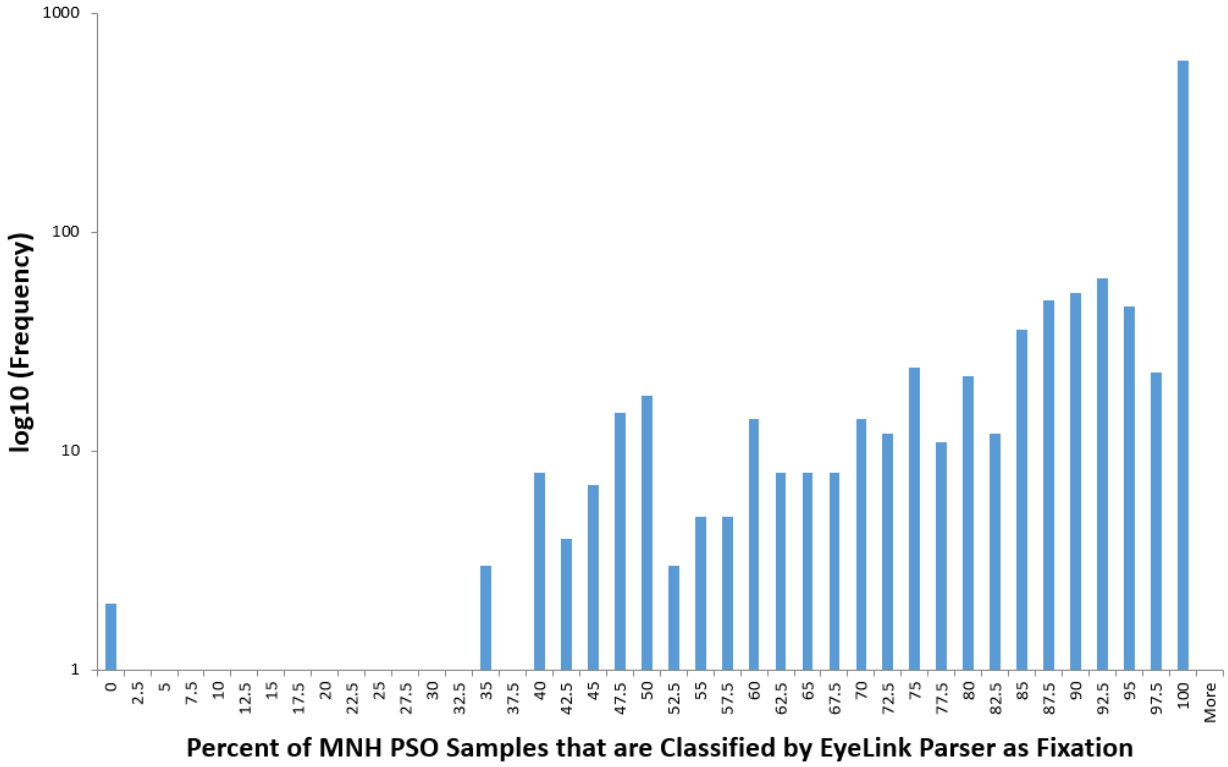

Figure 4: Histogram of percent of MNH defined PSO Samples that are classified by EyeLink Parser as fixation. Note that the ordinate is the log10 of the frequency.

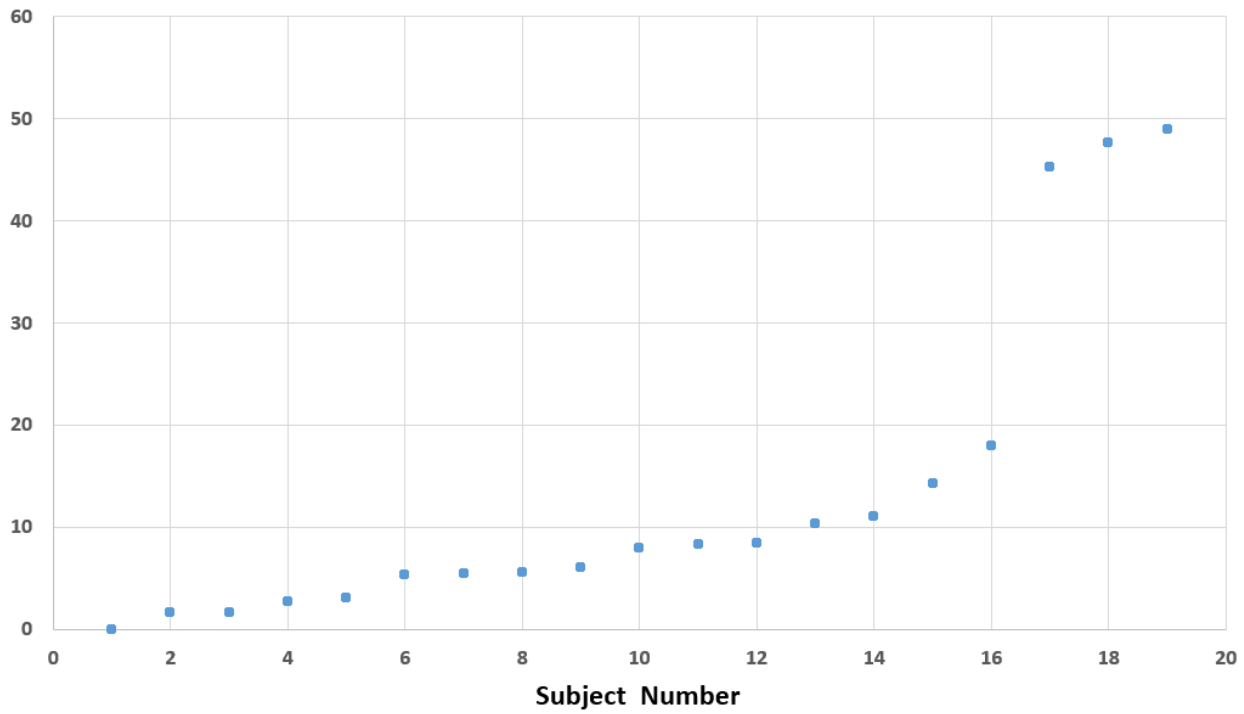

Figure 5: Percent of MNH-defined PSOs that included 20% or more samples classified as saccade by the Eyelink Parser – subject by subject analysis. For 16 subjects, less than 20% of MNH defined PSOs were classified as saccade by the EyeLink Parser. For 3 subjects, 45-50% of all MNH defined PSOs consisted of 20% or more samples classified as saccade.

Table 1: Comparing Error Numbers between the EyeLink Parser and the ONH (Top) and the MNH (Bottom) Algorithms

		ONH vs EyeLink Parser			
Error Number	Error Name	Total Errors: ONH	Total Errors: EyeLink Parser	p-value	Abs(d)
25	Number of Saccades That Start Too Early	1515	17	0.0000	17.10
27	Number of Saccades That End Too Early	3	315	0.0192	1.51
28	Number of Saccades That End Too Late	824	167	0.0001	10.29

		MNH vs EyeLink Parser			
Error Number	Error Name	Total Errors: MNH	Total Errors: EyeLink Parser	p-value	Abs(d)
25	Number of Saccades That Start Too Early	263	17	0.0000	17.10
27	Number of Saccades That End Too Early	6	315	0.0044	2.28
28	Number of Saccades That End Too Late	104	167	ns	