The Results of the DEM Test on an Adult Population

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The Developmental Eye Movement Test (DEM) is a well-known test frequently used with children to evaluate the accuracy and speed of fine saccades, such as the ones used in reading. The DEM has the advantage over other similar tests in that it, "Factors out consequences of automaticity on oculomotor performance," according to the Journal of the American Optometric Association. The test is also applied to adults in a clinical setting with suspected oculomotor deficits, but the test does not provide normative data for this population of people, there are only results up to and including age 13.

There are few other developmental tests that are focused primarily on eye movements. Some of these include the Eye Trac, NYSOA King Devick, and the Taylor Visagraph. The Eye Trac and the Visagraph both use infrared light to detect the eye movements made during reading. While these types of tests may be the most efficient way to evaluate the eye movements made during the act of reading including fixations, regressions, and saccades, they are not utilized in a typical primary care office due to cost. These infrared tests are primarily seen in teaching institutions or research settings. They are much less accessible for applying in a real world situation compared to the DEM which is inexpensive and portable. There is also the NYSOA King Devick test which involves having a patient read numbers aloud that are in a line straight across. The goal of the test is to evaluate saccadic performance. It may evaluate the proficiency of a patients saccades, but it does not compare the time necessary to call out any vertically oriented numbers to eliminate problems associated with visual-verbal automaticity as accounted for with the DEM. A study done by Kulp, MT and Schmidt, PP, found that,

"Visual difficulties may affect performance on the NYSOA King Devick, but not the DEM." This study found that the DEM is more accurate in assessing the saccadic insufficiencies in children who have vision problems versus the NYSOA King Devick. For these reasons and more, the DEM is considered the standard in evaluating the saccadic performance of a patient as exhibited during reading.

We performed the DEM during a routine comprehensive eye exam on an adult population to determine normative data, because the test only provides data up to the age of 13. The DEM was performed exactly as outlined in the test booklet provided with the DEM. The study involved 200 people of no particular gender or race who were between the ages of 18 and 40. The subjects did not have any history of ocular disease, strabismus, amblyopia, eye muscle dysfunction, vision therapy, reading disorders such as dyslexia, accommodative problems, or learning disabilities. All participants had a 20/20 best corrected near visual acuity in each eye. The goal of the study is to determine if an adult would perform similar to a 13 year-old.

The data collected included the vertical score in seconds, horizontal score in seconds, and the number of errors made by the subject. The analyzation of our data included dividing the adjusted horizontal time in seconds (raw horizontal time minus any errors) by the vertical time in seconds to determine the ratio for each participant in the study. This ratio is the main scoring factor in determining a patient's performance in comparison their normative age group.

After performing the DEM on 200 adults from the ages of 18 to 40, the majority of these adults performed at a similar level as the age 13.0 – 13.11 group. The mean ratio that we found for our sample was 1.08, with a standard deviation of .13, so at least 95%

of the subjects should fall between a ratio of .82 and 1.34. In our sample, there were not any outliers, and some of the extremes are discussed in the following paragraph. This mean ratio can be compared to the 13 year-old age group, that had a mean ratio of 1.12 and a standard deviation of .12. With the ratio for our sample population being lower than that of the 13 year-old group, it shows that our adult population was able to perform marginally quicker than that of the thirteen year old patient. So when applying the test to an adult, you should expect equal if not more timely responses as those compared to the average 13 year-old.

There was no significant amount of mistakes made by our subjects, only 1 substitution error, and 2 omission errors from all the subjects. There was no significant difference in the performance of our younger vs. our older subjects, and the average age was 26.3. There were two subjects that fell below the 15^{th} percentile in the ratio category, one of whom fit the type II category described in the DEM booklet, and there is the question of some oculomotor dysfunction that is going undiagnosed. The other patient seemed to exhibit both an increased horizontal and vertical test time, which points to a possible problem with both automaticity and oculomotor skills. There were 10 subjects that displayed a vertical or horizontal time in seconds that was below the 50th percentile for the age 13 group results, which is only 5% of the subjects, and of these 2 subjects fell into the Type IV behavior which represents difficulty in automaticity in number calling skills along with an ocular motility problem. Overall, we found 8 subjects that fell into the Type II category of exhibiting oculomotor dysfunction, which is 4%. We thought it is likely that this percentage of adults might not have been diagnosed. 95% of our subjects

fell into the Type I behavior, which is an, "essentially normal performance in horizontal time, vertical time, and ratio," according to the DEM test booklet discussion.

Due to the results we obtained in our study, we would like to propose that a normal adult should perform comparable to the 13 year-old who has no oculomotor dysfunction. We wanted to evaluate the saccadic eye movement time to assure that the older patient should not be given some type of time adjustment due to age. The only adjustment that might be made is to assume the typical adult patient might be marginally quicker than that of the 13 year-old. This is to be expected especially for our sample population with an average age of 26.3 because research has found that, "Young adults typically had the fastest saccadic reaction time," according to an article by Munoz, DP. Another factor that might have influenced the time for the adult population is attention. Adults are able to exhibit more focused and prolonged attention than the average child, and studies have found that attention can affect the amount of errors that were made by children when tested on the DEM or other visual performance tests. There should be no hesitations when using the DEM to test adult patients on their saccadic performance and utilizing the 13 year-old group norms.

References:

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