Comparison of Danish and American Children

on the

NYSOA King-Devic Saccadic Test

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Many studies have been done on the connection between students' eye movements and educational performance. From these studies have emerged several clinical measuring tools for optometric use. One such test, widely used in the United States, Canada, and Australia, is the New York State Optometric Association King-Devic (NYSOA KD) test. This test is easy to administer and has been incorporated in many visual screening protocol used by non-professionals. The test is also used in formal investigations into understanding learning-related visual problems. The norms derived from the early studies were done on children in the United States. In order to use this test in Denmark we wanted to know if the norms derived from studying American children could be used directly or if new norms for Danish children must be established. Our hypothesis is that Danish children would perform the same as age-matched American children.

To test this, we obtained permission to work with random samples of students from three different schools. Due to time and personnel restrictions and to allow the size of our groups to be large enough to allow formal comparisons with the US data, we chose to test only four different age groups. We worked with 6-, 9-, 12- and 14-year-olds. Our testing samples were equally divided with nearly equal numbers of boys and girls. We tested 139 subjects in all.

Two examiners worked with each of the subjects during the testing. One examiner was involved in the actual administration of the test while the other observed a number of other qualitative findings. The standard testing forms were used during the testing and the child was seated at a table on a chair with a back. Lighting was the standard lighting in the particular classroom used.

The demonstration card was placed before the subject and he was asked to call off the names of the numbers as quickly as he could. Each subject was told that he would be timed and that he should go as quickly as possible. The stopwatch was clearly visible and after hearing "ready, set, go", the stopwatch was started. As soon as the last number had

been called off the stopwatch was stopped. The time elapsed for each of the three test forms was recorded. During the testing, the second examiner was making other observations, which will be reported later. Once the demonstration card was completed each of the three test forms were placed in front of the subject and the instructions were repeated and the times were recorded.

Results

The following three tables show the scores for each of the separate trials with the Danish scores and the American scores included for comparison.

Scores for Sample I

Age	Danish	DK St.Dev.	US Subjects	US St.Dev.
6	62.6	+/- 21.7	31.0	+/-10.1
9	26.9	+/- 6.8	21.0	+/- 7.2
12	19.0	+/- 3.2	16.9	+/- 3.6
14	17.8	+/- 3.6	14.9	+/- 2.4

Scores for Sample II

Age	Danish	DK St.Dev.	US Subjects	US St.Dev.
6	66.4	+/- 21.7	37.1	+/-13.0
9	28.9	+/- 8.0	22.9	+/- 7.5
12	20.0	+/- 3.3	17.7	+/- 4.4
14	18.6	+/- 3.6	16.9	+/- 2.3

Scores for Sample III

Age	Danish	DK St.Dev.	US Subjects	US St.Dev.
6	82.6	+/- 25.0	51.0	+/-19.4
9	34.6	+/- 10.1	29.5	+/-10.8

12	23.0	+/- 4.5	19.4	+/- 5.3
14	20.4	+/- 3.8	18.7	+/- 2.5

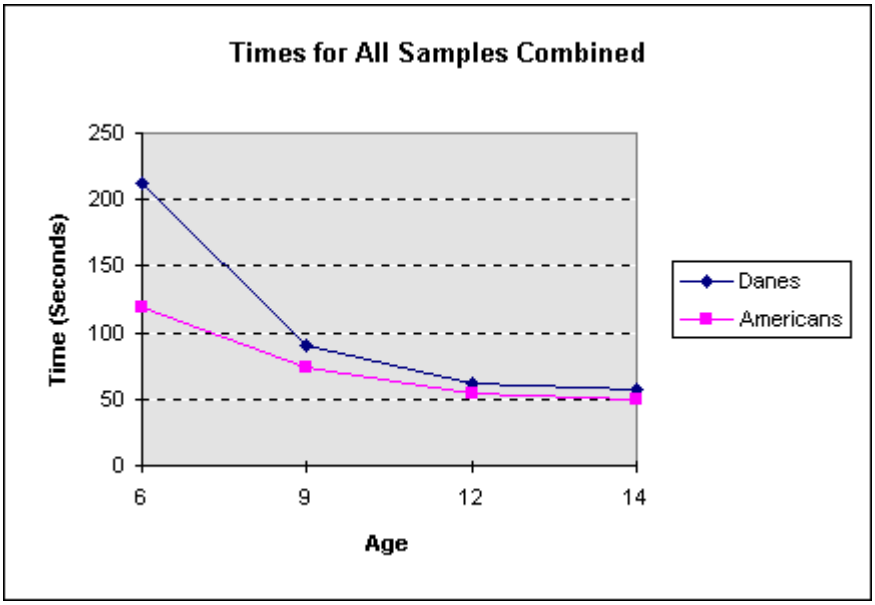
It can be seen from the above data that the Danish children performed more slowly than the American children did at all ages with the biggest differences occurring at the youngest ages. Due to the fact that the actual data was not available from the NYSOA norming studies we were not able to determine the levels of significance. However, simple inspection of the data yields the fact that the biggest differences are at the 6 year old level and that the differences are much smaller at the older age groups.

The following table shows the data for the combined scores from all three samples.

Scores for All Samples Combined

Age	Danish	DK St.Dev.	US Subjects	US St.Dev.
6	211.6	+/- 68.4	119.0	+/- 40.9
9	90.4	+/- 24.9	73.4	+/- 26.0
12	62.0	+/- 11.0	54.0	+/- 13.5
14	56.8	+/- 11.0	50.4	+/- 5.8

The same pattern from each of the individual trials can be seen here as well. The scores for the youngest Danish children are much slower than their American counterparts. The spread of the scores at this young age group was also much wider than that seen for the 6-year-old American children. As one looks down the table towards the group of 14-year-olds, one sees the Danish scores catching up with the American scores but still slightly slower. The following graph shows this same data.



Previous reports on the NYSOA KD have focussed on the actual time and accuracy of the responses of the subjects. Over the years clinicians have made many other observations relative to understanding the visual behavior of their patients. Many of these observations can be made during the NYSOA KD test. During this study we quantified a number of these qualitative observations.

The first thing we looked at was the presence of up and down head movement, sometimes called "head bobbing". The child nods his head toward the paper as he reads each number as if to emphasize it.

NYSOA KD Head Bobbing

Age	No Movement	Some Movement	Moderate Movement
6	24 (82.76%)	3 (10.34%)	2 (6.90%)
9	25 (64.10%)	12 (30.77%)	2 (5.13%)
12	24 (75.00%)	7 (21.88%)	1 (3.13%)
14	35 (89.74%)	2 (5.13%)	2 (5.13%)

It was interesting to us that the amount of head bobbing increased from the 6- to the 9-year-old age groups. It is possible that this strategy takes a while to develop as a way to help the child perform the eye movement and/or to maintain the visual fixation during the act of decoding the number. The data shows that some head bobbing is still seen as late as age 12. Head bobbing is nearly gone by age 14 but is still present in about 10% of the children tested.

We next looked at the amount of side to side head movement of our subjects. It has long been noted that many children who have trouble learning are found to have the visual condition known as "ocular motor dysfunction". They are lacking control of the ocular motor system in situations where they must derive meaning from the printed page. In other words, they have yet to learn to use their eyes free of movement in the rest of the body. Often the head is observed to move more in degrees than would be required to move the eyes from one side of the paper to the other if the eyes were actually fixed in the head. In this situation the person's eyes would actually have to move in a retrograde direction, from right to left, as the person "tracked" from left to right across the printed page. The following is a table of our observations of the side to side movement of the heads of our subjects.

NYSOA KD Side to Side Head Movement

Age	No Movement	Some Movement	Moderate Movement
6	15 (51.72%)	12 (41.38%)	2 (6.90%)
9	8 (20.51%)	29 (74.36%)	2 (5.13%)
12	11 (34.38%)	21 (65.63%)	0 (0.00%)
14	18 (46.15%)	20 (51.28%)	1 (2.56%)

Once again we see that the amount of head movement increases from the 6-year-old to our 9-year-old group. We were most interested in the fact that the amount of head movement remained in over half of the oldest two groups. Since not all of the children showing what we termed excessive head movement have reading difficulties, the presence of side to side head movement can not by itself be diagnostic of a reading problem. However, we do feel that this should affect one's long-term reading efficiency. This was not measured in this study and it would have been interesting to see if there was more head movement in the Danish children than in the American children. This might then give some clue as to why the Danish time scores were slower than the American children were at all ages.

We made observations of the number of times the subjects lost their place and required assistance from the examiner to continue. The examiner was instructed to wait for the subject to either verbally state that he was lost or for the subject to ask for assistance in finding his place before pointing to the beginning of the next line from which he could continue. If the subject got lost, time continued to run on the stopwatch while the examiner made the prompt. The following table reports on the number of such loss of place incidents.

NYSOA KD Loss of Place

Age	No Loss of Place	Losses of Place
6	10 (34.48%)	19 (65.52%)
9	33 (84.62%)	6 (15.38%)
12	31 (96.87%)	1 (3.13%)
14	38 (97.44%)	1 (2.56%)

This clearly shows that our youngest subjects got lost often and that there was still some loss of place at age 9. However, by age 12 loss of place had nearly disappeared.

Next we report on the number of times our subjects repeated a line or major portion of a line. Automatic left-to-right, top-down sequencing is a critical part of the spatial organization strategies needed for efficient reading. It has been observed clinically that in some children prior to this ability emerging, several strategies exist for getting back to the beginning of the next line other than making the single saccadic eye movement to the first number on the next line. One such strategy is to drop down at the end of the line to the next line and to then move step by step back to the left. When the end is reached the reader starts again. Inaccuracies in making the return sweep lead to loss of place and one type of error noted is to repeat the line just read. Here we report on the number of line repetitions.

NYSOA KD Line Repetitions

Age	No Line Repetitions	Number of Repetitions
6	25 (86.21%)	4 (13.79%)
9	35 (89.74%)	4 (10.26%)
12	29 (90.62%)	3 (9.38%)
14	35 (89.74%)	4 (10.26%)

Here no age trends were observable. The percent of those repeating lines seems to stay the same through all ages. A slight trend was noted from age 6 to 12 but then returned to the average level of around 10% in the 14 year old group.

Other factors noted included the following:

We found that 37.93% of our 6-year-olds attempted to use their fingers to keep their place during some part of the testing. This was not seen at all in the older age groups. We

found that 24% of the 6-year-olds skipped a line but that none of the other children in the other age groups skipped lines or major portions of lines.

We found that 10-12% of the children in the 6-, 9- and 12-year-old groups shouted the letters out loud rather than using their normal speaking voices. By age 14 this had completely disappeared. We feel that this is an example of the type of motor overflow see in the sideways head movement as well as the head bobbing. In this instance the motor overflow is spilling over into the auditory areas of motor control. Generally when a new motor act is being learned or developed one observes that the person over-commits resources and moves more of his body than is necessary to perform the task. Once the task has been learned or developed he differentiate the movements more precisely using only the parts of the body that are essential to the task.

Discussion

It is apparent from the comparison of the Danish and American scores that at younger ages the Danish children are significantly slower than the American children are. At older ages the scores of the Danish more closely matched those of the American children. The difference in the youngest group was very significant. We found that many of the 6-year-old Danish children did not know the names of the numbers, which naturally affected their ability to perform the test.

Some possible explanations for the differences in performance include the fact that American children start school earlier and as a result learn their letters and numbers earlier than Danish children. In Denmark there is very little emphasis on organized child- and vision-development as well as very few educational television programs such as Sesame Street. The fact that the Danish children catch up almost entirely by age 9 and certainly by ages 12 and 14 shows diminished effects of these developmental and early educational programs and emphases in the U.S. The Danes simply prefer to allow development to occur at its own pace rather than push their children at younger ages. Since by age 12 they have caught up, the Danish attitude does not seem to restrict their children in later years.

Conclusion

Clinical experience has shown that children who have the necessary visual abilities to handle the demands of the education system will have eliminated most supportive head and upper body movement by between ages 6 and 8. To still have over 50% of the 14 year olds showing either side-to-side or up-and-down head movement shows that many Danish school children do not have the visual abilities necessary to meet the demands of

their schooling. They are putting much more effort into performing the visual mechanics of the task. This extra effort is taking away from the child's ability to learn from those same educational experiences. Behavioral vision care offers the possibility of making large scale changes in these visual abilities and can help equip the student of the next century with the tools needed to meet the demands of the information age.

Finally, it would be helpful to have data on the qualitative findings on the American children so that they could be compared to the Danish children. This data would also help in the teaching of our clinical discipline. Many of the observations that are made by senior clinicians have not been quantified and could be relatively easily. It is our hope that this study will inspire further work in the U.S. in these areas.

References

1. Cohen, Lieberman, Stolzberg, Ritty, "The NYSOA Vision Screening Battery – A Total Approach", JAOA 979-984, #1 November 1983.
2. Kulp, Parjean Taylor & Paulette P. Schmidt, "Reliability of the NYSOA King-Devic Saccadic Eye Movement Test in Kindergartners and First Graders", JAOA Vol 68 #9, 589-595 September 1997.
3. Lieberman, Cohen, Rubin, "NYSOA K-D Test", JAOA 631-637, #7 July 1983.

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