Comparison of Danish and American Children

on the

Wold Sentence Copy Test

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Behavioral optometry is not as well known in Scandinavia as in the United States. We wanted to see if an American test could be used in Denmark and chose the Wold Sentence Copy Test[1]. We were particularly interested in seeing if there was a difference between Danish and American school children. Our hypothesis is that Danish and American children are different because of significant cultural and social differences. The Wold Sentence Copy Test consists of a single line of text that the subjects were asked to copy as quickly as possible. The total time to perform the test is recorded.

Robert Wold, O.D., an optometrist first made the test in United States in 1970 from Chula Vista, California. The following table shows the norms used in the United States on this test.

Grade	Time (seconds)
2	166.3
3	157.0
4	144.1
5	130.6
6	121.1
7	113.7
8	105.0

We tested a total of 166 children divided into four age groups, 8, 10, 12, and 14 years of age. Students were selected at random from three different schools, two private and one public. Due to limitations of time and other resources we chose to test only four age groups. The youngest and the oldest groups tested by us correspond to the youngest oldest and ages for which norms are given on the test by Wold. To test our hypothesis

that Danish children are different than American children, we tested the extremes of the ages, as well as two age groups in between. It was assumed that the odd-numbered age scores could be interpolated from the data collected. It was also assumed that the odd-numbered age scores would fall between the scores from the oldest and youngest groups. Given our limited resources, we tested only four age groups in order to ensure the largest possible groups. The original test text was translated into Danish by Camilla Huld of Copenhagen (see appendix A).

Each child was given the following instructional set: "Copy this sentence as quickly as you can. It's all right if you want to make it neat but don't worry too much about that, please try to hurry." A stopwatch was used; however, we kept the stopwatch from view so as to not put too much stress on the subjects. We also made the following observations while the children were taking the test:

How the child held the paper

How the child held the pencil

Working distance

Supporting hand (on the paper)

Vocalizations

Head posture

THE RESULTS FROM WOLD SENTENCE COPY TEST

The following are the data that we collected. The first column of the table shows the age of each of the four groups tested. The second column shows the number of children tested in each of the age groups. The third column has the average scores for the Danish children tested by us. The next two columns show the minimum and maximum scores for each age group. The sixth column shows the standard deviations for our groups. The final column shows the norms that are in use in the United States.

Age	Sample Size	Average (Seconds)	Minimum (Seconds)	Maximum (Seconds)	Standard Deviation	USA Score (Seconds)
8	39	327.9	162.8	749.6	139.6	166.3
10	45	142.9	74.7	317.9	49.5	144.1
12	37	92.6	63.7	159.5	19.5	121.1
14	45	74.2	50.4	117.2	15.0	105.0

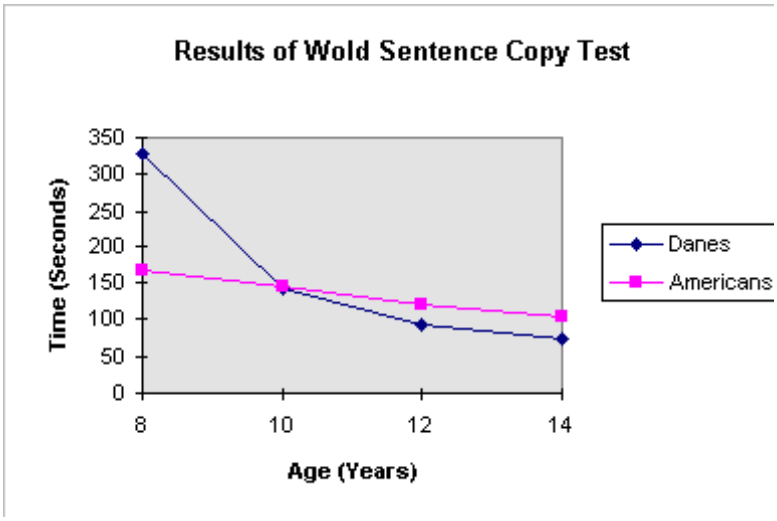


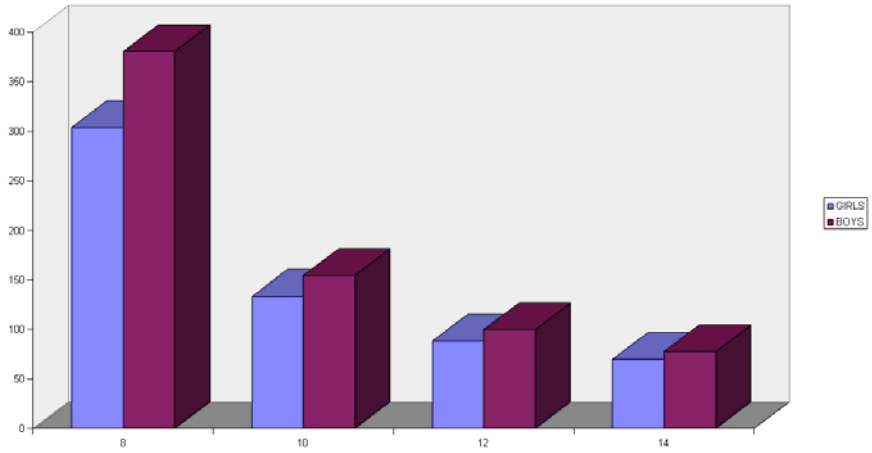
Figure I

The following is a graphic representation of the scores of the Danish and American subjects.

Discussion

The youngest Danish children's scores (age 8) were much slower than that of the 8-year-old American children. The averages of the Danish scores were slightly more than twice the times for the American children. Interestingly, by the age of l0 the Danish children (142.9 sec. +/- 49.5 sec.) had completely caught up with the American children (144 sec.). At later ages the Danish children out-performed the American children. Unfortunately Wold did not report his data in enough detail to allow us to perform any powerful statistics to test for the levels of significance. Wold established his norms from literature in the field of education and did not actually derive norms for his test from populations that had actually taken his test. Therefore, we are unable to report the levels of significance of difference between our results and that of Wold. We offer our data here in a manner that will allow for future research to have a benchmark against which to measure differences.

Figure 2 shows the differences we noted between the boys and girls in our study. In general the boys scores were slower than the girls scores at all ages. The boys also showed many more signs of having difficulty in maintaining concentration over time. It remains for future research to take large enough samples to make definite statements about these differences. We however note them here to give direction to some possible future research.



Accuracy Problems

Previous studies have not included precise data about the accuracy of their subjects' performance. We counted the exact number of characters copied to assess the levels of accuracy including all punctuation markings. At age 8, the children didn't copy the commas or punctuation. We feel that this is because at this age they had not learned about punctuation. At age 10 some of them did include the commas and the punctuation. However, most continued to leave them out. At the age of 12 and 14 most of them included the comma and the punctuation although some of them asked if they should.

In the previous reports on the Wold Sentence Copy Test clinicians have concentrated their attention on the actual time spent copying a sentence. Other clinical observations relative to understanding the patients' visual behavior have been done over the years. In fact, Wold's main purpose in putting the test into the literature was that it should be used as a vehicle for allowing these observations to be made. In our research we quantified a number of these types of observations. The works of Dr. Darell Boyd Harmon [2,3] helped us become aware of the importance of these qualitative findings. Our hope is that these findings can give us more insights into how patients interact with their environment.

It is our hope that in the future optometrists will look more widely to the role of movements and posture and performance.

We observed how the child held the pencil. Children given a pen, pencil, or crayon to write with prior to developing the sensory motor knowledge of how their hands and arms work will often develop inefficient ways to manipulate the writing implement.[4] This will lead to increased energy and concentration on the simple mechanics of the task whenever the child writes or draws and will detract from overall efficiency. The following are our findings for each age group:

Pencil Grip

	3 FINGERS		4 FINGERS		5 FINGERS		TOO CLOSE TO THE POINT	
8 YEARS	14	35.9%	11	28.,2%	4	10.3%	10	25.6%
10 YEARS	22	48.9%	18	40.0%	0	0.0%	5	11.1%
12 YEARS	27	73.5%	6	16.2%	0	0.0%	2	4.5%
14 YEARS	28	62.2%	15	33.3%	0	0.0%	2	4.5%

A proper pencil grip consists of having only three fingers in contact with the pencil. The above table shows that our 12-year-olds showed the highest percentage of three-fingered pencil grips. It was interesting to note that the 14-year-olds did not follow the trend of increasingly better and better pencil grips. We are uncertain if this reflects educational attitudes towards proper writing postures or if other factors are contributing to the development of pencil postures. It would be interesting to perform a longitudinal study to see how individuals change their pencil grips over time.

The last column of the above table shows by age the number of children who hold the pencil too close to the point. In a good pencil grip the fingers should be about 3 cm from the tip. It has been noted that those who hold the pencil close to the point will tend to get physically close to the paper and will tire much sooner. In addition, asymmetries in posture during sustained near-centered activities will eventually lead to asymmetric visual conditions such as astigmatism and anisometropia.

Working Distance

Closer than normal working distances are often an early sign of the development of nearsightedness. This is a physical manifestation of the drive to center closer than identification. Clinically this would first be demonstrated by either a lower exophoria or an esophoria at near. On this test we also made observation of changes in working distance over time which manifests as a person getting closer and closer to the paper as the test progresses.

We used as our working definition of a "proper working distance" as that child's Harmon distance, the distance from their elbow to their first knuckle. Exact measurements of the working distance were not made during the test as this would disrupt the child's performance on the test. Rather, one person during the test situation was responsible for making the working distance observation.

As children get older we see that there is an increase in the number of children who use a proper working distance, closer to their Harmon distance. It is interesting to note that the age category which had the most number of children working at their Harmon distance were the 14-year old. What we found particularly interesting is that even in this group we had less than 50% working at their Harmon distance. Contrary to our thoughts we found that fewer children worked very close as they got older.

WORKING DISTANCE

	NORMAL		CLOSER		VERY CLOSE	
8 YEARS	14	35.9%	18	46.2%	7	17.9%
10 YEARS	16	35.6%	23	51.1%	6	13.3%
12 YEARS	14	37.8%	16	43.2%	7	19.0%
10 YEARS	22	48.9%	13	28.9%	10	2.2%

Vocalization

We noted that a number of children talked out loud during the testing. They appeared to need to say out loud the letters and/or words they were copying. It seems that vocalizing is being used by those subjects to augment possible short-term memory difficulties. We found that none of the children in any of the age groups spoke out very loudly. We did find that very few children did any vocalizing and that those that did were mostly the youngest of the children.

VOCALIZATION

	QUIET		VERBALIZED		LOUD	
8 YEARS	29	74.4%	10	25.6%	0	0%
10 YEARS	40	88.95	5	11.1%	0	0%
12 YEARS	35	94.6%	2	5.4%	0	0%
14 YEARS	43	95.6%	2	4.4%	0	0%

The last observations we made were in reference to how our subjects held their paper and what their postures were during the task. The first table summarizes how our subjects oriented the paper on the table. The paper should be placed parallel to the writing arm when that arm is resting in the middle of the paper, with the writing elbow resting comfortably on the table. This results in the paper for a right-handed writer being turned counter-clockwise with the top of the paper tilted to the left. The opposite holds true for the left-handed writer, the paper turned clockwise with the top tilted to the right.

PAPER OBSERVATION

	NORMAL		RIGHT		LEFT	
8 YEARS	29	74.4%	3	7.6%	7	18.0%

10 YEARS	35	77.8%	4	8.9%	6	13.3%
12 YEARS	22	59.5%	2	5.4%	13	35.1%
14 YEARS	23	51.1%	2	4.4%	20	44.5%

It is evident from the above table that at l0 years of age we found the most number of subjects orienting their papers correctly. We found that at the later ages progressively more of our subjects tilted the paper too far to their left. We are uncertain as to why the asymmetries favored the left tilt over the right tilt. It is possible that the stress of sustained near centered visual activities is causing the subjects to pull the paper closer to them. Since the vast majority of our subjects were right-handed, this would result in the paper being tilted excessively to the left, closer to the subject.

We then looked at where our subjects placed their non-writing hands. When the supporting hand is being used properly it is placed on the side of the paper and takes an active role in positioning, holding, and moving the paper. The following table shows where our subjects held the paper.

SUPPORTING HAND

	TOP		BOTTOM		SIDE		NO SUPPORT	
8 YEARS	5	12.8%	15	38.5%	18	46.2%	1	2.5 %
10 YEARS	14	31.1%	15	33.3%	15	33.3%	1	2.2%
12 YEARS	4	10.8%	21	56.8%	11	29.7%	1	2.7%
14 YEARS	14	31.1%	16	35.6%	15	33.3%	0	0.0%

It is evident from this table that very few children have learned how to properly use the non-writing hand to either effectively or to efficiently support the act of writing. The 8-year-old group shows the highest percentage of proper use of the support hand, but still did not even represent half the children. By age 14, only one-third of the children are using their supporting hand properly.

To be in best balance during the act of writing, the child's head should be nearly straight up. A very slight tilt to the side of the supporting hand is acceptable. However, we often observe excessive amounts of tilt as well as excessive amounts of head movement from side to side and up and down. The following table summarizes the head posture observations as well as excessive head movement.

HEAD POSTURE

	STRAIGHT UP		TILTED		MOVES SIDE-TO-SIDE		BOTH	
8 YEARS	16	41.0%	17	43.6%	2	6.1%	4	10.2%
10 YEARS	22	48.9%	14	31.1%	3	6.7%	6	13.3%
12 YEARS	12	32.4%	15	40.5%	5	13.5%	5	13.5%
14 YEARS	9	20.0%	30	66.6%	3	6.7%	3	6.7%

In general we found the trend away from balanced postures to more asymmetric head postures the older the child gets. At the age of 14 we found only 20% of our subjects positioning their heads for maximum efficiency. We did note less and less head movement and more stabilization of posture into an inefficient one.

Conclusion

Our hypothesis was that Danish children were different than like American children. In the profession of optometry it has been common practice to use tests from the United States without renorming of the tests. We found that our hypothesis was supported; Danish children are different than their counterparts from the United States. Thus, it is apparent that further testing on a broader scale needs to be done in Denmark to cover the additional age groups not tested by us. This may be a point that has application as behavioral optometry spreads internationally; that we cannot all use each other's norms without some studies that would justify their use.

On the qualitative observations our expectation was that at the younger ages we would expect to see the children performing nearer to the balanced unstressed posture. We expected that asymmetries would increase at later ages due to the stresses of school, learning, and sustained near-centered visual tasks. This was not supported by the testing.

A possible explanation of why our youngest group performed so much more slowly than their American counterparts is that young Danish children don't get the same stimulation through the media as American children do. In Denmark, the school system for young children is looser than in the United States. The children spend more time playing outside and get a slower start in the academic part of their studies. Computers and other multimedia are not used as much in Denmark at young ages. Young Danish children simply play and have fun. The social attitudes in Denmark are that the youngest shall be able to be children as long as possible. We think also that Danish children get a slower start in learning to read and write. Also, there are no Danish television programs geared towards developing reading, writing, and mathematics in young children. Most Danish children start kindergarten at the age of 6 and attendance in a preschool is not very common.

Although the Danish children have a slow start, our study shows that they catch up with their age-matched American children and then actually pass them to a significant degree. The reason for that could be that they possibly spend more time developing their writing

skills. Although computers are becoming more common in homes, the Danish child's access to computers in school is limited.

Our conclusion is that additional study needs to be done with larger groups from all over Denmark with a much broader sampling of age groups. We have gotten good insights that we should not use the results from others without giving full consideration to the cultural and social background of the subjects we are working with.

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