The NVO Box™ test of spatial orientation and learning

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Abstract

Two groups of 41 people in total were tested with a view to establishing test standards: 23 tenth graders were tested at a Tenth Grade Centre in Gladsaxe as well as 18 pupils from Technical School Metal on Tuborgvej in Copenhagen, Denmark.

15 of the test subjects, or 37%, were rated as very competent. This group clearly managed the challenges without any obvious difficulty – assessed according to the average times of the entire group.

17 test subjects, or 41%, failed entirely with results far below average, and three subjects were unable to complete the test.

Looked at as a *pass/fail* test, the test results demonstrated that some people manage this kind of task particularly well, while others fail completely.

If a familiar three-dimensional shape is turned so that what was at the front is at the back, what was on the right is on the left and what was on the left is on the right – is it still possible to envisage the layout at the rear (the side which was originally visible, but can now no longer be seen, only imagined)? We can assume that imagination skills step in and that it is the ability to imagine that is challenged and, ideally, activated to make the necessary abstraction.

The results showed that there was no correlation between the scores in the NVO Box test and the Similarity test (Wechsler Adult Intelligence Scale (WAIS-IV)), but, on the contrary, a moderate correlation between the NVO Box test and Matrices (WAIS-IV). This makes sense given that some young people attained particularly good results in this test despite a poor academic record at school. In terms of age, there was a moderately significant correlation at school T between grade and age. The older the student the lower the grades. At school G, no such correlation existed.

Keywords: Ecological, Spatial, Orientation, Imagination, Learning, Blindness, Pass/Fail.

Background

The author has used this test for a good many years in conjunction with a procedure in which the test subjects were originally asked to place the shapes in the correct moulds twice in a row, and the focus was on the result achieved on the second attempt, which had to take no more than two minutes to be rated as good. After a few years, the test was expanded, with the test subjects taking a 15-minute break doing other tests and then being asked again to place the shapes in the correct moulds in two consecutive tries. Here the focus was on the time spent on the second try, which was still supposed to be no longer than two minutes, and also on the fourth try, where the time ideally was supposed to be well under two minutes.

This paper introduces a new, improved version of the NVO Box™ test where the test subject has not four, but eight tries, with the board turned 180 degrees horizontally after the first four tries, after which two more tries take place. From this position the board is then turned 180 degrees vertically, after which the last two tries are performed. Both of these manoeuvres can, to varying degrees, disrupt the learning effect from the first four tries, depending on the person.

In other words, the test is also a learning test to assess whether a test subject succeeds after the first four tries in retaining their sense of orientation and understanding of the board when it is repositioned twice in 2 + 2 additional tries.

Furthermore, certain shapes with awkward features, which some of the test subjects found extremely difficult to identify using their tactile skills, have now been replaced by shapes in a more suitable form.

Three photos of the NVO Box™ and two QR demonstrations

NVO stands for non-visual orientation. The test is a tactile-motor test that can be used by the sighted, the sight impaired and the blind, as the test subject uses only the hands to touch, feel and match the shapes to the moulds in the red wooden box.

The test, which is relatively short, takes approximately one hour to perform in its full-length version, where the board is placed in three different positions, and an additional interview and other tests are also carried out in the process. The test length can be halved by only performing the first four tries.

The late Professor Annelise Christensen – a leading expert in rehabilitation psychology – does me the honour of trying out the NVO Box™ test at a demonstration at the annual meeting of neuropsychologists in Middelfart, Denmark in 2015.

QR demonstration 1

40-second recording of 17-year-old male with top performances

From a very young age the test subject had displayed challenging behaviour, and his schooling had been characterised by both behavioural and academic issues. The video shows how he easily mastered the task.

Results of the NVO Box™ test

During the introductory stage there are no problems with tactile identification of the shapes.

First try: 1'40"

Second try: 1'09"

Break

Third try: 0'39"

Fourth try: 0'41"

Board is turned 180 degrees horizontally

Fifth try: 0'48"

Sixth try: 0'36"

Board is turned 180 degrees vertically

Seventh try: 0'52"

Eighth try: 0'55"

The test subject was asked for a fortnight after the actual test to repeat a try in connection with a video recording.

QR demonstration 2

52-second recording of a brain damaged middle-aged male

The test subject was completely blind after suffering a cardiac arrest. His optic nerve had suffered permanent damage due to lack of oxygen. In addition, a number of cognitive problems had arisen, primarily with regard to orientation.

Results of the NVO-Box™ test

In the introductory phase there are minor problems with tactile identification of the shapes and rather slightly unusual names are suggested for the forms. Unable to identify the cross. A semi-circle is referred to as a flat teardrop. When holding a shape in the form of a tear drop, the test subject states that the same shape has already occurred (referring to the semi-circle). A shape in the form of a boat is perceived to be a snail. He has difficulty finding an expression for a rhombus, but when prompted (the shape features on playing cards), he states correctly that it is a diamond.

First try 17'21" (despite plenty of help)

Test is aborted

Method

The test starts with an introduction that enables the test subject to familiarise themselves with the box. Without being able to see the board and the shapes, the person picks up a shape from the board and feels it with both hands. If the test subject is sighted, they are then shown a poster with drawings of the 10 shapes, each labelled with a number, and the test subject states the number of the shape they believe they are holding in their hands. They then place the shape at the side of the box – in one of the furrows next to the board ("the ditch"). If the test subject states the wrong number, they are asked to describe the form of the shape to be sure that they have had a chance to understand its form.

If the test person is severely sight impaired, they are asked instead to describe the form of the shape to be sure that they have had the chance to understand its form.

When the introduction is over, the tester puts all the shapes in their place in the furrow on the right-hand and left-hand side of the box in the same order each time (without revealing to the test subject that they are in the same order): two shapes stacked on top of one another, a single shape and again two shapes on top of one another on the right-hand side, and the same on the left-hand side. The test subject is then instructed to fit all the shapes into their respective moulds as speedily as they can, though not so hastily that there is a risk of confusion.

The test subject is advised to remove a shape from the board and place it in the furrow if they give up trying to find the matching mould, in order to avoid cluttering the board.

In addition to the eight test results from the repeat tries, the NVO Box™ test is supplemented by two sub-tests from Wechsler Adult Intelligence Scale (WAIS IV) (Similarities and Matrices) as part of the validation procedure. The two sub-tests are conducted in the break after the first two tries with the NVO-Box™ test.

Scoring principles

The individual person's test results are assessed in two stages:

Step 1 The results are assessed on the basis of the standards established for the first four tries based on the performances of the 41 test subjects.

The test subject first performs the test by completing four identical tries – with a break between the second and third try. Because of the potential learning effect from the first try, the test subject can be expected to spend a shorter time on the second try. Sometimes slightly more time is expected for the third try after the break, where the test subject needs to reactivate what they have learned, and then a shorter time for the fourth try.

Since the conditions for the first four tries remain the same, these four tries present an opportunity for a straightforward learning sequence, making it interesting to observe how

the results for the individual test subjects are with regard to the mean values for the respective tries. Particular attention is paid to the second and fourth tries.

Step 2 The results of the last four tries are assessed based on whether the times for each of the tries produce a good learning curve. With the last four tries the ratings change, especially for both the fifth and the seventh try because the position of the board changes, as mentioned earlier.

The test subject is expected to spend more time on the fifth and seventh tries. Particular attention is paid to whether the times for the sixth and eighth tries are low – corresponding to the average times or less.

Assessment of time profiles

The main principle for the scoring is that a try is good if it is completed within the average length of time or less.

The red lines in the graphs in figure 1 showing the times delimit the average times (first try: 204"; second try: 110"; fourth try 4: 85"; sixth try: 98" and eighth try: 76").

A slight increase is expected in the time for the third try, which is after the break. Correspondingly a higher time is expected for the fifth and seventh tries as a result of the altered position of the board.

General assessment

Times for first try:

a. **Good:** Close to average time (204 sec.)
b. **Very good:** Below the average (i.e. under 204 sec.)
c. **High:** (about 300 sec.)
d. **Very high:** (over 300 sec.)

Other ratings:

Very competent performance: Very good first try, and times for all other tries are average or less.

Good performance: All tries are average or less, except for the time for the first try, which may be high.

Poor performance: All times are consistently higher than the average.

Extremely poor performance: Times are so high that the test has to be aborted so as not to frustrate the test subject.

Ambiguous performance: When there is a big discrepancy between the results in step 1 and step 2. For example, a good performance in the second try and a poor performance in the fourth try, or vice versa. Or, for example, a good performance in the sixth try and a poor performance in the eighth try, or vice versa.

Ambiguous: It is possible that the test subject could quietly master this type of challenge with a little more practice.

Importance is attached to the following times: first, second, fourth (step 1 of the test) and sixth and eighth (step 2 of the test).

Results I

Two groups of people were tested with a view to establishing standards for the test:

1. A 10th grade class with 23 pupils at a tenth-grade centre in Gladsaxe.
2. 18 test subjects from Teknisk Skole Metal on Tuborgvej in Copenhagen.

The test subjects received a small CD gift voucher as a token of appreciation for their participation.

The fact that all 23 pupils in the 10th grade volunteered for the task and that none of the pupils at Technical School Metal was absent on the testing days showed that the level of motivation was high. Table 1 shows the underlying data for these test assessments.

Table 1. Underlying data, average times in seconds and standard deviations for the eight tries

		Oplægnings nr.								WAIS	WAIS
Skole	Elev	1	2	3	4	5	6	7	8	Ligheder	Matricer
G	1	205	56	79	54	115	86	71	64	15	22
G	2	126	129	105	103	102	116	105	83	22	23
G	3	302	119	145	142	86	132	141	82	20	18
G	4	138	113	119	51	146	135	61	97	24	20
G	5	310	125	165	105	156	95	127	101	21	19
G	6	105	54	51	40	49	57	51	43	15	24
G	7	137	86	111	76	97	82	161	122	18	20
G	8	329	156	103	200	229	210	-	-	17	19
G	9	202	59	39	28	60	35	35	51	13	16
G	10	180	80	64	69	84	65	55	44	20	21
G	11	114	54	76	45	46	45	55	65	22	20
G	12	98	43	36	29	42	41	49	32	20	22
G	13	288	188	244	119	301	198	218	119	11	14
G	14	210	259	153	146	154	152	169	171	14	17
G	15	154	66	78	58	69	54	72	50	16	19
G	16	245	144	245	121	137	132	180	91	22	19
G	17	492	205	141	284	264	223	242	80	17	16
G	18	202	157	120	98	89	118	135	181	24	17
G	19	147	66	107	99	73	91	77	42	14	20
G	20	104	61	69	58	87	81	124	52	17	15
G	21	271	108	95	41	69	48	47	44	19	21
G	22	134	131	151	69	152	117	185	138	14	17
G	23	151	78	64	66	93	66	72	55	17	20
T	1	145	110	148	116	98	78	95	81	16	19
T	2	103	47	47	34	53	33	43	32	19	19
T	3	212	125	90	82	95	169	82	66	19	20
T	4	109	144	66	46	75	72	74	50	26	19
T	5	589	159	283	195	179	261	-	-	26	23
T	6	107	80	53	36	44	60	40	34	23	21
T	7	221	157	148	146	339	135	139	135	19	16
T	8	105	109	119	65	83	53	83	65	17	22
T	9	261	89	67	38	57	46	120	95	23	20
T	10	281	110	240	88	104	124	113	62	22	23
T	11	190	139	123	83	182	85	120	82	16	20
T	12	178	109	142	68	105	76	74	69	18	20
T	13	140	85	74	47	66	59	55	49	28	23
T	14	138	56	43	39	57	43	73	44	27	22
T	15	94	58	73	49	85	67	93	61	20	23
T	16	133	92	46	31	63	80	78	46	14	24
T	17	392	136	101	138	118	100	89	50	20	22
T	18	337	153	97	85	204	116	108	120	17	20
Gennemsnit		204	110	110	85	115	98	100	76		
Standardafvigelse		110	47	60	54	70	54	50	37		

Gennemsnit = average times in seconds

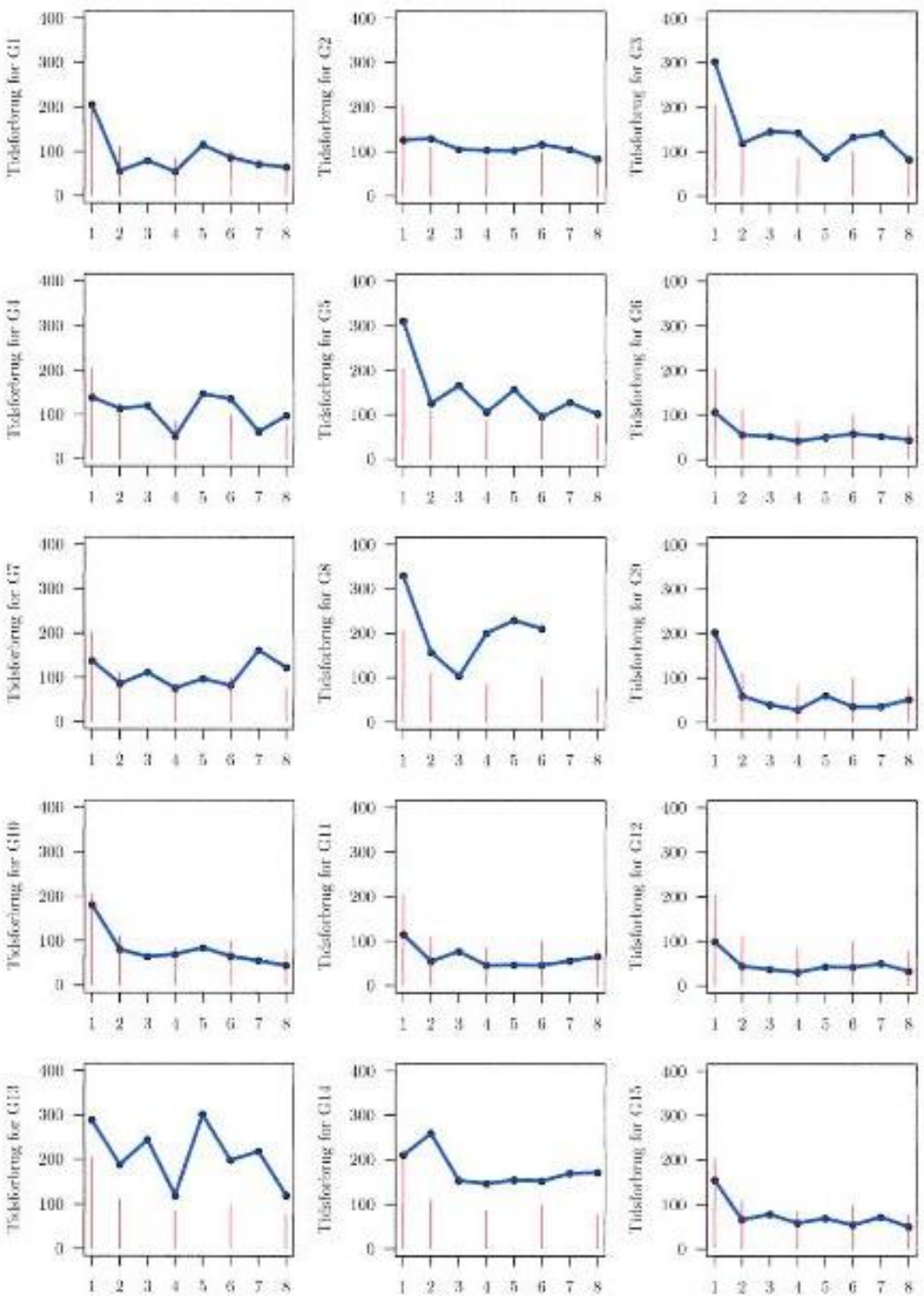
Standardsafvigelse: standard deviation

Times and tries for 10th graders in Gladsaxe and Technical School Metal pupils

Figure 1a): Gladsaxe 10th graders (G): G1 – G23.

y-axis: The average time in seconds for all students. x-axis: the 8 trials.

OBS Note the red lines in the graphs in figure 1a showing the times delimit the average times for all students.



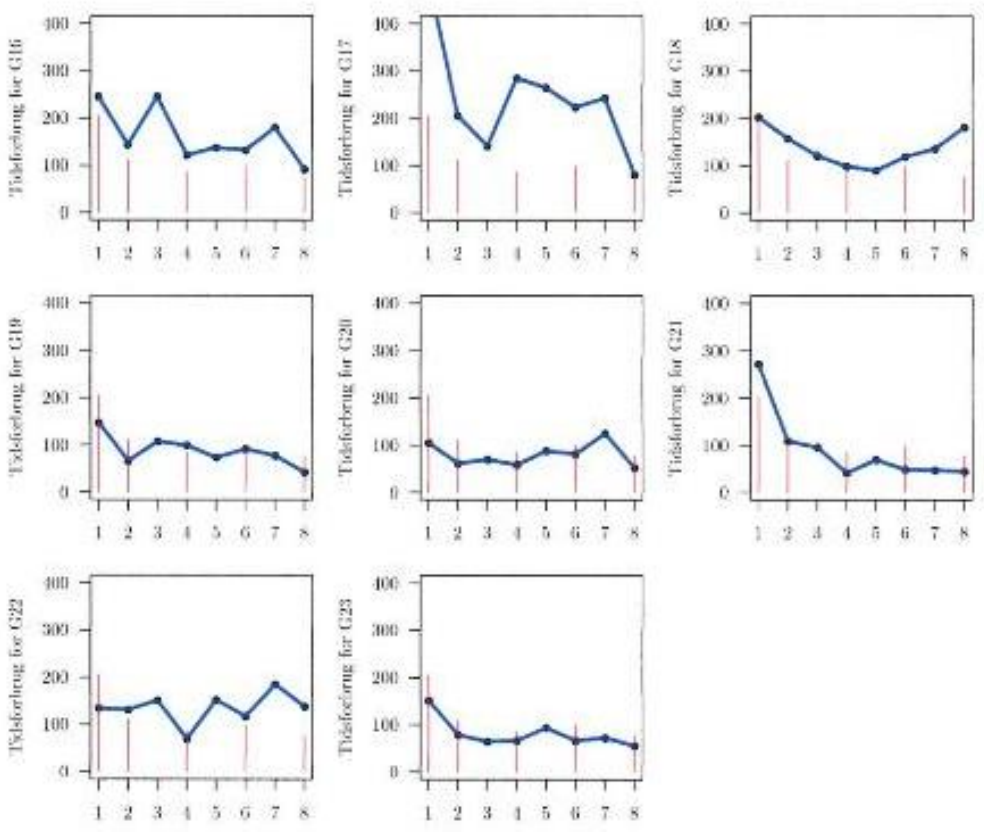
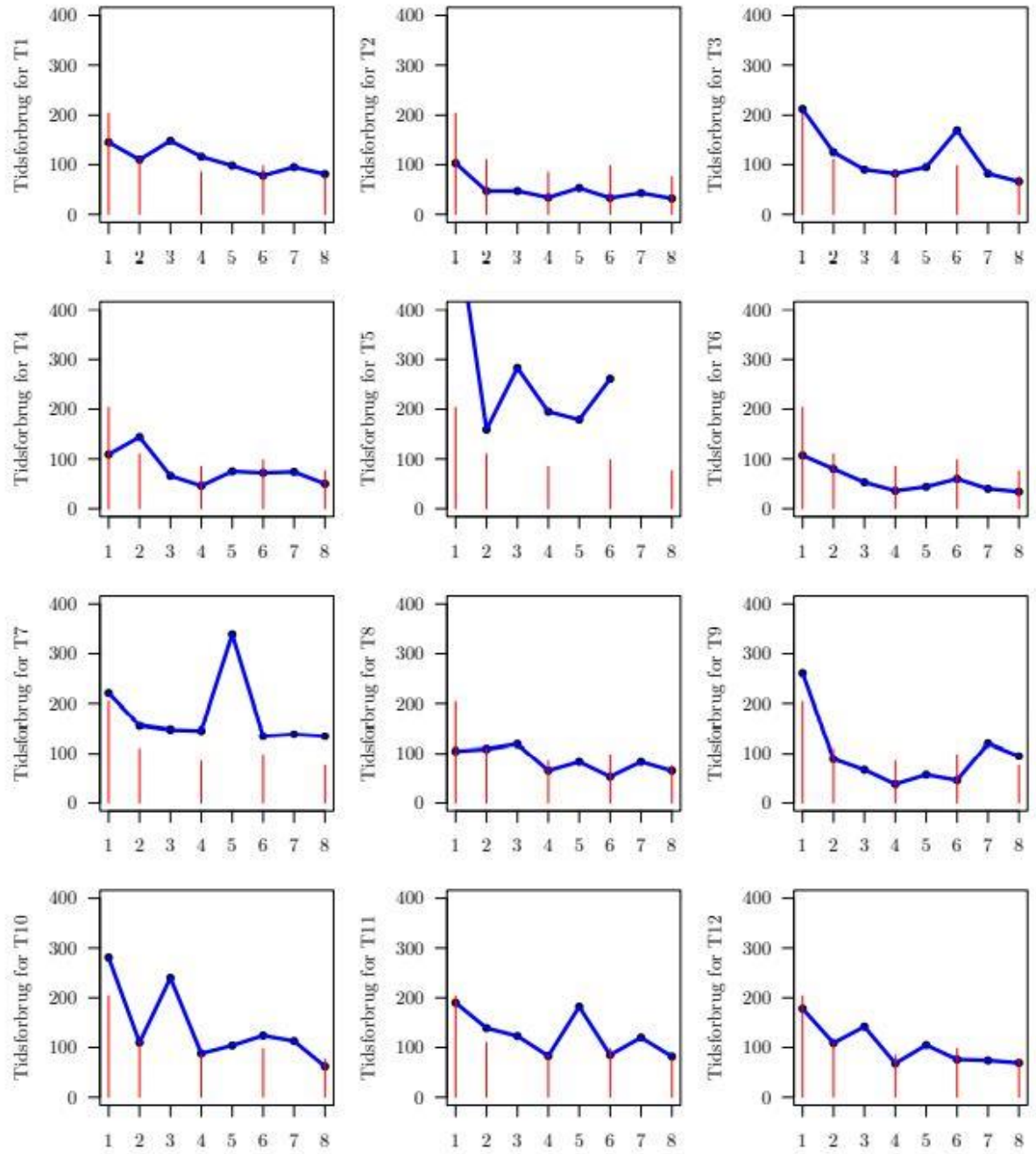
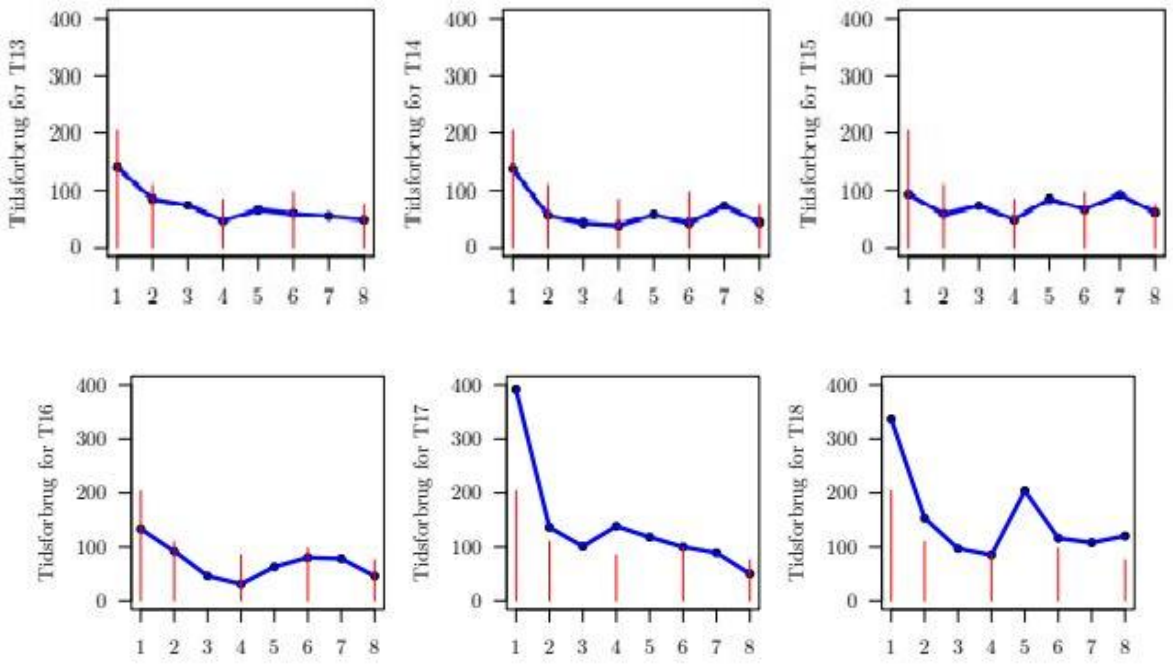

Tidsforbrug for G16
Tidsforbrug for G17
Tidsforbrug for G18
Tidsforbrug for G19
Tidsforbrug for G20
Tidsforbrug for G21
Tidsforbrug for G22
Tidsforbrug for G23
0
100
200
300
400
1 2 3 4 5 6 7 8

Figure 1b): Technical School Metal (T) pupils T1 - T18

y-axis: The average time in seconds for all students. x-axis: the 8 trials.

OBS Note the red lines in the graphs in figure 1b showing the times delimit the average times for all students.




Tidsforbrug for T13
Tidsforbrug for T14
Tidsforbrug for T15
Tidsforbrug for T16
Tidsforbrug for T17
Tidsforbrug for T18
0
100
200
300
400
1 2 3 4 5 6 7 8

Correlation between performance on the NVO Box™ test and the result for WAIS Similarities and for WAIS Matrices

Table 2 presents Pearson's correlations between times for the individual tries, WAIS Similarities and WAIS Matrices. The raw WAIS scores are used.

Table 2): **Pearson's correlation coefficient. The numbers in parentheses are the p-value for a test for no correlation**

Oplægning	Ligheder	Matricer
1	0,06 (0,700)	-0,13 (0,407)
2	-0,09 (0,586)	-0,42 (0,007)
3	0,01 (0,966)	-0,22 (0,167)
4	-0,08 (0,601)	-0,33 (0,033)
5	-0,25 (0,112)	-0,49 (0,001)
6	-0,05 (0,762)	-0,28 (0,072)
7	-0,25 (0,128)	-0,58 (0,000)
8	-0,12 (0,468)	-0,51 (0,001)
1, 2, 3, 4	-0,01 (0,968)	-0,28 (0,076)
1, 2, . . ., 8	-0,06 (0,725)	-0,35 (0,024)

OBS Note that it is essential that the commas in the table be changed to decimals. Though not the commas between the number of tries.

Pearson's correlation coefficient between the time for the first try and WAIS Similarities is 0.06. A test for no correlation between the time for the first try and WAIS Similarities calculates a non-significant *p*-value of 0.700. The general picture is that the correlation between the time spent on the individual tries and WAIS Similarities is insignificant, which means there is no correlation.

The situation is different when it comes to the correlation between times for the individual tries and the WAIS Matrices. Here we can see that there is generally a significant negative correlation between the times for the individual tries and the WAIS Matrices, especially for the fifth, seventh and eighth tries. Figure 2 illustrates the correlation between the times for the seventh try and the WAIS Matrices. Pearson's correlation coefficient is -0.58.

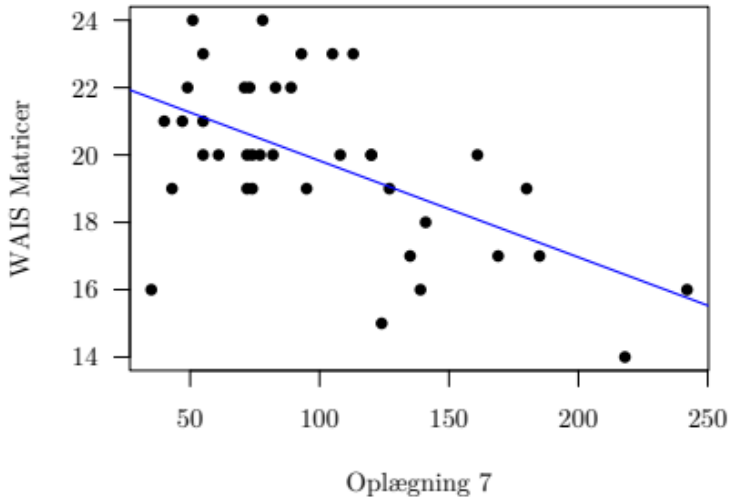


Figure 2): **Correlation between times for the seventh try and the WAIS Matrices**

Results for step 1

With the first try the test subject is in an unfamiliar and perhaps confusing situation, and the result for this try can be expected to vary greatly from person to person (average time 204 seconds and standard deviation (SD) 110). With the second try most test subjects have gathered some solid experience to build on, and this is reflected in the numbers (average time 110 seconds and SD 47). The third try takes place after a break of about 20 minutes, during which the test subject does other things, which is why we can expect some people to spend a little longer on this try (average time 110 seconds and SD 60). Finally, we can expect what has been learned to be well established by the fourth try (average time 85 seconds and SD 54).

Results for step 2

With step 2 the board is first turned (fifth try) by 180 degrees horizontally, which can be expected to be a challenge for most people. With the sixth try, some of the control is regained and the average time is 98 seconds (SD 54), and with the eighth and last try after the board has been turned 180 degrees vertically (seventh try), the average time is 76 seconds (SD 37).

Table 3 shows a list of combinations of step 1 and step 2, and how they can be intuitively combined in one grade level.

Combinations of step 1 and step 2

Step 1	+ Step 2	Combined
ambiguous	poor	poor
ambiguous	good	good
ambiguous	very competent	good
ambiguous	ambiguous	poor
poor	ambiguous	poor
poor	good	ambiguous
poor	very competent	ambiguous
poor	poor	poor
poor	extremely poor	extremely poor
very competent	ambiguous	good
very competent	good	good
very competent	very competent	very competent
good	ambiguous	ambiguous
good	good	good
good	very competent	very competent
good	poor	ambiguous

Table 3): **List of combinations of step 1 and step 2, and how they can be intuitively combined in one grade level**

Figur 3): **Overall results for Gladsaxe (G): 10th graders**

G1.

Step 1: Good first try; good second and fourth try

Result: Good performance

Step 2: Good sixth and eighth try

Result: Good performance

Overall result: Good performance

G2.

Step 1: Very good first try; poor second and fourth try

Result: Poor performance

Step 2: Poor sixth and eighth try

Result: Poor performance

Overall result: Poor performance (generally on the high side with regard to time spent)

G3.

Step 1: Very high time for first try; poor second and fourth try

Result: Poor performance

Step 2: Poor sixth and eighth try

Result: Poor performance

Overall result: Poor performance (performance near the general performance)

G4.

Step 1: Very good first try; good second and fourth try

Result: Good performance

Step 2: Poor sixth and eighth try

Result: Poor performance

Overall result: Ambiguous performance

G5.

Step 1: Very high time for first try; poor second and fourth try

Result: Poor performance

Step 2: Good time for the sixth try; poor time for eighth try

Result: Ambiguous performance

Overall result: Poor performance

G6.

Step 1: Very good first, second and fourth try (all times below average)

Result: Very competent performance

Step 2: Very good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

G7.

Step 1: Good first, second and fourth try

Result: Good performance

Step 2: Good sixth try; poor eighth try

Result: Ambiguous performance

Overall result: Ambiguous performance

G8.

Step 1: High time for first try (5-6 minutes); poor second and fourth try

Result: Poor performance

Step 2: Test stopped after the sixth try

Result: Extremely poor performance

Overall assessment: Extremely poor performance

G9.

Step 1: Good first try; very good second and fourth try (all times below average)

Result: Very competent performance

Step 2: Very good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

G10.

Step 1: Good first try; very good second and fourth try (all times below average)

Result: Very competent performance

Step 2: Very good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

G11.

Step 1: Very good first, second and fourth try (all times below average)

Result: Very competent performance

Step 2: Very good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

G12.

Step 1: Very good first, second and fourth try (all times below average)

Result: Very competent performance

Step 2: Very good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

G13.

Step 1: Very high time for first try; poor second and fourth try (no times below average)

Result: Poor performance

Step 2: Poor sixth and eighth try (no times below average)

Result: Poor performance

Overall result: Poor performance

G14.

Step 1: Good first try; poor second and fourth try (no time below average)

Result: Poor performance

Step 2: Poor sixth and eighth try (no times below average)

Result: Poor performance

Overall result: Poor performance

G15.

Step 1: Good first try; very good second and fourth try (all times below average)

Result: Very competent performance

Step 2: Very good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

G16.

Step 1: High time for first try; poor second and fourth try (all times worse than average)

Result: Poor performance

Step 2: Poor sixth and eighth try (no times below average)

Result: Poor performance

Overall result: Poor performance

G17.

Step 1: Very high time for first try (8 minutes); poor second and fourth try (all times worse than average)

Result: Poor performance

Step 2: Poor sixth and eighth try (no times below average)

Result: Poor performance

Overall result: Poor performance

G18.

Step 1: Good first try; poor second and fourth try

Result: Poor performance

Step 2: Poor sixth and eighth try

Result: Poor performance

Overall result: Poor performance

G19.

Step 1: Good first try; very good second try; poor fourth try

Result: Ambiguous performance

Step 2: Good sixth and eighth try (all times better than average)

Result: Good performance

Overall result: Good performance

G20.

Step 1: Very good first try; very good second and fourth try

Result: Very competent performance

Step 2: Good sixth and eighth try

Result: Good performance

Overall result: Good performance

G21.

Step 1: Very high time for first try; good second and fourth try

Result: Good performance

Step 2: Good sixth and eighth try (all times better than average)

Result: Very competent performance

Overall result: Very competent performance

G22.

Step 1: Good first try; poor second try; good fourth try

Result: Ambiguous performance

Step 2: Poor sixth and eighth try (all times worse than average)

Result: Poor performance

Overall result: Poor performance

G23.

Step 1: Good first try; very good second and fourth try (all times below average)

Result: Very competent performance

Step 2: Good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

Figure 4): **Overall results for Technical School Metal (T) pupils**

T1.

Step 1: Good first try and second try; poor fourth try

Result: Ambiguous performance

Step 2: Good sixth try; poor eighth try

Result: Ambiguous performance

Overall result: Ambiguous performance

T2.

Step 1: Very good first, second and fourth try (all times below average)

Result: Very competent performance

Step 2: Good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

T3.

Step 1: High time for first try; poor second try; good fourth try

Result: Ambiguous performance

Step 2: Poor sixth try; good eighth try

Result: Ambiguous performance

Overall result: Poor performance

T4.

Step 1: Very good first try; poor second try; good fourth try

Result: Ambiguous performance

Step 2: Good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Good performance

T5.

Step 1: Very high time for first try (9-10 minutes); poor second and fourth try

Result: Poor performance

Step 2: Poor fifth and sixth try (task not mastered and not completed)

Result: Extremely poor performance

Overall result: Extremely poor performance

T6.

Step 1: Very good first and second try; very good time for fourth try (all times better than average)

Result: Very competent performance

Step 2: Good sixth and eighth try (all times better than average)

Result: Very competent performance

Overall result: Very competent performance

T7.

Step 1: Good first try; poor second and fourth try

Result: Poor performance

Step 2: Poor sixth try; very high time for fifth try; poor eighth try (no times better than average)

Result: Extremely poor performance

Overall result: Extremely poor performance

T8.

Step 1: Very good first, second and fourth try

Result: Good performance

Step 2: Good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

T9.

Step 1: High time for first try; very good second and fourth try

Result: Good performance

Step 2: Good time for sixth try; poor time for eighth try

Result: Ambiguous performance

Overall result: Ambiguous performance

T10.

Step 1: High time for first try; good second try; poor fourth try

Result: Ambiguous performance

Step 2: Poor sixth try; good eighth try

Result: Ambiguous performance

Overall result: Poor performance

T11.

Step 1: Good first try; poor second try; good fourth try

Result: Ambiguous performance

Step 2: Good sixth try; poor eighth try

Result: Ambiguous performance

Overall result: Poor performance

T12.

Step 1: Good first, second and fourth try

Result: Good performance

Step 2: Good sixth and eighth try (all times are below average)

Result: Very competent performance

Overall result: Very competent performance

T13.

Step 1: Good first try; very good second and fourth try (all times below average)

Result: Very competent performance

Step 2: Good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

T14.

Step 1: Good first try; very good second and fourth try (all times below average)

Result: Very competent performance

Step 2: Good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

T15.

Step 1: Very good first try; very good second and fourth try (all times below average)

Result: Very competent performance

Step 2: Good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

T16.

Step 1: Good first try; very good second and fourth try (all times below average)

Result: Very competent performance

Step 2: Good sixth and eighth try (all times below average)

Result: Very competent performance

Overall result: Very competent performance

T17.

Step 1: Very high time for first try (6-7 minutes); poor time for second and fourth try

Result: Poor performance

Step 2: Poor time for the sixth try; good time for the eighth try

Result: Ambiguous performance

Overall result: Poor performance

T18.

Step 1: High time for first try (5-6 minutes); poor second try; good fourth try

Result: Ambiguous performance

Step 2: Poor time for the sixth and eighth try

Result: Poor performance

Overall result: Poor performance

Results II

Gender, Age, Scores and School

Table 4) shows the underlying data for these relations.

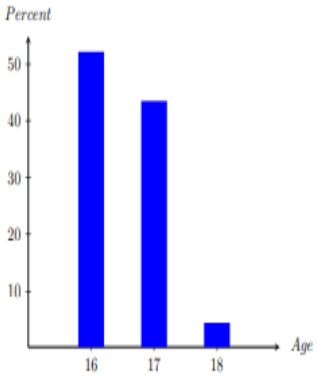
School	Pupil	Gender	Age	Score	*p*-percentile
G	1	2	16	4	0,343
G	2	2	16	3	0,031
G	3	2	16	3	0,031
G	4	1	17	2	−0,951
G	5	1	17	3	0,031
G	6	2	17	5	1,343
G	7	2	16	2	−0,951
G	8	1	16	1	−1,452
G	9	2	16	4	0,343
G	10	1	17	5	1,343
G	11	2	17	5	1,343
G	12	1	17	5	1,343
G	13	2	16	3	0,031
G	14	2	16	3	0,031
G	15	2	16	5	1,343
G	16	1	17	3	0,031
G	17	2	17	3	0,031
G	18	1	18	3	0,031
G	19	2	17	4	0,343
G	20	2	17	5	1,343
G	21	1	16	4	0,343
G	22	2	16	3	0,031
G	23	2	16	5	1,343
T	1	1	18	2	−0,951
T	2	1	20	5	1,343
T	3	1	19	3	0,031
T	4	1	22	4	0,343
T	5	1	41	1	−1,452
T	6	1	26	5	1,343
T	7	1	34	1	−1,452
T	8	1	21	5	1,343
T	9	1	27	2	−0,951
T	10	1	17	3	0,031
T	11	1	18	3	0,031
T	12	1	21	5	1,343
T	13	1	19	5	1,343
T	14	1	19	5	1,343
T	15	1	22	5	1,343
T	16	1	19	5	1,343
T	17	1	39	3	0,031
T	18	1	23	3	0,031

Table 4): **The underlying data. Ratings: score 1 = Extremely poor performance, score 2 = Ambiguous performance, score 3 = Poor performance, score 4 = Good performance, score 5 = Very competent performance.**

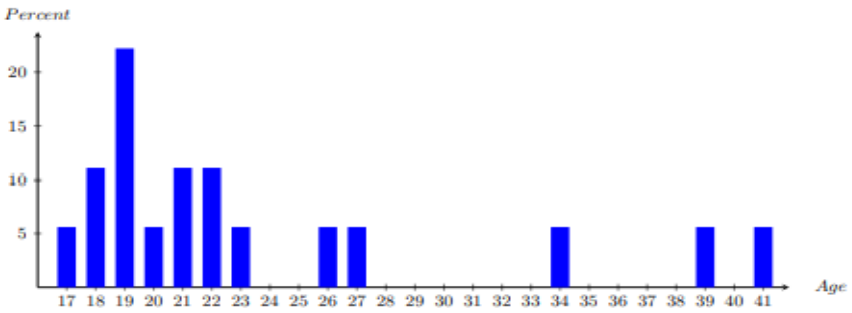
AGE

School	Age	Frequency	Percent
G	16	10	52.2
G	17	12	43.5
G	18	1	4.4
T	17	1	5.6
T	18	2	11.1
T	19	4	22.2
T	20	1	5.6
T	21	2	11.1
T	22	2	11.1
T	23	1	5.6
T	26	1	5.6
T	27	1	5.6
T	34	1	5.6
T	39	1	5.6
T	41	1	5.6

Table 5): **The age distribution by school**



Figur 5): **The age distribution at school G**



Figur 6): **The age distribution at school T**

SCHOOL

School	Frequency	Percent
G	23	56.1
T	18	43.9

	Score					
School	1	2	3	4	5	Count
G	4.4%	8.7%	39.1%	17.4%	30.4%	23
T	11.1%	11.1%	27.8%	5.6%	44.4%	15

Table 6): **The grade distribution among students at school G and T**

OBS It should be noted that the grade scores: 1, 2,3, 4 and 5 were not used in the statistical analyses. The grade score was transformed into a cumulative percentile in a normal distribution.

The grade distribution among students at school G and T is not significantly different.

GENDER

School	Gender	Frequency	Percent
G	Woman	15	65.2
G	Man	8	34.8
T	Woman	0	-
T	Man	18	100

Table 7): **The gender distribution in the two schools**

	Score					
Gender	1	2	3	4	5	Count
Woman	-	6.7%	40.0%	20.0%	33.3%	15
Man	12.5%	12.5%	37.5%	12.5%	25.0%	8

Table 8): **The grade distribution among men and women**

The grade distribution among men and women at school G and T is not significantly different.

Discussion

15 of the test subjects were rated as very competent (37%). This group clearly managed the challenges without any obvious difficulty – assessed according to the average times of the entire group.

17 test subjects, or 41%, completely failed with results far below average – three people had such difficulty that they were unable to complete the test.

Furthermore one group (n=5) was good without being outstanding and another group (n=4) was not clear-cut (ambiguous).

The grade distribution among students at school G and T was not significantly different. The grade distribution among men and women at school G and T was not significantly different.

In terms of age, there was a moderately significant correlation at school T between grade and age. The older the student the lower the grades. At school G, no such correlation existed.

If you approach the test in terms of the first two groups mentioned, where the result was either very competent or extremely poor, the test can be looked at as a pass/fail test; here the test results demonstrate, almost without any need for calculations, that some people manage these types of tasks particularly well and others equally badly, presumably because they have difficulty with spatial challenges when they cannot use their vision to make corrections. One group is strikingly good while the other is strikingly bad.

The task requires imagination skills, and we can assume that the stability of these imagination skills is a prerequisite for the learning effect to continue after the changes. “Spatial visualization ability can be defined as the cognitive ability to understand, mentally encode and manipulate three-dimensional visuo-spatial forms. Component processes of spatial visualization include encoding a visuo-spatial stimulus, constructing a visual-spatial image form perceptual input, mentally rotating an image, switching one´s view perspective, and comparing a visual stimulus in working memory (Cohen, C. A, & Hegarty, M. (2007))”. In addition to innate factors, the stability of the learning will presumably depend on whether the learning has been acquired via a narrow learning process with limited environmental factors (vulnerable learning) or if it has been acquired in a complex field with large variation (robust learning) (jvn.f. Thomas Nissen: Indlæring og pædagogik. Copenhagen, Munksgaard, 1970). Step 1 of the NVO Box™ test is not an especially strictly controlled process, but nonetheless more so than step 2.

The results showed that there was no correlation between the scores in the NVO Box™ test and the Similarity test (WAIS- IV), but, on the contrary, a moderate correlation between the NVO Box™ test and Matrices (WAIS-IV). This fits in with the fact that some young people attained exceptionally good results in this test despite a poor academic record at school.

Perspectives

The test is a suitable tool to assess whether the test subject has problems with spatial orientation.

It can be used, for example, to help ascertain if a person suffering from loss of vision and blindness has fundamental problems with spatial orientation, which they previously compensated for with their sight, and therefore now has problems managing independently. Some people with recently occurring blindness will for this reason have trouble learning to find their way around their own home or at a course venue. Thus, the test is a relevant tool for teachers training the visually impaired in mobility and activities of daily living.

The test can furthermore reveal the extent to which someone with sight impairment and brain damage has competences that point to good practical skills. Practical skills are typically overlooked in normal intelligence tests, even though it can be important to know about these skills to determine the best kind of occupation for that person in the future.

Finally, the test is encouraging for young people who achieve very good results in the test despite having a poor academic record. Our impression is that success in this test, by virtue of its natural, concrete character, would be more convincing for an 18-year-old pupil than a top performance in WAIS IV Matrices.

References

The list is being drawn up.

Cohen, C. A, & Hegarty, M. (2007). Sources of Difficulty in Imagining Cross Sections of 3D Objects. *Proceedings of the Annual Meeting of the Cognitive Science Society*, 29. Retrieved from https://escholarship.org/uc/item/98p7t49b

Thomas Nissen: Indlæring og pædagogik. Copenhagen, Munksgaard, 1970.

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