

NSUCO OCULOMOTOR TEST

Purpose: To assess the quality of both saccadic and pursuit eye movements.

Indications: Allows clinician to provide a quick, inexpensive analysis of the patients eye movements with minimal patient cooperation.

Apparatus and Setup: Two small (approximately 1/2 cm in diameter) colored, reflective spheres (balls) mounted on dowel sticks. One target is used for pursuits, two for saccades. For those unwilling or unable to be tested with the colored ball targets, use animated toy targets on pencils (one for pursuits, two for saccades).

Time Required: Minimal time is required, under two minutes.

In an effort to maintain test validity and reliability, the following administration and scoring instructions are adapted directly from the test manual for the NSUCO Oculomotor Test. Proper use of the test and norming of results requires the purchase of the NSUCO Oculomotor Test and adherence to the protocol listed in the test manual.

Preset (Administration):

The protocol for proper administration is given as shown in the NSUCO Oculomotor Test manual written by W. C. Maples, O.D.

I. Posture:

The patient stands with feet a shoulder-width apart, arms hanging naturally at their side, directly in front of the examiner.

II. Head:

Do not give instructions on head movement. Scoring of the test is based on whether or not the patient chooses to use their head for assistance.

III. Target characteristics:

As seen above in "Apparatus and Setup".

IV. Movement of the target:

A. Directional:

1. Saccades are performed in the horizontal meridian only (five round trips).
2. Pursuits are performed rotationally, both clockwise (two rotations) and counterclockwise (two rotations).

B. Extent:

1. Saccade extent should be no more than 10 cm on each side of the patient's mid-line (20 cm total).
2. Pursuit path should be no more than 20 cm in diameter. The upper and lower extent of the circular path should coincide with the patient's mid-line.

V. Test distance from the patient:

Testing is done no more than 40 cm and no less than the Harmon distance, i.e., the distance from the subject's middle knuckle to his elbow.

VI. Ocular condition:

Testing is done binocularly.

VII. Age of the patient:

The manual states that the test can be performed on anyone two years old to adult, however, the norms are calculated for 5 years old to 14 years old and above.

VIII. Instructions:

A. Saccades:

"When I say red, look at the red ball (dog toy). When I say green, look at the green ball (dinosaur toy). Remember, don't look until I tell you to."

B. Pursuits:

"Watch the ball (dog) as it goes around. Try to see yourself in the ball (watch the dog's eyes). Don't ever take your eyes off the ball (dog)."

Scoring:

The scoring of the NSUCO involves giving point values to the observations made by the clinician. The clinician will score the test for both the pursuits and saccades based on the same four factors: ability, accuracy, head movement and body movement. The manual stresses the point that the clinician should be cautioned: DO NOT ATTEMPT at first to record the performance on this by recording the number that is associated with the observed performance. Instead, record the observed performance in written form and assign numerical values later. There are two types of observations to be scored: qualitative (based on the clinician's qualitative judgment of performance) and quantitative (requires the clinician to count the number of times that he/she observes a particular type of behavior).

Qualitative Testing: The five qualitative aspects to be graded include:

1. Head movement of pursuits
2. Head movement of saccades
3. Body movement of pursuits
4. Body movement of saccades
5. Accuracy of saccades (amount of over and undershooting)

Based on a five point scale (five being the highest and one the lowest), the clinician makes an assessment as to how much of the time the patient showed motor overload type behaviors.

Quantitative Testing: There are three aspects to be counted:

1. Pursuit ability (the number of rotations made on pursuits)
2. Saccadic ability (the number of successful round trips made on saccades)
3. Accuracy of pursuits (the number of target losses or refixations on pursuits)

Once again, the scoring is based on a five point scale with five being the highest. The ability of pursuits is judged by the number of rotations the patient can complete without losing attention. The manual cautions that "it should be emphasized that if the subject loses fixation, but then spontaneously recovers, this is not considered to be a loss of ability or attention", but instead will be "scored as an accuracy factor".¹ (41) The saccadic ability is assessed by counting the number of successful round trips completed before total loss of attention is observed.

The NSUCO Method of Scoring Saccades and Pursuits Ability:

Qualitative Testing:

HEAD AND BODY MOVEMENTS

1. Large movement of the head (body) at any time
2. Moderate movement of the head (body) at any time
3. Consistent slight movement of the head (body) (greater than 50% of the time)
4. Intermittent slight movement of the head (body) (less than 50% of the time)
5. No movement of the head (body)

Quantitative Testing:

SACCADE ABILITY

1. Completes less than two round trips
2. Completes two round trips
3. Completes three round trips
4. Completes four round trips
5. Completes five round trips

PURSUIT ABILITY

1. Cannot complete 1/2 rotation in either the clockwise or counterclockwise direction
2. Completes 1/2 rotation in either direction
3. Completes one rotation in either direction but not two rotations
4. Completes two rotations in one direction but less than two rotations in the other direction
5. Completes two rotations in each direction

SACCADE ACCURACY

1. Large over- or undershooting is noted one or more times
2. Moderate over- or undershooting noted one or more times
3. Constant slight over- or undershooting noted (greater than 50% of the time)
4. Intermittent slight over- or undershooting noted (less than 50% of the time)
5. No over- or undershooting noted

PURSUIT ACCURACY

1. Refixations more than 10 times
2. Refixations five to 10 times
3. Refixations three or four times
4. Refixations two times or less
5. No refixations

When finished scoring, the examiner can compare their results to the norms established by Maples over a number of years on school screenings with a total of 1,714 children (878 males, 836 females). The norms are established for children 5 to 14 years old. Maples determined the minimal acceptable scores by age and sex for both saccades and pursuits (listed below in the following two tables). Failure of the NSUCO Oculomotor Test occurs when the child scores below these values for their sex and age group.

NSUCO SACCADE TEST Minimal Acceptable Score by Age and Sex

AGE	ABILITY		ACCURACY		HEAD MVMNT		BODY MVMNT	
	Male	Female	Male	Female	Male	Female	Male	Female
5	5	5	3	3	2	2	3	4
6	5	5	3	3	2	3	3	4
7	5	5	3	3	3	3	3	4
8	5	5	3	3	3	3	4	4
9	5	5	3	3	3	3	4	4
10	5	5	3	3	3	4	4	4
11	5	5	3	3	3	4	4	5
12	5	5	3	3	3	4	4	5
13	5	5	3	3	3	4	5	5
14=>	5	5	4	3	3	4	5	5

NSUCO PURSUIT TEST Minimal Acceptable Score by Age and Sex

AGE	ABILITY		ACCURACY		HEAD MVMNT		BODY MVMNT	
	Male	Female	Male	Female	Male	Female	Male	Female
5	4	5	2	3	2	3	3	4
6	4	5	2	3	2	3	3	4
7	5	5	3	3	3	3	3	4
8	5	5	3	3	3	3	4	4
9	5	5	3	4	3	3	4	4
10	5	5	4	4	4	4	4	5
11	5	5	4	4	4	4	4	5
12	5	5	4	4	4	4	5	5
13	5	5	4	4	4	4	5	5
14=>	5	5	5	4	4	4	5	5

Critique: The NSUCO Oculomotor Test appears to be a reliable, inexpensive, and quick diagnostic test of oculomotor skills. The test also appears to demonstrate good predictive validity of children's reading skills.

Three types of reliability were tested on the NSUCO Oculomotor Test: test-retest reliability (subject performance reliability), intrarater reliability (observer reliability based on how consistent the same observer scores the subject's behavior on two different occasions), and interrater reliability (observer reliability based on how closely the two clinicians grade the same behavior). The NSUCO Oculomotor Test demonstrated acceptable test-retest, inter- and intrarater reliability. Due to the use of ordinal level data, they used the Wilcoxon Matched Pairs Signed-Rank Test to calculate the reliability of their data. The Wilcoxon takes into account the magnitude of difference between the two

ranked scores if they were not identical. However, for their statistical analysis, they only considered exact agreement as agreement.

The average intra-rater reliability findings also demonstrated good reliability values for both the quantitative and qualitative scores on pursuits and saccades. The reliability values for the four variables tested with pursuits: “ability” showed 95%, “accuracy” showed 90%, “head movement” showed 76%, while “body movement” showed 100% reliability. The four variables tested with saccades: “ability” showed 90%, “accuracy” showed 62%, “head movement” showed 86%, and “body movement” showed 95% intra-rater reliability.

The average inter-rater reliability findings demonstrated good reliability values for both the quantitative and qualitative scores on pursuits and saccades. The inter-rater reliability values for the four variables tested with pursuits: “ability” showed 88.1%, “accuracy” showed 68.6%, “head movement” showed 63.7%, while “body movement” showed 73.5% reliability. The four variables tested with saccades: “ability” showed 98.0%, “accuracy” showed 55.5%, “head movement” showed 68.4%, and “body movement” showed 78.2% inter-rater reliability.

The test-retest reliability findings for the NSUCO Oculomotor test showed that although the child did not perform exactly the same, their differences were not statistically significant between testing. Only "head movements" on the saccade subtest showed a statistically significant improvement in skills. The test-retest reliability values for the four variables tested with pursuits include: “ability” showed 97.9% agreement, “accuracy” showed 64.9% exact agreement, “head movement” showed 56.7% exact agreement (23% increased while 19% decreased), and “body movement” showed 74.2% exact agreement. The four variables tested with saccades include: “ability” showed 100% exact agreement, “accuracy” showed 25.8% exact agreement (42% increased while 30% decreased), “head movement” showed 43.8% exact agreement (37% increased while only 18% decreased), and “body movement” showed 74.2% exact agreement.

The validity of the NSUCO Oculomotor Test was tested by administering the test to three groups of individuals: gifted students, normal students, and learning disabled students. They established a score of a three or below as a failure criterion, while passing anyone who scored a four or a five. Two different studies were conducted. One small study on only gifted students and learning-disabled (LD) students with only one observer. They found the LD to be poorer in every aspect of the oculomotor testing with a statistical significant difference in five of the eight categories. The second study was conducted on a group of "normal" students at a local school with the additional knowledge of the good and poor readers provided by previous school testing. This study contained 24 observers and all of them were masked from the knowledge of reading skills. They found "the failure rate for the poor readers to be twice that of the good readers."¹ (51) Both the Mann-Whitney U Test and the student t-test found the NSUCO Oculomotor Test could statistically predict these two groups of good and poor readers.

Survey results (1997):

How often used: 1.97. Fifty one of the 91 optometrists did not use the NSUCO Oculomotor Test. Twenty one optometrists responded that they use the test "frequently" or "all the time".

Usefulness: 3.26 . Nineteen responders found the test either "very" or "extremely" useful. However, 56 of the 91 left the question blank, thereby skewing the results.

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References:

1. Maples WC. NSUCO oculomotor test. Santa Ana, CA: Optometric Extension Program. 1995.