Comparison of the binocular stereoacuity measured by the *TNO stereotest* vs the *Frisby Stereotest Near FSN* in healthy adult subjects

A prospective, monocentric, non-controlled, non-randomized and open study.

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ABSTRACT: In young visually normal adults subjects, stereo acuity is tested several times, with both *TNO Stereotest* and *Frisby Stereotest Near FSN*, in order to compare the correlation of the results obtained by the two tests (primary assessment criterion) and also to evaluate the sensibility of the TNO to the subject positioning (secondary assessment criterion). METHODS: A specific testing protocol was designed in order to avoid any bias and a detailed ophthalmologic and refractive examination was systematically made (*Tropicamide* cycloplegia) in order to ensure the inclusion criterion respects. RESULTS: The stereo acuity obtained in normal subjects by the TNO (whichever way we used it) is centered on a mean value of 60" (seconds of arc) while a mean value of 15" for the FSN. Both tests succeed to provide an evidence of stereo acuity of the 77 subjects. CONCLUSIONS: the results from the two tests are not interchangeable. In our opinion, both tests address similarly the binocular stereopsis cues (vergence and disparity). But, as a result, the non correlation founded between the two tests probably lies in monocular depth cues (accommodation, texture gradient, …)

Regarding the TNO sensitivity to the subject positioning, against all logic, better results were founded when the subjects is not allowed to move his head in front of the plates … This paradoxical result could be explained by the high variability of the measurements and the low number of observations. An another study should be conducted to confirm the relative non sensitivity of the TNO to the presentation conditions.

1. INTRODUCTION:

The Netherland Organization Stereotest *TNO* and the *Frisby Stereotest Near FSN* are both random-dot stereo (RDS) clinical tests : based upon anaglyphic Red/Green format for the TNO instead of real depth perception (without any eye dissociation) for the FSN.

This kind of clinical tests (for infants, preschool children and adults) are useful to provide evidence of binocular function even without approaching stereothreshold. However, the specific purpose of this paper is to compare the stereo acuity values obtained by this two tests.

2. PURPOSE:

The aims of this study was twofold:
1) To compare the binocular stereo acuity measured by the *TNO Stereotest* VS the *Frisby Stereotest Near FSN,*
2) To test the TNO sensitivity to the subject positioning.
Both in healthy young adults subjects.

3. MATERIAL:

The subjects underwent succesively three stereo acuity measurements in a room set up with two dedicated workspaces:⌈SEP⌉
1. A desk for **TNO 1** (testing without strict control)⌈SEP⌉
2. A chin rest, oriented toward a the test support. The chin rest distance to the test support is adjusted through a chin displacement along floor marks. This workspace is dedicated to the **TNO 2** and **FNS** (with strict control of the subject positioning).

The room is a bright space with only diffuse ceiling lights (no natural light), and without shadowing.

IMPORTANT NOTE: in order to ensure the strict control of the subject head positioning, we used a chin rest for the TNO 2 and FSN testing. **This is specific to the purpose of the present study and is not representative of the way to assess stereopsis in routine clinical practice.**

4. METHODS:

Visually normal adults underwent three stereo acuity measurements with both TNO and FSN tests:
1. **TNO 1**: TNO testing without strict control of the subject positioning.
2. **TNO 2**: TNO testing with strict control of the subject positioning.
3. **FSN**: FSN testing with strict control of the subject positioning.

Distances of presentation:

TNO1 : without strict control of the subject's positioning
The examiner holds the plates approximately at a distance of 40cm, squarely in front of the subject. The subject is allowed to move <u>gently and slowly</u> his head.

TNO 2 : with strict control of the subject's positioning
The subject's head is firmly supported by the chin rest at a precise distance of 40cm of the plate. He is not allowed to move his head.

FSN : installed in the chin rest, the subject is assessed at two presentation distances :
1. 67cm : for the 120" (6mm plate), 60" (3mm plate) and 30" (1,5mm) levels
2. 95cm : for the 15" (1,5mm) level

Precautions:
Since the TNO test is assessed twice and in order to avoid any learning bias:
- The passing order of the TNO measurements is randomly chosen. The FNS testing is always assessed between the two TNO.
- Between the two TNO testing, the plates are presented upside down. As a result, the red-green spectacles are reversed too, to ensure to keep a same depth direction.

Inclusion Criterion:
A detailed ophthalmologic and a refractive examination is systematically performed (*Tropicamide* cycloplegia) :
- Adults, aged between 18 and 40y,
- Without any visual disease (10/10 – 20/20 for each eye, eventually with correction / Tolerated ametropia : -1,0 to +2,0 dioptries)
- Without dyschromatopsia,

<u>Primary Assessment Criterion:</u>
For both TNO and FSN, the subject is asked to recognize successively two figures per disparity level.

4 disparity levels have been assessed, in decreasing acuity order: 120", 60", 30" & 15".

For each level, two tests items have been presented. If no one, or only one figure is recognized, or if the subject makes a wrong answer (and even if he corrects it), the testing is stopped.

The qualitative variable retained is the lowest disparity recognized for each of the three tests. The maximum response time allowed is 30 seconds per level.

<u>Secondary Assessment Criterion:</u>
The qualitative variable retained is the lower disparity recognized for the 2 testing

5. RESULTS:

90 adults, aged between 20 to 38 years old〔Mean (SD) : 25 y (4,4)〕were recruited between September and October 2011.
13 subjects (14,4%) were excluded from the analysis (6 because of an over range ametropy, 3 for microstrabisms, 4 for protocol non respect). Therefore, 77 subjects (85,6%) were finally retained.

A *Kappa* test was performed for both assessment criterions:
1) No statistically significant agreements were found between the TNO and FSN stereo acuity (p=0,4866 & p=0,5762)
2) No statistically significant agreements were found between the two different ways to achieve the TNO measurement (p=0,2340)

Both tests succeed to provide an evidence of stereo acuity of the 77 subjects but the stereo acuity obtained in normal subjects by the TNO (whichever way we used it) is centered on a mean value of 60" (seconds of arc) while a mean value of 15" for the FSN.

6. DISCUSSION:

The results from the two tests are not interchangeable. In our opinion, both tests address similarly the binocular stereopsis cues (vergence and disparity). But, as a result, the non correlation founded between the two tests probably lies in monocular depth cues (accommodation, texture gradient, …)

Regarding the TNO sensitivity to the subject positioning, against all logic, better results were founded when the subjects is not allowed to move his head in front of the plates … This paradoxical result could be explained by the high variability of the measurements and the low number of observations. An another study should be conducted to confirm the relative non sensitivity of the TNO to the presentation conditions.

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