Henson 9000
Threshold testing

Threshold tests are used when there is a need to accurately measure the depth of any visual field loss. This type of measurement is important when it comes to monitoring a visual field defect and to establish if there has been any change in the defect which may require a management revision. Threshold tests take longer to perform than screening tests and are, therefore, more costly to undertake and largely confined to cases where there is already some visual field loss or high risk of loss. They are not normally used for screening.

There are three different characteristics of any visual field test:

1. **There are the locations to be tested (24-2, 30-2, 60-4 etc);**
2. **The type of stimulus used (white-on-white, blue-on-yellow, gratings etc);**
3. **The algorithm used to establish the threshold Full Threshold, SITA, ZATA etc).**

For example a test could use the 24-2 pattern of test locations, with a white-on-white stimulus using the SITA algorithm.

The first threshold algorithm (Full Threshold) was developed in the 1970s. It is reasonably accurate but takes in excess of 10 minutes per eye to perform. A later development (FastPac, Fast Threshold) shortened the test time but was less accurate and as such was not widely adopted. In the 1980/90s a series of papers were published by vision scientists (not perimetrists) on the more efficient Bayesian approach to obtaining thresholds. One of the algorithms promoted by these researchers (King-Smith 1994) was called ZEST (Zippy Estimate by Sequential Testing). In 1997 a Swedish group of ophthalmologists utilised this work to develop a new perimetric algorithm (SITA- Swedish Interactive Threshold Algorithm). The ZEST algorithm has also been used to develop ZATA (Zippy Adaptive Threshold Algorithm).

An important characteristic of these new algorithms is what is termed their terminating criteria. This specifies how accurate the threshold measure should be. As a general rule the more accurate you want it to be the longer it will take. The Swedish group set the terminating criteria to give an accuracy similar to the Full Threshold technique (SITA Standard) and later produced a second version that was less accurate but faster (SITA Fast).

Post the development of SITA we have learnt a lot more about how patients with glaucoma respond to stimuli and the importance of keeping test times down to a minimum. These findings have been used to develop ZATA.

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The Henson 9000 ZATA algorithm

While ZATA is based upon the same principles as SITA it differs in some important ways.

1. **When possible it uses prior data as a starting level.** This makes it more efficient and faster especially in eyes where there is some pre-existing visual field defect. It makes better use of prior knowledge.
2. **It does not use a single terminating criteria.** It can be thought of as a combination of SITA Standard and SITA Fast. It uses the SITA Standard terminating criteria in locations where there is some visual field loss and in the adjacent test locations but uses a less accurate (faster) terminating criteria in other locations. This again reduces test times especially in patients who have no visual field loss.
3. **It does not attempt to accurately measure thresholds in severely damaged test locations (<10dB).** Accurate measures at these locations are impossible to obtain with any algorithm due to changes in the visual system that make it very variable. This again reduces test times in patients with severely damaged test locations and reduces the number of presentations in these areas and the long sequences of 'not seen' responses which are non-productive and can be very frustrating to the patient and perimetrist.

Summary

Facility	Benefit	Humphrey	Octopus
Uses Bayesian algorithm. ZATA	Faster with no loss of accuracy.	SITA	No Bayesian based algorithm but alternative with loss of spatial resolution
Uses prior data	Faster especially in patients with visual field loss. More efficient.	Always starts from the same the same values (normal)	NA
Varies the terminating criteria to give more accurate thresholds at damaged and neighbouring locations	Faster especially in patients with no visual field loss	Uses the same terminating criteria for all locations	NA
Uses looser terminating criteria	Faster especially in patients who have	Uses the same terminating	NA

in severely damaged locations (<10dB)	severely damaged regions (common in hospital populations). Also, reduces the number of non-seen presentations.	criteria for all locations	
30/24-2 stimulus patterns within single test. Operator can extend the 24-2 to a 30-2 test during or at the end of an examination	More efficient	Has both 24-2 and 30-2 tests but not possible to extend from 24-2 to 30-2. If, at the end of a 24-2 test it is decided that a 30-2 is needed then you have to start again, repeating all the 24-2 test locations.	Ditto to HFA
At end of test can switch view to threshold, greyscale, or defect values		Can only view threshold values on screen.	

Other facilities to aid testing

Facility	Benefit	Humphrey	Octopus
Fast start up with LED technology	No need to wait until light sources have warmed up	Uses old style light sources that require long warm up times	LED technology
Fast access to database to recall prior data	Faster	Can only recall patient details such as name, dob, etc. No facility to recall and use prior data (thresholds values)	
Stream lined software with most	Faster testing, easier operation	Poorly designed software which	

operations requiring single click	and faster training	requires many slow response selections for routine tasks	
Fast printing on wide range of printers (any Windows based printer)	Better quality prints with many options regarding page size, colour etc. Does not need to finish printing prior to continuing with other tasks.	Very limited range of printers. Slow and unable to multitask.	
Fast storage of data with wide range of options through Windows OS	Easy to link to other Windows based systems including file servers	Very poor networking facilities backup options etc.	
Excellent, fast Windows based database	Easy to access data and export to other SW	Very poor database that can only be used after the machine has warmed up. Not accessible to third party software. Limited search options, slow response times.