Performance, usability and comparison of three and four alternate forced choice versions of the handheld Radial Shape Discrimination test

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Purpose

The handheld Radial Shape Discrimination (hRSD) test is a global shape discrimination test that uses perfect and distorted circular contours (radial frequency patterns) as visual stimuli. In patients with macular disease the threshold for detecting distortion increases1. The hRSD test, presented on a mobile device (e.g., an Apple iPod touch or iPhone; Figure 3) is being widely used to detect macular pathologies and in the US has FDA approval for use in self-monitoring by patients. Recently a 4 alternate forced choice (4AFC) version of the test (which should provide a more precise estimate of threshold) was introduced (Figure 2) in addition to the 3 alternate forced choice (3AFC) version used previously. We compared the performance of these versions of the test.

Methods

Participants

We recruited 106 healthy adult participants: 64 F, 42 M, median age 33 years (SOQ 21, range 18-72). 5 eyes with ocular pathologies were excluded.

Procedures

Vision tests (near and distance visual acuity, VA; Pelli Robson Contrast Sensitivity, CS; Amster grid, AG) were conducted monocularly with participants' habitual visual correction. Slit lamp biomicroscopy and undilated fundoscopy were performed. Threshold results for the 3- and 4AFC hRSD tests were recorded as a logMAR value, and the time taken for each test recorded. The test order (3AFC vs 4AFC) was counterbalanced across participants and they also completed a 5 question usability survey.

Data Analysis

For the majority of participants in whom results were available from both eyes, data from one eye was randomly selected for analysis since the data from the left and right eyes cannot be treated as independent. Averaging the results of both eyes can cause loss of information.

Statistical analysis was conducted using SPSS. Normality of distributions was investigated using the Kolmogorov-Smirnov test. Because all parameters were not normally distributed, non-parametric descriptive statistics and tests were used for analysis.

Results

For all eyes which had a normal undilated fundoscopy examination, median (IQR) distance VA was: -0.08 (0.15) logMAR, near VA was: -0.08 (0.15) logMAR and CS 1.65 (0.5) logC. The 3AFC and 4AFC hRSD median (IQR) thresholds were: -0.85 (0.14) and -0.83 (0.13) respectively (Wilcoxon signed rank paired test; Z= -3.512, p=0.131; NS; Figure 3a). There was no significant difference in median (IQR) test time; 3AFC: 188s (IQR); 4AFC: 187s (IQR); Z= -1.045, p=0.664; NS. Figure 3b). Bland-Altman analysis demonstrated that the bias was close to 0 and there were relatively narrow limits of agreement (Figure 4). Across participants, the thresholds were significantly correlated (Spearman’s rho=0.57, p<0.0001; Figure 5a) as were the test times (Spearman’s rho=0.46, p<0.0001; Figure 5b). Age was not correlated with distance VA (Spearman’s rho=0.133, p=0.173) but correlated with near VA (Spearman’s rho=0.537, p<0.0001; Figure 6). Age was not correlated with 3AFC thresholds (Spearman’s rho=0.16, p=0.102) or 4AFC thresholds (Spearman’s rho=0.17, p=0.087; Figure 6). 104/106 eyes reported a normal Amster grid. From the usability survey, the majority of participants understood how to use the test, found it easy to use, felt it did not take too long and were confident using it (Table 1). While 41.5% of participants expressed no preference between versions of the hRSD test, 33.9% found the 3AFC version easier to use, 24.6% found the 4AFC hRSD easier to use (Figure 7).

Discussion

Initial published data on the hRSD test was based on chart testing or a desktop testing protocol2. Subsequent data demonstrated substantial equivalence between the desktop version of the test and the handheld 3AFC version3. The 3AFC handheld version of the test has been extensively used. As this is currently the most widely available, our aim was to investigate whether thresholds and usability were similar for the two versions of the test.

We confirmed that there were no statistically significant differences between the two versions. The hRSD thresholds in this study were similar to previous published thresholds of -0.86 logMAR2. In our healthy adult participants, age had no influence on thresholds, agreeing with previous results that in the absence of pathology performance is stable4,5.

Previous hRSD usability data for the 3AFC test showed a favourable participant response6, which we have confirmed; there was no clear pattern of preference between the 3AFC and 4AFC.

Given that the hRSD test is relatively inexpensive, convenient, user friendly, and that the test results are relatively resistant to the effects of ageing, it is ideal for screening and home monitoring of age-related eye disease.

Related work:

We are currently investigating the sensitivity and specificity of the hRSD test for the detection of nAMD (EDMAud project) and DMD (EDMOND project).

Conclusion

The 3AFC and 4AFC versions of the hRSD test had comparable performance, there were no statistically significant differences in either thresholds or test time. Given the underlying psychometric advantages of a 4AFC task, this version should be used as standard.

References


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