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Comparison of color vision discrimination performance ability in binocular and monocular condition and stereoscopic sensitivity

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Aim: To evaluate the performance of the color vision discrimination degree in binocular and monocular vision and comparison the its differences either with dominant or non-dominant eye seeing in monocular condition among medical students with normal color vision.

Methods: A total of 52 students studying at Baskent University Faculty of Medicine including 33 males (63.46%) and 19 females (36.54%) with the mean age of 21, 18±25.2 years (mean±SD) each of them have visual acuity of 20/20 and none of them had congenital color vision deficiency (CCVD) were recruited for this study. Ishihara Pseudoisochromatic Plate Test (IPPT) was used to evaluate CCVD. The color vision discrimination ability degree for the right eye (RE), left eye (LE) and both eyes together were examined using the Farnsworth-Munsell 100 hue (FM100) test. Total and local error scores were calculated. Dominant eye (DE) was determined using the Gundogan Method. The total error scores (TES) from the FM100 test between the binocular vision (BV) and monocular condition of both with DE and non-dominant eye (NDE) were compared. The presence of the binocularity and stereoscopic sensitivity (SS) were investigated using the TNO test. All participants divided into four groups within a range of 480-60 arc/s. The statistical software; SPSS 20 (IBM Corp. Released 2011) and IBM SPSS Statistics for Windows (Version 20.0 Armonk, NY: IBM Corp.) was used for calculations. All values presented as mean±standard deviation and frequencies. Repeated measures of analysis of variance were analyzed by Mauchly's sphericity test and Box's Test of Equality of Covariance Matrices. For comparisons of means of repeated measures Repeated Measures Analysis of Variance was used. If parametric tests (factorial design for repeated measures analysis) do not provide the preconditions, Greenhouse-Geisser (1959) correction or Huynh-Feldt (1976) correction was used for corrections to the Degrees of Freedom. The Corrected Bonferroni test was used for multiple comparisons.

Results: The color vision discrimination ability degree of all students TES of BV, DE and NDE were found 61.22±30.32, 58.80±29.92 and 68.44±31.46 respectively. The differences were not significant between each group. (p=0.189) the blue/yellow (b/y) local error scores of BV, DE and NDE were 35.80±19.32, 34.68±18.95 and 36.24±17.56 respectively, the differences were not statistically significant either. (p=0.412) The red/green (r/g) local error scores of BV, DE and NDE detected were 25.42±14.65, 24.12±14.70 and 32.20±14.21. The error score of NDE was significantly higher than that of other two groups (p=0.009). Even not reported statistically the error scores of DE were lower even than BV for each spectrum. All individuals' BV, DE and NDE FM100 test of TES were detected according to stereoscopic degree in which participant with 480 arc/s Stereoscopic Sensitivity (SS) have 61.32±30.63, 59.22±29.89, 68.10±32.13, subject with 240 arc/s in SS have 61.32±30.63, 59.22±29.89, 68.10±32.13 in 120 arc/s SS, 60.75±31.12, 58.48±29.77, 66.24±31.49 and with 60 arc/s SS have 61.59±30.96, 59.02±29.90, 66.15±31.85 respectively. The differences were not significant in each stereoscopic level.

Conclusion: In normal subjects without CCVD the color vision discrimination was lower in NDE than in both DE and in BV for each spectrum but it is only significant in R/G spectrum. According to our research result R/G spectrum is the most affected one by eye dominance. The further studies are necessary to evaluate our research results, the reason of inhibiting DE's color vision discrimination ability in binocular seeing position. According to our research, FM100 tests showed no correlation in terms of mean TES with the depth perception evaluated with the test based on color perception