S-cone Pathway Contribution to Depth Perception

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One of the central tasks of the visual system is to derive the third dimension in the visual scene from the two dimensional images that fall on the retinal surface. To accomplish this several mechanisms have evolved, the two most central of which are stereopsis and motion parallax. Stereoscopic depth perception utilizes the disparity cues between the images that fall on the retinae of the left and right eyes. The purpose of this study was to determine what role the S-cone channel plays in the processing of stereopsis. Thirteen subjects aging from 17-24 (20 ± 1,4 years; 8 females) with 20/20 best corrected visual acuity were tested for uncrossed (distal) binocular disparity using the Frisby stereo test (Clement Clarke International Ltd, London, UK). Stereoacuity was measured with the best corrected binocular vision and using a band pass blue filter (Schott BG25) to isolate the S-cone responses. A four alternative forced-choice procedure was used and the stereoacuity was measured using a staircase procedure. The viewing distance started at 1 meter presenting plate 1 (4.027mm), following a correct response we presented plate 2 (2.013mm) and plate 3 (0.67mm). If the subject was able to see the stereo target in plate 3 we increased the viewing distance in steps of 10 cm until the first wrong response occurred. For the next 3 reversals the steps were reduced to 5 cm.
Blue filter stereoacuity was higher for all subjects. The mean stereoacuity without blue filter was 5.4 sec of arc (± 2.4) and under blue filter condition it was 14.8 (± 8.5). This difference had a statistical significance (U= 4,00; p= .024, Mann-Whitney U test). Our results show that the S-cone input contributes to depth perception but the stereoacuity measured for this retinal pathway is significantly lower than under the three cone inputs of normal vision. This low participation of the S-cone system in this spatial vision task may be related to the low density of S cones in the retina, and to the greater light diffraction in the blue condition, causing image blurr.