accommodative distances: from left to right, those distances are 0, 0.15, 0.3, 0.45, and 0.6D, where 0.6D corresponds to focusing on the near end of the line and 0D to focusing on the far end. None of the three rules provide a clearly better approximation to the real world. But it is important to note that the box rule and Liu and Hua's non-linear rule [16] often produce steeper blur gradients (i.e., greater change in blur with position along the line) than the real world and those steep gradients will be quite visible. This is particularly evident when the eye is focused at either end of the line (0 and 0.6D). In those cases, the linear rule produces gradients that are similar to those in the real world. We conclude that the linear rule provides appearance that is as good as or slightly better than the Liu and Hua rule [16] and the box rule. It thus provides a reasonable approximation to the appearance of the real world.

6. Summary and conclusions

We evaluated the effectiveness of different depth-weighted blending rules in a multi-plane display, including a linear rule described by Akeley and colleagues [4,6] and a non-linear rule described by Liu and Hua [16]. In evaluating effectiveness, we considered three criteria: 1) maximizing retinal-image contrast when the eye accommodates to the simulated distance; 2) providing an appropriate contrast gradient to drive the eye's accommodative response; 3) appearance. We found some circumstances in which a non-linear rule provided highest retinal contrast, but the deviation from linearity was opposite to the one Liu and Hua [16] reported. When we incorporated typical optical aberrations and neural filtering, and presented natural stimuli, we found that the linear blending rule was clearly the best rule with respect to the first two criteria and was marginally the best with respect to the third criterion. We conclude that the linear rule is overall the best depth-weighted blending rule for multi-plane displays. As such displays become more commonplace, future work should examine how variation in optical aberrations of the eye, the amplitude spectrum of the stimulus, and the separation between the planes affect image quality, in particular the appearance of stimuli at different depths.

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