Discrimination of Synthetic Chromatic Distributions which Resemble Natural Distributions

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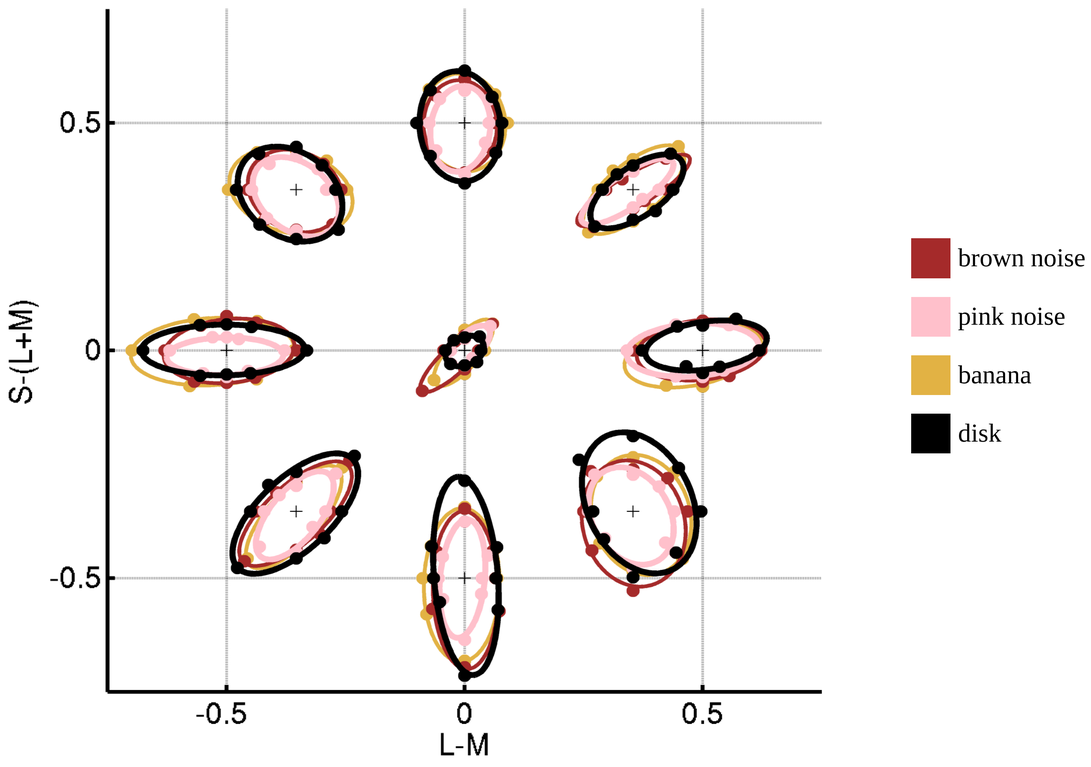
Introduction

Traditional measurements of color discrimination have used patches of a single homogeneous color. Color vision, however, evolved in an environment where we find objects with textures comprised of different hues and brightnesses. Previous results showed that the distribution of hues in natural objects influences chromatic discrimination (Hansen&Gegenfurtner, TWK 2005). Here we investigated chromatic discrimination for synthetic chromatic textures with a chromatic distribution and compared it to discrimination for homogeneous colored disks and natural objects.

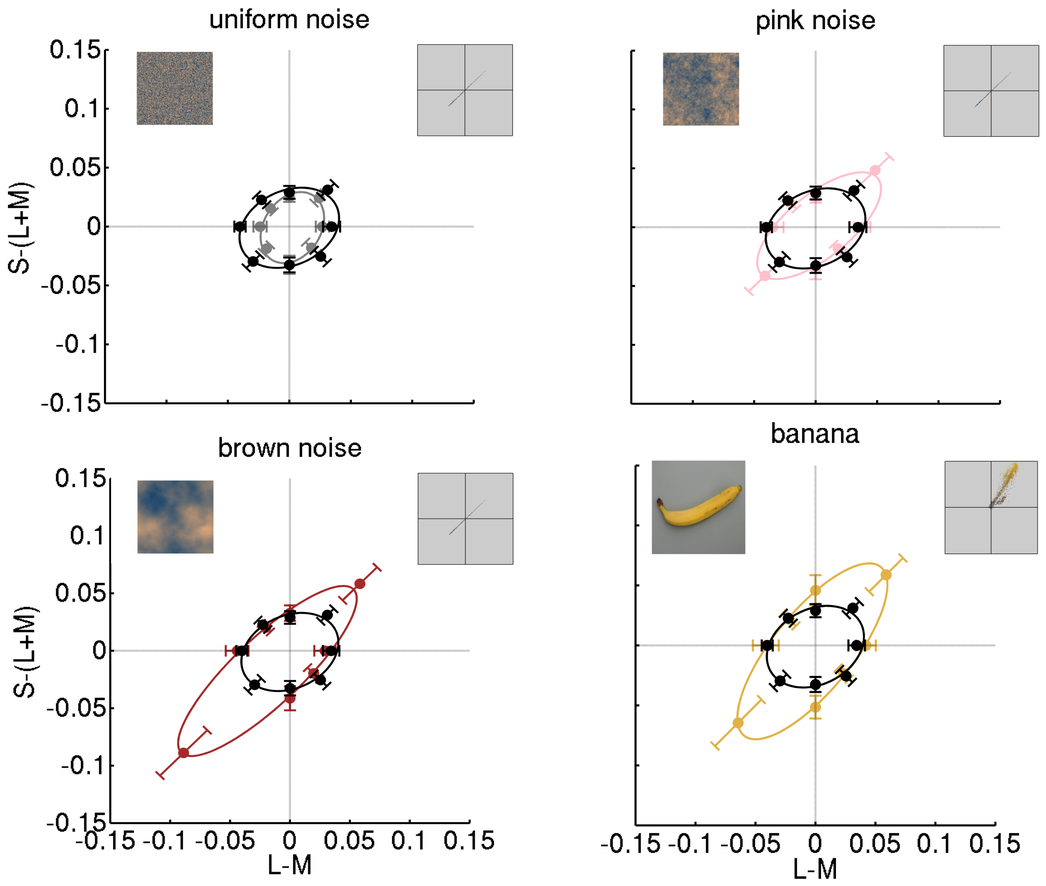
Results

Discrimination at 9 test locations



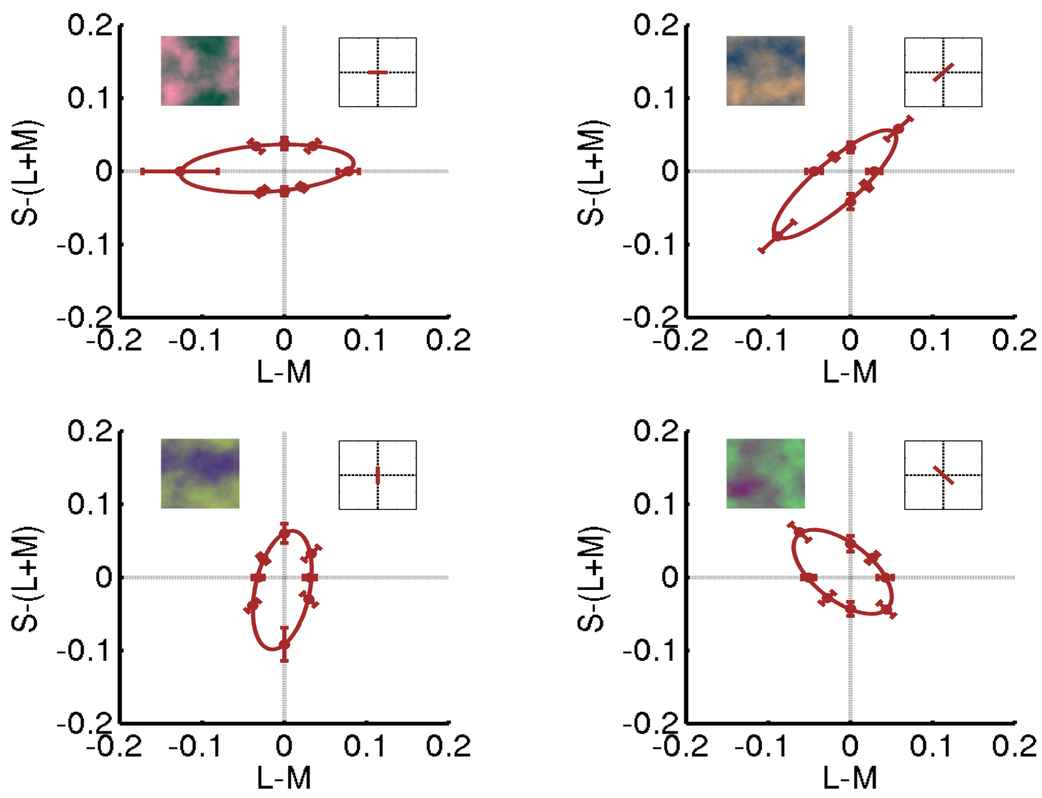
Discrimination was best at the adaptation point. At the adaptation point discrimination ellipses for the stimuli were different: Those for the disk were circular, while those for the pink and brown noise synthetic chromatic textures and the natural object were elongated. Away from the adaptation point the threshold contours for all stimuli were elongated along the contrast axis connecting the adaptation point and the color at the test location.

Discrimination at the adaptation point



At the adaptation point discrimination threshold contours for all stimuli but the uniform noise stimulus showed a similar elongation as the threshold contours for the natural objects. The elongation of the ellipses followed the distribution of hues in the stimuli.

Discrimination for different chromatic directions



Methods

The stimuli were either homogeneous colored disks, digital photographs of fruit objects or synthetic chromatic textures. The synthetic textures were generated with the objective to resemble the distributions of natural objects both in spatial frequency and chromatic distributions. We modeled the spatial frequency characteristics by using both pink and brown noise. In a 4 AFC experiment four isoluminant stimuli were presented on a homogeneous gray background (adaptation point). The mean color of one of these stimuli (comparison stimulus) was varied along eight directions in the isoluminant plane of the DKL color space. The observers' task was to indicate the position of the comparison stimulus. Discrimination thresholds were measured along eight comparison directions using an adaptive staircase method. Ellipses were fitted to the threshold contours. Discrimination was tested at nine different test locations. Three observers participated in the experiment. The data shown is averaged across observers.

Conclusions

- Discrimination ellipses follow the distribution of hues in the stimulus.
- Chromatic discrimination is best at the adaptation point.
- In addition to the chromatic distributions the spatial frequency distributions of the stimuli affect chromatic discrimination.
- Discrimination is not mediated solely by mechanisms tuned to the cardinal axes of the color space.

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