The Role of Color in Real-World Scene Contextual Cueing

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Motivation

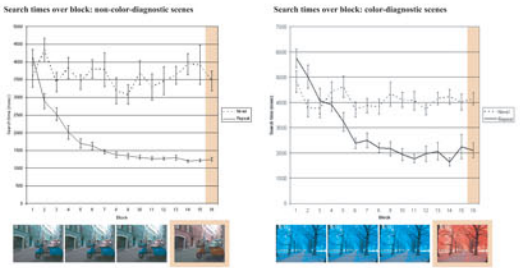
- What is the role of color in natural scene memory and recognition?
- Do color manipulations from contextual cueing with abstract stimuli extend to contextual cueing with real-world scenes?
- Does the role of color in visual search in real-world scenes depend upon whether the scenes are color diagnostic?

Stimuli and task

Participants searched for targets in natural scenes which had been altered to appear in unnatural colors. Targets were tiny gray letters (T or L) embedded in each image.

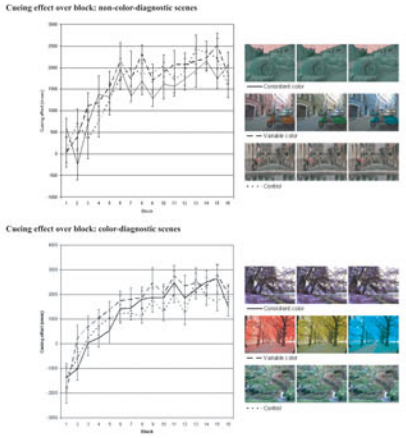
Two image sets were used: a non-color-diagnostic, heterogeneous set of natural images (Brockmole & Henderson, 2006) and a color-diagnostic set of scenes of parks.

Transfer of learning



- Participants learned to locate targets in consistently-colored scenes, then the scene colors were changed
- There was no search cost associated with the change in scene colors for either color-diagnostic or non-color-diagnostic scenes

Contextual cueing effect



- Scenes were shown in one of three conditions: natural colors (control), consistent unnatural colors, and variable unnatural colors (scenes changed color with every repetition)
- Contextual cueing effect was similar across all three conditions, for both color-diagnostic and non-color-diagnostic scenes

Discussion

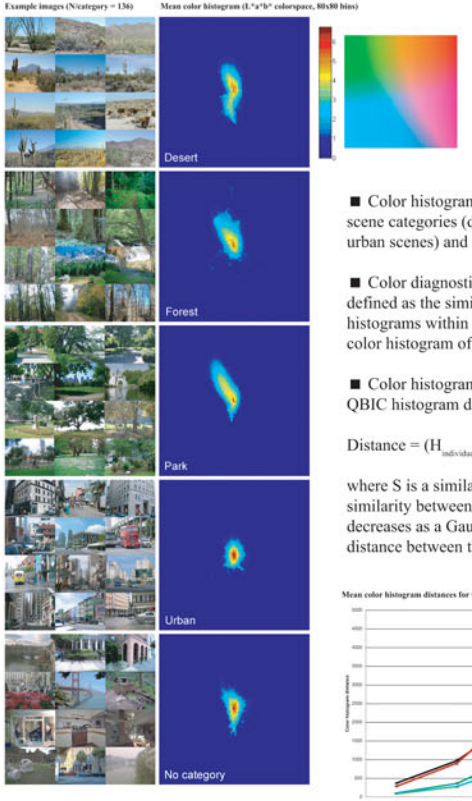
- In real-world scene contextual cueing, scene-target associations are independent of scene color
- Natural scenes are information-rich; color is only one of many signals which could be used to recognize scenes and remember target locations
- Color may be more important for fast recognition of natural scenes but play less of a role in relatively slow search tasks

Brockmole, J. R., & Henderson, J. M. (2006a). Using real-world scenes as contextual cues during search. *Visual Cognition, 13*, 99-108.

Niblack, W., Barber, R., Equitz, W., Flickner, M., Glasman, E. H., Petkovic, D., Yanker, P., Faloutsos, C., & Taubin, G. (1993). The QBIC project: Querying images by content using color, texture, and shape. *Proceedings of SPIE: Storage and Retrieval for Image and Video Databases, 1908*, 173-187.

Oliva, A. & Schyns, P. G. (2000). Diagnostic colours mediate scene recognition. *Cognitive Psychology, 41*, 176-210.

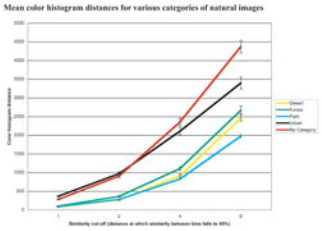
Assessing Color Diagnosticity



- Color histograms were computed for four scene categories (deserts, forests, parks, and urban scenes) and a heterogeneous image set
- Color diagnosticity of a category was defined as the similarity of individual color histograms within the category to the mean color histogram of that category
- Color histograms were compared using QBIC histogram distance algorithm:

$$\text{Distance} = (H_{individual} - H_{mean})^T S (H_{individual} - H_{mean})$$

where S is a similarity matrix in which the similarity between nearby histogram bins decreases as a Gaussian function of the distance between the bins



- Color histogram distances were computed using similarity matrices with a range of cut-off values
- Deserts, forests, and parks had significantly lower color histogram distances than urban scenes or scenes in the heterogeneous image set, but did not significantly differ from each other
- Color histogram distances of urban scenes did not significantly differ from those of the uncategorized image set
- We concluded that the three natural scene categories (deserts, forests, and parks) were color-diagnostic, and the urban scenes and uncategorized image set were non-color-diagnostic