Effect of largest illumination area on lightness of an object

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In everyday situations objects are found covered simultaneously by more than one illumination level as well as moving from one illumination to another. What is the lightness of such objects? Our previous findings showed that the lightness of an object moving through two areas of illumination identical in size would be determined by its appearance in the higher of the two illuminations.

However, what if one illumination covers larger area? We expect that both largest illumination in the whole visual scene (i.e. global illumination) and largest illumination on the object itself (i.e. local illumination) should influence its lightness. This should be the case even when the object spends equal time in both illuminations. Our present study tested these predictions.

Ten participants took part in four experiments, always providing lightness matches for the same five gray targets (spanning the range from black to white). There were two illumination levels in the scene and their position and area size were varied across experiments.

In Experiment 1 both areas of illumination covered equal size and each target was placed in each illumination separately. Participants provided two lightness matches for the targets – one for each illumination level. Constancy failure was observed: targets placed in the higher illumination were judged as lighter than the same targets placed in the lower illumination ($F(1,9)=15.703$, $p=0.003$).

In the next three experiments, the target moved between the two illumination levels and the participants provided matches only after the target was hidden from their view. In Experiment 2 the lower illumination covered largest global area. Matches from this experiment were consistent only with the matches obtained in the lower illumination, in the first experiment ($F(1,9)=18.996$, $p=0.002$). This result confirms that largest global area of illumination determines object lightness. Surprisingly, results from Experiment 3, where higher illumination covered largest global area, again showed that the object lightness was consistent only with low-illumination-matches ($F(2,14)=8.415$, $p=0.004$) from Experiment 1.

In the fourth experiment the lower illumination covered largest global area, while higher illumination covered largest local area. When compared with the second experiment, results showed only a marginally significant difference ($p=0.059$). However, the direction of this difference (lighter matches in Experiment 4) suggests that the largest local area also influence object color appearance.

Obtained results are consistent with our previous work [1-3] from spatial and temporal domains and confirmed that both global and local areas of illumination influence lightness of an object.

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