How We Look at Photographs- as indicated by Contrast Detection, Preference and Fixations

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Abstract

The research applied image evaluation methods to examine visual perception theories with photography, through investigation of the relationship between the aesthetic experience of looking at photographs and the ability to actually discriminate the photographic language building blocks- luminance contrast and spatial configuration, at different regions of the characteristic curve. The relationship between contrast discrimination performance and preference of contrast in photographs was investigated and eye-movement tracking methods revealed the effect of contrast over fixation patterns and aesthetic experience.

Key Words: *contrast discrimination, photographs, grey-scale, highlights, shadows, mid-tones, contrast preference ,fixations, local vs. global frameworks*

Introduction

In order to examine the roles and interferences of local and global elements in lightness perception and object recognition processes when looking at photographs with meaningful contents, we examined whether contrast discrimination is a response to spatial configuration properties of photographs, or also a function of conceptual contents. In three experiments we compared contrast discrimination performances of observers, when presented with contrast increments applied to discrete tonal regions in grey-scales vs. photographs.

Experimental

Procedure

In Experiment 1, observers performed contrast discrimination in grey-scales by rank-order tasks. In Experiments 2, trained and novice observers performed contrast discrimination of photographs by sorting-tasks. In Experiment 3 observers performed a one-scale (from 1- most dislike to 5- like most) preference evaluation task for the photographs. In experiment 4 observers fixations were recorded, while viewing sets of photographs.

Stimuli

Grey-Scales Rank Order Task (Experiment 1): Kodak Scientific Imaging Systems Gray Scale. Sample size was 20cmX3cm, with a 3cm wide neutral grey masking.

Photograph- Sorting Task (Experiments 2 & 3) and Photograph- Contrast Preference (Experiments 4):

Nine black-and-white photographs by the photographer Ansel Adams[1] belonging to three major themes in photography: *Landscape*, *Portrait* and *Architecture* Sample size was 25cmx30cm with a 3cm wide neutral grey masking.

Contrast effect on Fixations (Experiments 5):

Eight black-and-white photographs were a subset of 10% contrast increment from the above stimuli for each of the regions: HI, MT and SH, and an unaltered set for OR. The sets were displayed using a Powerpoint presentation. The length of time for each stimulus was 20 seconds, with an automatic slide transition of 1 second. Eye recording technique was EMR. The model used was EMR-8B Eyemark recorder

The order was counter balanced between subjects.

Stimuli reproduction process

The photographs and grey-scales were scanned in an "Epson" scanner GT-9700F. For each stimuli a sample set composed of two prints with original tones and three sets of 10 prints, for each of the three curves was composed: "**OR**" – 2 direct reproductions without contrast increment. (1) "**SH**" - contrast was increased in the shadow region (toe) and compressed the highlights. As a result the visual impression is that the images look lighter. (2) "**HI**"- contrast was increased in highlight region (shoulder) and compressed the shadows. The resulting visual impression is the overall darkening of the images. (3) "**MT**"- contrast was increased in the mid-tones region (straight line), while compressed both highlights and shadows. Contrast increment ranged between 1% and 10% in increments of 1%. Samples were named 1 to 10 accordingly. Prints were produced by Lambda system in a silver gelatin process, on a photographic black-and-white paper.

Subjects

Experiment 1-3: Subjects belonged to two groups: (1) 18 observers who were skilled in image evaluation tasks, named: "trained" group. (2) 15 inexperienced observers, named: "novice" group. Average age was 25 and 27. 50% of the trained subjects and 10% of the novice were familiar with Ansel Adams work and 28% of the trained and 5% of novice reported to have previously seen the photographs used as stimuli.

Experiment 4: 30 subjects aged between 20-30. 46% of the participants were either familiar with the photographer or reported to previously have seen the photographs used as stimuli.

Experiment 5: 32 students. Each 8 viewed one set out of the four region sets.

Results

Experiments 1-3. Contrast Discrimination in Grey-Scale and Photographs:

In the photographs we found substantial differences in contrast discrimination, depending on the region: HI and SH were between 20% to 30%, whereas MT was 75~85%, but there was no significant effect of category as shown in figure 1. Trained and novice subject discrimination rates were similar for MT, but showed opposite discrimination for HI and SH regions (trained: HI-low, SH-high: novice: HI-high, SH-low, which could either account for the effect of training and skill over interpretation of the term 'contrast', or indicates that novice subjects search for contrast in highlights while trained subject search for contrast in shadows.

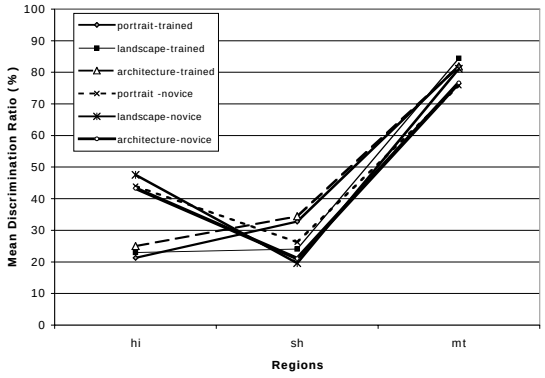

Figure 1. Effect of region and category over contrast discrimination ratio in photographs (Experiment 2)

Also in grey-scales subjects' performance in SH differed significantly from HI and MT. Spearman Correlation, shown in Figure 2, revealed high correlation between contrast and rank in HI and MT grey-scale set, where: $r_{HI}=r_{mt}=0.99$,. In SH grey-scale set, correlation was low, $r_{SH}=(-0.21)$, and even opposite in direction. This means that in SH, samples with more contrast were ranked lower than samples with less contrast (opposite to rank).

Another interesting result was differences in photographs of light vs. night scenes in SH region (with no affect on HI and MT).

These results can be explained with '*Anchoring Theory for Lightness Perception*'[2,3], according to which, in mapping luminance into a lightness scale, the highest luminance is anchored (assigned) to white, and the rest of the values are scaled relative to it. Other factors which influence anchoring are: configuration, articulation, insulation and gestalt grouping principles. The anchor can occur within a *local framework*, containing a group of patches or a *global framework* that could include even the entire image or the entire visual field. While strong anchoring to local framework increase lightness constancy, when the global framework is stronger, it is decreased.

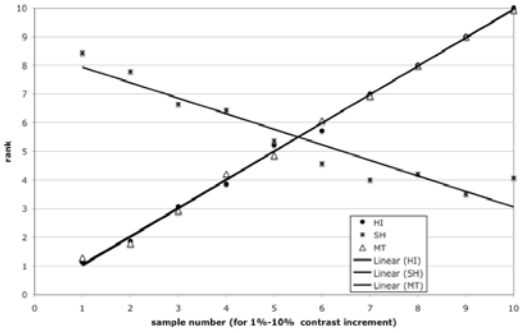

Figure 2. Spearman Correlation between contrast increment and rank in grey-scales

Hence, in SH (see stimuli preparation) as the grey-scale is perceived as lighter, the assignment to white is enhanced and so does the strength of the global framework. In addition, simple configuration, low gradient, and no articulation cause a decrease in lightness constancy, and in effect lower response ratio in SH. In photographs, high articulation and insulation, complex configuration and a variety in gradients contributed to the strengthening of local frameworks and as a result to an increase in lightness constancy and improvement in the response.

Experiment 4. Contrast Preference:

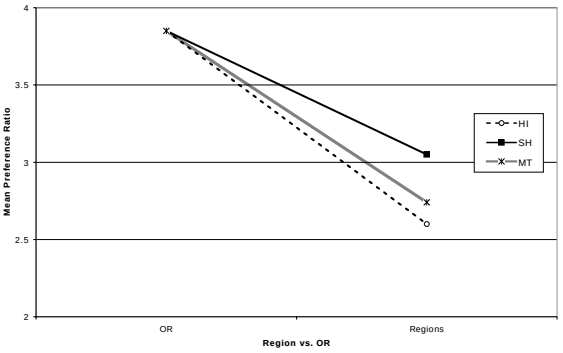

Figure 3. Effect of Region (OR vs. HI, SH and MT) over preference (Experiment 3)

Preference results, similarly to discrimination, were not affected by conceptual content but by region. Mean preference at SH (3.1) was higher than MT (2.7) and HI (2.1), although in all regions preference decreased systematically with contrast increment, compared to OR (3.9), as shown in Figure 3. This suggests that preference is independent of spatial configuration. An interesting result is, that the stimuli OR were the most preferred. This suggests a match in preference between the

photographer, and the observer, and is in line with recent theories in neural-aesthetics[4,5].

Figure 4 shows the differential effect of contrast increment (2%, 6% and 10%) over regions. For 2% contrast increment, preferences at regions HI, SH and MT are: 3.59, 3.60 and 3.55 respectively, for 6% the preference of SH over the other regions is already significant: 2.52, 3.3 and 2.8, and the difference is even greater for 10% increment: 1.58, 2.67 and 1.97

One way of explaining these results is in relation to Anchoring Theory of Lightness perception, according to which, as the contrast in the shadow region increases, insulation decreases and the white areas grow, thus the photograph is perceived as becoming lighter. The decrease in lightness constancy is perhaps the reason for what seems to be greater tolerance to contrast increments, when occurring discretely in shadow regions, than when occurring in highlights or mid-tones.

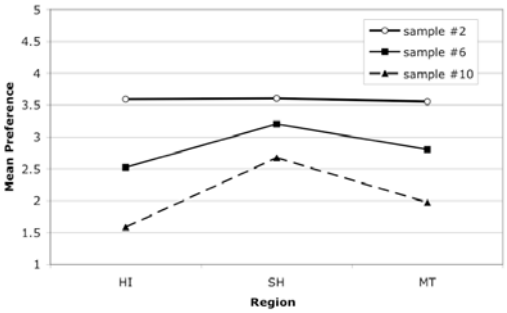

Figure 4. Preferences in regions HI vs. SH vs. MT for stimuli 2%, 6% and 10% contrast increment

Experiment 5. Contrast Effect on Fixation

Fixation concentrations were observed to occur in particular areas of the photographs. Since scanpaths are highly idiosyncratic and differ markedly from one observer to the next, and between stimuli, averaging the recordings, would have also average out the specific cases in which fixation centers did form.

Such an example can be seen in figure 5, where, a fixation center was formed on the moon. In OR the center is most visible whereas in SH, there is no fixation center on the moon. The intentional search implies that viewers must have been aware of the categories of the photographs, it was expected that category would significantly influence attention, even over the period of a prolonged gaze. This is based on *Reverse- Hierarchy Paradigm*[6-7], according to which there is a continuum between the two types of attention that yields shifts between the feature search processing to the global processing and vice versa. Hence category influences attentive fixations, and these fixations in turn are affected by contrast.

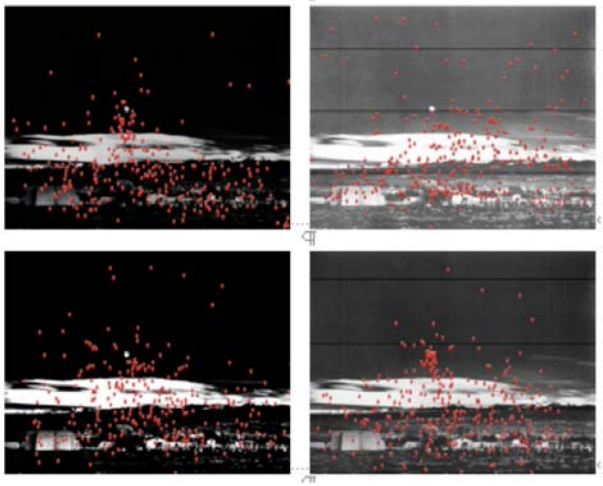

Figure 5. Fixation center formed on the moon (Top:HI,SH;Bottom:MT,OR)

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