

# Age differences in lightness perception<sup>1</sup>

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*Adults and children made lightness judgments of targets in light and in shadow when the targets were presented singly and mounted together on a chart. The adults showed greater constancy than the children when the targets were presented simultaneously on a chart. Presented singly, however, the differences between the adults and the children were not statistically reliable. These results indicate the importance of the cues in the perceptual situation in relation to developmental differences in lightness perception.*

Studies of lightness constancy as a function of age have produced varying results. Brunswik (1956, p. 83) reports an increase in constancy between the ages of 3 and 11. Burzlaff (1931) substantiated an increase in constancy with age when a single color wheel was used, but found that the age trend disappeared when the standard and comparison stimuli consisted of a series of grays on a chart. Developmental differences apparently depend on the perceptual situation. To investigate this question, adults and children made lightness judgments of targets in light and in shadow when the targets were presented (a) singly and (b) simultaneously on a chart.

## Method

The experiment was conducted in a darkroom. The targets were chips, each 1-1/4 by 1-1/2 in., ranging from white to black. Their reflectances were: 5, 10, 32, 63, and 100 percent. These chips were placed on a background either singly or as a group mounted on a cardboard backing in an irregular order. The background was a 4 ft. square board covered with black cloth and placed perpendicular to the O's line of sight at a distance of 46 in. A shadow caster invisible to O partially shaded the background. The illuminance of the illuminated part of the background was 1.5 ft.-c. and of the shaded part of the background was .85 ft.-c. The presence of the shadow was heightened by placing white, gray, and black papers (7 by 1-1/2 in.) on the background so that they lay half in light and half in shadow.

The plan of the experiment was to present O with the chart and the single chips shadowed and illuminated. There were four experimental conditions: (a) chart illuminated, (b) chart shadowed, (c) chips illuminated, and (d) chips shadowed. The shaded and illuminated locations on the background were chosen so that they were equally distant from the white, gray, and black papers and from the O. The same Os were run in all the experimental conditions. A balanced order was, therefore, employed with one-quarter the Os beginning

with each condition first. The illuminated and shaded conditions, however, were run consecutively. A typical experimental sequence, for example, was: the chart in light, the chart in shadow, the chips in shadow, and the chips in light. Each O made two matches of each of the five targets. If an O's two lightness matches of a target differed by two or more steps on the comparison chart, a third match was obtained. The geometric mean of an O's matches was taken as representative of his lightness judgment. The order of presentation of targets within a condition was always randomized.

Fifteen adults and 15 children served in the experiment. The children ranged from 5 years 0 months to 6 years 5 months with a mean age of 5 years 9 months. The adults were college students. Each O was seated in front of a table on which was placed a comparison chart of 10 chips ranging in approximately equal visual steps from white to black. The illuminance of the chart was 1.4 ft.-c. The instructions were as follows: "I am going to show you small squares of different colors. Sometimes the squares will be stuck together like this (show the chart), other times they will be alone like this (show individual squares). I would like you to tell me the color of each square. When I show you one of them, I would like you to look at the chart in front of you and point at the one that is most like the one on the board." To familiarize the Os with the task, 3 gray chips of lightnesses not used in the experiment were presented first.

## Results

The geometric means of Os' lightness matches are presented in Figs. 1 and 2. Both the adults and the children made relatively accurate judgments of the lightnesses of the targets on the chart when illuminated. The single chips, however, are consistently matched to comparison targets with higher reflectances. This is not unexpected, since single chips on a black background would tend, on the basis of contrast, to be lighter than the grays on the comparison chart. Constancy of lightness occurs if Os despite the differences in luminance between the targets in light and in shadow match them to the same grays on the comparison chart. It may be seen from Figs. 1 and 2 that on the whole Os' lightness matches in shadow fall below their matches in light. Table 1 shows the number of times that adults and children judged the shadowed targets darker than the illuminated targets. A Chi-square test of the difference in the total number of times the shadowed targets were judged darker by adults and by children on the chart is significant at the .01 level. It

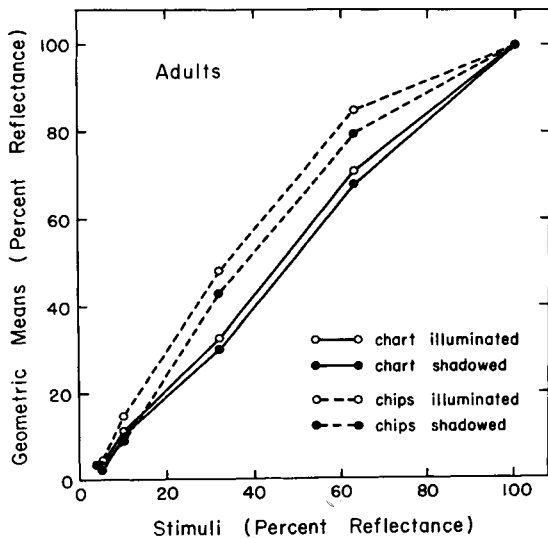


Fig. 1. Lightness judgments of the adults.

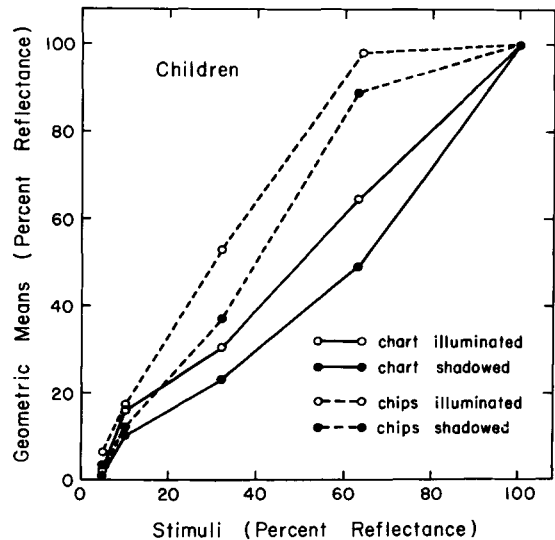


Fig. 2. Lightness judgments of the children.

should be noted that both adults and children showed constancy on the white target (reflectance 100 percent) and tended not to show constancy on the black target (reflectance 5 percent). The difference between the adults and the children occurred on the gray targets. A Chi-square test of the difference in the number of adults and children reporting the shadowed target darker on the single chips is not significant.

#### Discussion

The results of the experiment indicate the importance of the cues in the perceptual situation for developmental differences in lightness perception. The results, however, differ from those of Burzlaff (1931). Burzlaff found that adults showed greater lightness constancy when a single target was presented but that both adults and children showed constancy when charts of grays were used. This discrepancy may be due to the fact that Burzlaff ran his experiment in an ordinary room where the cues for illumination would be greater than in the darkroom where the present experiment was con-

ducted. In general, the results show that age differences in lightness perception may be expected depending upon the clarity and complexity of the cues indicating the illumination distribution in the field. What cues are responsible for the greater constancy adults exhibited on the chart is not clear. Perhaps the presence of the white target on the chart, which always was judged correctly, provided adults, but not children, with an anchor enabling them to make more constant lightness judgments. Whatever the true explanation for the change produced by the chart, the results show that the cue properties of stimuli may influence whether a variation in luminance is seen as a difference in the illumination of a surface or as a difference in the lightness of a surface. This is consistent with the findings of Beck (1965) and Fieandt (Brunswik, 1963, p. 125-127).

Table 1. Number of Times the Shaded Target was Judged Darker than the Illuminated Target

Percent Reflectance	Chart					Chips				
	5	10	32	63	100	5	10	32	63	100
Adults	10	5	5	6	0	11	10	8	5	0
Children	8	12	12	13	0	12	10	11	6	1

#### References

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#### Notes

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