Table 1. Skin resistance values for white and negro children in the St. Louis study. Numbers are average resistance values in kilo-ohms.

Whites		Negroes	
Male (*N*, 65)	Female (*N*, 55)	Male (*N*, 22)	Female (*N*, 32)
Mean			
170.75	168.94	210.09	309.93
Standard deviation			
67.15	67.66	111.79	60.72

1000-ohm deflection was noted which was not associated with a demonstrable external stimulus.

The EEG amplitude was the average of the height of the waves measured from the left parieto-occipital lead at each 1-second interval for 10 seconds of artifact-free record. Resting heart rate was based on the average of the five fastest beats in a 10-second interval. The same 10-second interval was used to obtain skin resistance, skin temperature, and respiration, the average time (peak to peak) of three respiratory cycles. The section for analysis was selected from a stable, artifact-free, 5-minute period of the record.

Autonomic reactivity was the change in skin resistance, heart rate, respiration, and skin temperatures produced by the unexpected sounding of a door bell buzzer located behind the subject. The buzzer was on for 5 seconds.

As in the St. Louis study, there was a significant difference in skin resistance, $t = 6.21$, $p < .001$, between the Negro and white subjects. The mean resistance level for the white subjects was 171,000 ohms compared with 373,000 for the Negro subjects. Only three of the Negroes had skin resistance below 200,000 ohms while 14 of the white subjects had resistances below 200,000 ohms. Sixteen of the Negroes, in contrast to no white subject, had resistance above 400,000. Nine of the Negro subjects had resistances above the 500,000 ohms limit of the scale and their basal resistance level is unknown. There was no significant difference in EEG amplitude, heart rate, respiration rate, skin temperature, spontaneous GSR activity, diastolic and systolic blood pressure, and manifest anxiety. There was likewise no difference between the two groups with respect to autonomic reactivity, including GSR, to the buzzer. The mean ohm decrease to stimuli was 30,000 ohms for Negro subjects and 28,000 ohms for white subjects. As there was a difference in prestimulus level, percentage change scores were also computed. The mean percentage change was 11 for the Negro subjects and 15 for the white subjects. The difference between percentages was not significant for this sample. Six Negro subjects' resistance was beyond the limits of the scale and if a response was present it could not be measured.

The finding of high skin resistance in the 7-year-old Negroes casts doubt on the possibility that the high skin resistance in the adult Negro is due to different life and work experiences. Difference in psychological or situational anxiety also does not appear to be significant. In the San Diego sample there was no difference on the manifest anxiety scale nor did the two groups differ on any of the other autonomic variables, especially EEG amplitude, which is often used as a measure of arousal or activation. Skin color per se likewise does not appear to be the important factor. The melanin-producing cells, which give the darker skin color, are located in the basal layers of the epidermis, stratum malpighii, and not in the stratum corneum where 80 percent of the skin resistance is supposed to be.

Two other possibilities exist. The thicker stratum corneum of the Negro may be the determining factor or there may be a possible difference in number of active eccrine sweat glands. These possible explanations are currently under investigation in a collaborative study with the Dermatology Service of the Naval Hospital.

These results indicate that race must also be included in the growing list of variables that determine the value of skin resistance. That this variable has not been reported to date is surprising but may be due in part to the fact that most GSR research has been done in our predominantly white college campus laboratories.

Whether difference in skin resistance will be present in other racial groups is not known. Data from nine subjects of Mexican or Spanish parents in the San Diego study, however, had a mean resting resistance of 271,000 ohms, which is higher than that of the white subjects but lower than that of the Negro subjects. Robert Malmo (personal communication) in scanning some recent data, noted that skin resistances of certain dark-skinned subjects (for example, subjects from India) were very high relative to those of the white subjects in his experiment. Further study of skin resistance in other races certainly seems warranted (*5*).

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2 November 1962

Somatic Instability Caused by a Cysteine-Sensitive Gene in Arabidopsis

Abstract. *A recessive gene immutans* (im) *is responsible for abnormal chloroplast development which results in variegation in* Arabidopsis *plants. Somatic mutability is simulated, though only functional disorder is involved. Cysteine and low temperature favor normal function, while homocysteine interferes with chloroplast development without producing an adverse effect on the growth of the mutant.*

Among the numerous x-ray induced variegation mutants in the mouseear-cress, *Arabidopsis*, was found, immutans (im) which has a phenotype not unlike those known to be controlled by unstable genes in other species (*1*). The mosaic patterns produced in the plants by this mutant range from nearly *albina* with widely scattered small specks of green to a condition in which the reverse situation prevails (Fig. 1). In the white tissues the chloroplasts fail to develop normally and their growth is arrested before differentiation is completed.

The mutant is temperature sensitive. If the plants are cultured on a glucose-agar mineral medium (*2*) at a constant temperature between 20° and 25°C with continuous illumination the cotyledons are either green or variegated and the rosette leaves exhibit relatively few,

Table 1. Effects of temperature on fresh weight and pigment content of *im* mutants of *Arabidopsis* plants cultured on glucose-agar mineral medium, with 8 hours of daily illumination at 300 ft ca. Pigment content in 85 percent acetone extract was determined by Röbbelen's technique (*3*).

Fresh weight (mg)	Pigment content (μg/g fresh wt)			
	Chlorophyll		Carotenoids	Total
	a	*b*		
High temperature 25° to 28°C day; 20°C night				
14.3	111.7	44.4	49.5	205.5
Low temperature 20°C day and night				
9.7	1036.9	428.7	269.9	1735.5

but well-defined, green sectors on an otherwise white background. At temperatures between 25° and 28°C with continuous illumination, the majority of the cotyledons are white or nearly white and the rosette leaves are predominantly white with some very few specks of green. When the mutants are subjected to temperatures below 25°C but are given only 8 hours of 300 ft ca illumination per day, a definite increase is produced in the number and size of the green sectors. No information is available concerning mutants grown under similar illumination at a constant temperature higher than 25°C because of poor survival at these conditions.

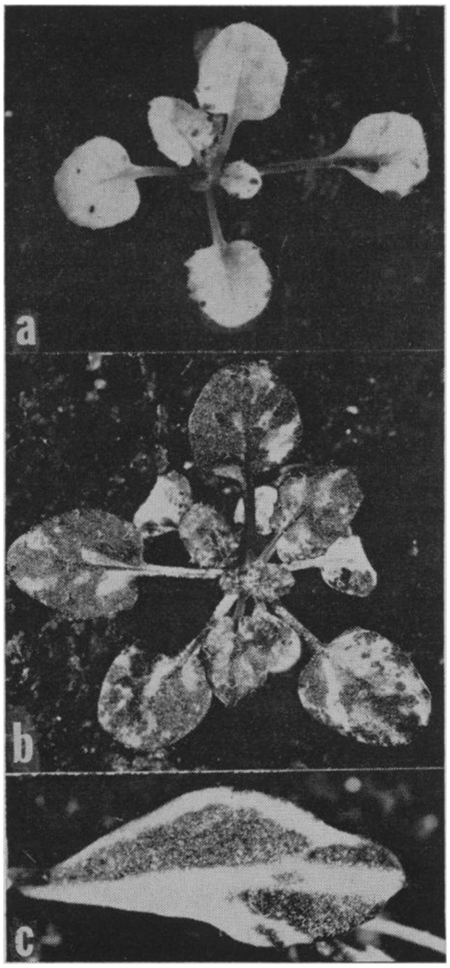

Fig. 1. Mutants grown with (*a*) high temperature and continuous illumination and (*b*) low temperature and short illumination. (*c*) Stem leaf with sectors reflecting the direction of leaf differentiation.

Plants grown on glucose-agar mineral medium with 8 hours of light per day developed faster at a higher temperature and produced elongated stems and well-formed flower buds within 60 days after being planted, but their pigment content was lower than that of those cultured at the lower temperature. Table 1 shows the results obtained under the different experimental conditions. On this same date, the plants which were given the second treatment did not have visible flower primordia upon macroscopic examination.

Further tests revealed that *im* mutants are not only sensitive to temperature and daylength but they also respond to treatment with cysteine. This amino acid is quite unstable at *p*H 5 and is oxidized rapidly to cystine. Notwithstanding this, and under conditions unfavorable to chloroplast differentiation (a temperature 23°C and constant illumination), mutants cultured on a cysteine-HCl-hydrate supplemented medium of about *p*H 5 produced a strikingly higher number of green sectors on otherwise albina rosette leaves than did the controls. There was very little difference of variegation in the cotyledons between the controls and the treated plants. In the rosette leaves there is, however, a definite gradient in both sector number and total pigment content as a result of cysteine concentration (Fig. 2).

The ratios of chlorophyll *a* to chlorophyll *b* and the chlorophyll-carotenoid were essentially the same in the mutant and in the normal green wild-type plants. This shows that pigment synthesis is normal in the green sectors of the variegated leaves. Greater pigment content did not result in a corresponding increase in plant weight, which suggests that the photosynthetic activity may be lower than normal in the green sectors of the mutant.

While traces of cysteine definitely promoted chloroplast differentiation in the mutant, cystine and homocysteine seemed to have an inhibitory effect. The rosette leaves of 17 homocysteine-treated plants were completely devoid of green cells (some greening, however, occurred in the cotyledons). On the other hand, the 20 plants which received the highest concentration of cysteine produced a total of 629 green sectors, and the 19 controls grown on a basal medium displayed 179 green sectors. Mutants receiving homocysteine as a supplement contained only one third as much total pigment as the controls and less than 6 percent as much as the wild-type plants. In spite of the almost complete inhibition of normal chloroplast development, the growth and development of the homocysteine-treated plants were fairly normal. Their fresh weight was even slightly higher than that of the controls and about half that of the wild-type plants. It appears then that homocysteine interferes specifically with chloroplast development in the mutant.

Gene *im*, which controls whether or not a "proplastid" develops into a normal chloroplast is a simply inherited recessive. Progeny of seeds derived from white sectors display the same variegation spectrum as do plants derived from green sectors. Thus the white and green cells of the *im* mutant apparently do not differ in their genetic code. The developmental pattern of a given sector, however, closely follows the direction of leaf differentiation, that is, cell division (Fig. 1*c*). Whether a given cell will produce normal or abnormal chloroplasts may be due to (i) the state of the gene itself, (ii) an inconsistent (unstable) translation system or the production of an ambiguous mes-

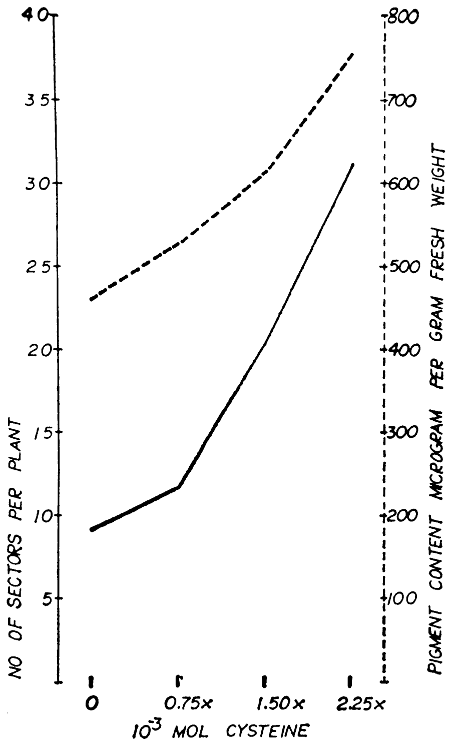

Fig. 2. Number of green sectors (solid line) and total pigment content (dashed line) as functions of cysteine supply.

sage, or (iii) a hypersensitive protein product.

The cellular physiology of this controllable instability may be interpreted in terms of several equally plausible hypotheses (redox changes, enzyme activation, feed-back mechanisms) which are amenable to experimental tests (*4*).

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26 December 1962

Cultural Differences in the Perception of Geometric Illusions

Abstract. *Data from 15 societies are presented showing substantial intersocietal differences of two types in susceptibility to geometric optical illusions. The pattern of response differences suggests the existence of different habits of perceptual inference which relate to cultural and ecological factors in the visual environment.*

Stimulus materials based upon geometric illusions were prepared in 1956 for standardized administration under varying field conditions in an effort to encourage the collection of cross-cultural data that might bear on the nativist-empiricist controversy concerning space perception (*1*). Over a 6-year period anthropologists and psychologists administered these tests to 14 non-European samples of children and adults, ranging in size from 46 to 344 in 12 locations in Africa and one in the Philippines, to a sample ($N = 44$) of South Africans of European descent in Johannesburg, to an American undergraduate sample ($N = 30$), and to a house-to-house sample ($N = 208$) in Evanston, Ill. In all, data were collected from 1878 persons. Analysis of these protocols provides evidence of substantial cross-cultural differences in response to these materials. The nature of these differences constitutes strong support for the empiricistic hypothesis that the perception of space involves, to an important extent, the acquisition of habits of perceptual inference.

The stimulus materials to be considered here consisted of 39 items, each one a variation of one of four figures constructed of straight lines, generally referred to in the psychological literature as perceptual, or geometric illusions. These were the Müller-Lyer figure (12 items), the Sander Parallelogram (seven), and two forms of the Horizontal-vertical figure (nine and eleven). For each illusion the discrepancy in length of the segments to be compared varied from item to item so as to permit the employment of a version of the psychophysical method of constant stimuli. As each stimulus was shown to a respondent, his task was simply to indicate the longer of two linear segments. To minimize difficulties of communication, the materials were designed so that the linear segments to be compared were not connected to the other lines, and were printed in different colors. Respondents could indicate choice by selecting one of two colors (saying *red* or *black*) in response to the Horizontal-vertical items, and by indicating *right* or *left* for the other illusions. Other steps taken to enhance the validity of response protocols included the administration of a short comprehension test requiring judgments similar to, but more obvious than, those demanded by the stimulus figures. Nonetheless, since no amount of precautionary measures could insure the elimination of all sources of error (for example, communication difficulties, response sets, and so forth) which could result in artifactually produced cross-cultural differences, an internal consistency check was made and all protocols containing gross departures from orderliness were withheld from analysis. (Another analysis was performed with all 1878 cases included, and the results were substantially the same as those obtained in the analysis of consistent cases only.)

The analysis proceeded as follows: Each respondent's four protocols were first examined for evidence of internal consistency. To be considered consistent, a protocol had to contain no more than one Guttman error (*2*). Each consistent protocol was then assigned a score which was simply the total number of times in that stimulus set that the respondent chose the typically overestimated segment. The mean of these scores was computed for each sample, and differences between pairs of means were evaluated by *t*-tests with significance levels modified by the Scheffé procedure (*3*) to compensate for the increase in error rate that accompanies nonindependent, multiple comparisons.

On both the Müller-Lyer and Sander Parallelogram illusions the three "European" samples made significantly more illusion-produced responses than did the non-European samples. (The innumerable *t* ratios resulting can only be sampled here. For example, on the Müller-Lyer illusion, comparisons of the Evanston sample with the non-European samples resulted in *t* ratios ranging from 7.96 to 15.39. A value of 3.57 is significant at the $p = .05$ level by the Scheffé test.) On the latter two illusions, the European samples had relatively low scores, with many, but not all, of the non-European samples having significantly larger mean scores. (For these illusions, the largest *t* ratios, up to 17.41, were found between pairs of non-European groups. Comparisons involving the Evanston sample and five non-European groups resulted in *t*'s ranging from 11.04 to 4.69.) When the samples were ranked according to mean number of illusion responses on each illusion, and the rank order correlations among the five illusions factor-analyzed, two orthogonal factors emerged; the Müller-Lyer and Sander Parallelogram illusions loaded highly on one, and the Horizontal-vertical illusions loaded highly on the other. Thus, the overall pattern of intersample differences indicates not only cross-cultural differences in illusion susceptibility, but in addition a systematic variation in those cross-cultural differences over two classes of illusion figures.

Both to illustrate and substantiate the findings which emerged from the analysis just described, proportions of individuals in each sample choosing the typically overestimated segment were computed for each item, separately for each illusion set. Psychophysical ogives were then constructed from these proportions and points of subjective equality (PSE) determined graphically. Table 1 contains PSE scores and mean number of illusion-responses for all samples on each of the illusions. (The scores shown in Table 1 were computed for internally consistent cases only, and, except where otherwise noted, the groups consisted of children and adults combined. In samples containing both children and adults, children typically had higher means and PSE's. Combining children and adults