MOOD JUDGEMENTS IN BLACK AND WHITE PICTURES AS A FUNCTION OF TONALITY AND POLARITY

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Abstract—The importance of line, shape, texture and colour in the aesthetic response to pictures is well established. This study seeks to study one aspect of colour, the distribution of light and shade, and to see how this affects a picture's mood. It follows the suggestion of Graves in looking specifically at two factors in tonality, contrast and lightness, as well as polarity. Subjects were requested to select which version of a picture best suited a particular mood word. The results confirmed the importance of the stimulus variables investigated and indicated a degree of consistency between different pictures.

INTRODUCTION

Line, shape, texture and colour are all vehicles for the communication of affect in pictorial art (Valentine, 1962). This article is concerned with how one dimension of colour — value, tone or lightness — influences a picture's mood.

Tonality is loosely defined in dictionaries (e.g. "the colour scheme of a picture" and "the overall scheme of colours and tones in a painting"). Despite a certain ambiguity, the fundamental idea is of a distribution of tones without reference to hue or saturation. Graves (1951, p. 276) (whose name is given to the Graves Design Judgement Test) argued that although the matter of tonality had been more or less vaguely recognized by artists and discussed in loose and general terms, no one had yet defined the tonalities which he considered to be so important in art. He preferred the terms *value key* or *key* in place of *tonality* but we will use the latter. *Value, tone* and *lightness* may be considered as synonyms here. Graves (p. 431) defines tonality as "a particular relationship of values in a painting, lithograph, etching etc., which is specified according to the dominant value and the darkest and lightness rather than *dominant value*, getting away from his subjective use of the term dominant — Graves does not necessarily mean largest area.

Having fixed the tonality of a picture it is still possible to radically alter its appearance by reallocating the tones to different areas. This can be done by changing *the polarity* of the picture from positive to negative (by analogy with the photographic process), that is, changing the darkest areas into the lightest and vice versa.

Experimental psychology has concerned itself with the affective (feeling or emotional) response to colours (Valentine, 1962, p. 53), and the influence of colour on the meanings of objects (Tannenbaum and Osgood, 1952, p. 299) and sculptures (p. 301). It has also addressed itself to the complex problem of predicting responses to combinations of colours (Hogg, 1969). Graves' view is that the way to a better understanding of how colours combine is via the concept of tonality. A picture's *mood* is the prevailing atmosphere, character or feeling associated with it. This may be evoked by many aspects of the picture including its content, texture, lines and colour. Even children of pre-school

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age (Lawler and Lawler, 1965) appear to have colour-mood associations but there appears to be a dearth of empirical work on the relationship between *tonality* and mood although discussion on such matters is not new.

Possibly because of the difficulty in producing large areas of reproducible and standard colours, the stimulus materials used in studying aesthetic responses to colours have tended to be small chips from charts and these are arguably remote from the stimuli which usually occasion aesthetic responses. We thought that more sophisticated stimuli would engender a more serious attitude in the subjects and encourage more reliable and valid responses. Attempts have been made to predict the observer's response to simple combinations (Hogg, 1969) but here again the stimulus materials, quite understandably, have been rather synthetic, consisting of simple combinations of colour chips.

If we simplify the problem of the response to colour combinations by leaving out two of the three colour dimensions used in the Munsell system, hue and chroma, then the problem becomes more tractable. It is then possible to use a photographic medium to investigate just one colour dimension, value or lightness, but in a more realistic and less artificial manner and also in a little more depth. It must be admitted that photographic stimuli do have two drawbacks: (i) they are not absolutely neutral in colour; and (ii) the range of values obtainable is rather limited when one compares it with the range of Munsell values, stopping well short of the blackest and whitest. Even so, quasi-grey or *black and white* photographs have become their own standard and remain a major medium of pictorial communication for the average person.

The aim of this paper is to establish the effect on subjects of combinations of quasi-grey colours, where only lightness or value is varied, and to see how mood may be affected by the tonality and polarity of black and white pictures. Graves suggested a classification of value keys (tonalities) in 1951 (p. 276) saying: "The matter of key has been more or less vaguely recognised by artists and has been discussed in rather loose and general terms. To my knowledge no one has yet named or defined these keys that are so important in art." To explain his scheme, he used pictures incorporating just three shades of grey, a simplifying action which we also followed. His classification involved two factors, contrast and lightness, and he identified eight different tonalities. In order to achieve a factorial (2 X 3) classification we selected the six most important of these by incorporating two levels of contrast — low and high — and three levels of median-lightness — dark, intermediate and light. We also decided to include the third dimension of polarity.

The stimuli used in our study were five faces and the abstract design used by Graves in illustrating his scheme. Twelve versions of each of the faces and six versions of the abstract (the positive and negative versions of the abstract differ only in orientation, making only one necessary) were produced directly on photographic paper under computer control using a microfilm plotter, as this permitted precise manipulations of the images. Clearly there is an enormous range of images that might have been used without exhausting the conventional subject matter of art. It might be expected that tonality and subject matter will *interact* to affect moods. Despite this it was thought that five portraits and an abstract would provide a reasonable test of generality of any trends, and provide a useful starting point.

Materials

METHOD

The original pictures from which the stimulus materials were produced were drawings and photographs. These were either digitized to 10 levels of lightness subjectively or to over 30 objectively, using an Optronics P-1000 Photoscan instrument. Areas of similar shades were then amalgamated so that each picture was reduced to three shades of grey. This was done on a trial and error basis under computer control until a picture was obtained which was recognisably similar to the original and where (with the exception of the abstract) no shade covered less than 15% of the total area. The resulting percentage areas of all pictures are given in Table 1. There were three female faces, two male faces and an abstract taken from page 283 of Graves' book.

Table 1. Distribution of shades of grey in the stimulus materials in terms of the percentage area covered

	The three areas of the pictures				
	Darkest	Median lightness	Lightest		
First female face	33	23	44		
Second female face	28	21	51		
Third female face	15	33	52		
First male face	38	45	17		
Second male face	19	22	59		
Abstract picture	5	89	6		

Each picture was printed directly onto photographic paper in six different tonalities using an FR80 microfilm plotter — see the six columns of pictures in Fig. 1 as an example. There were two dark tonalities where the median-lightness area was printed a dark grey (approximately Munsell N4/ — that is around 10% reflectance, R), two intermediate mid grey (ca N6/; ca 30% R) and two light grey (ca N9/; ca 80% R). In Fig. 1 these correspond to the left, centre and right blocks of four pictures respectively. One each of the dark, intermediate and light tonalities was also low in contrast while the other was high. For the low-contrast pictures the difference in lightness between the darkest and lightest areas was judged to be around one unit on the Munsell value scale, while for the high-contrasts the difference was approximately five units. Thus in Fig. 1 the contrasts of the pictures alternate between low and high from left to right. For all low-contrast and for the intermediate-lightness, high-contrast pictures, the lightest and darkest areas were equidistant in lightness from the median-lightness areas. However, for the dark, high-contrast and the light, high contrast pictures the distances were unequal. This was because it was not possible to get greys very much higher than around N9/ or lower than around N4/.

Different shades of grey were approximated by drawing lines of differing intensity, thickness and proximity. Close scrutiny reveals a varying texture, but at normal viewing distance the impression is one of more or less homogenous areas. Each picture was between 150 mm x 150mm and 150mm x 240 mm in size and was composed of between 13,000 and 22,000 squares or rectangles.

For each set of faces two versions of each of the six tonalities were produced — one normal of positive polarity and .the other negative with the lightest and darkest areas interchanged — to give 12 pictures in all. In Fig. 1 the pictures in the top line are all positive and those in the bottom negatives.

Each picture was mounted on card and covered with transparent self-adhesive film to retard colour changes presumably due to the action of oxygen. Previous experience had



Fig. 1. This is one of the five sets of faces. It is the second female and was digitized electronically. From left to right the tonalities are dark, low-contrast; dark, high-contrast; intermediate, low-contrast; intermediate, high-contrast; light, low-contrast; and light, high-contrast. The pictures in the top line are of positive polarity and those in the bottom negative. Photography and printing have distorted the original shades of grey in this illustration. shown this to work and it also protected the stimuli from physical damage. The protective film gave each picture a glossy finish.

Subjects and procedure

The subjects were unselected students and staff who came mainly from the Technology Faculty of Manchester University. Each of them was asked to make judgements on no more than three sets of pictures. Each set was judged by at least 45 people. On the few occasions when a subject returned an incomplete set of responses, his other results were discarded.

Each set of six or 12 pictures was shuffled before being dealt out i n a 3 x 2 o r 4 x 3 array. No particular care was taken over the illumination beyond ensuring that the level was adequate for subject comfort and that specular reflections interfered minimally with the task. Twelve words were chosen either on the basis that previous studies (e.g. Tucker, 1955) had shown them to be relevant to judgements of colours or because we thought they might be important for such judgements. The 12 words formed six bipolar pairs although the subjects' attention was not drawn to this explicitly. The words were presented in the following sequence '.peaceful, energetic, hot, cold, evil, good, ugly, beautiful, happy, sad, ferocious and gentle. For each word the subject was asked to choose that picture from the set which they judged to best fit that mood.

RESULTS

The percentage frequency with which portraits of positive and negative polarity, and low and high contrast were chosen is given in Table 2. One hundred and eighteen people made a total of 235 selections for each word. The most frequent polarity of chosen pictures was consistent for all five faces for each word with the exception of *ferocious*, *cold* and *hot*. The modal contrasts of selections were similarly consistent with the exception of those for *happy*. Apart from these exceptions all modes were statistically significant.

Table 2. Most frequently chosen polarities and contrasts for each word

Mood word	Polarity	Contrast	
Peaceful	80 positive	91 low	
Energetic	78 positive	88 high	
Gentle Ferocious	79 positive (61 negative)	92 low 82 high	
Good	87 positive	71 low	
Evil	75 negative	75 high	
Beautiful	88 positive	73 low	
Ugly	72 negative	73 high	
Cold	(56 positive)	63 low	
Hot	(55 negative)	72 high	
Sad	62 negative	82 high	
Happy	89 positive	(50 high)	

Note. The table gives the percentage frequency with which portraits of the two polarities and contrasts were chosen to represent the above mood words. Where the choices were not consistent between the five faces this has been indicated by parentheses. For each word 100% represents 235 choices made by 118 people.

Table 3 shows the relative frequency with which portraits of dark, intermediate and light median-lightness were chosen to match the mood words, x^2 tests (3 x 5) give statistically significant evidence of a variation in choices between faces for only *peaceful* and *gentle*; however, the modal choice was identical for only five of the 12 words. Dark tonalities were consistently chosen most often for *ferocious, evil* and *ugly*, and light for *cold* and *happy*.

The abstract figure also used as a stimulus is a sample of one, so any deductions must be cautious. However, it is not being considered alone, so clearly it is of interest to see whether the results for this abstract (included because it featured in Graves' book) matched those of the faces. The most frequently chosen median-lightness choices of 45 subjects were identical to the aggregate modes given in Table 3 for the faces for ten out of 12 words. The exceptions were *peaceful* and *gentle* where the most frequently chosen abstracts were of light tonality although, as with faces, the dark pictures were least chosen.

The similarity of the abstract and face results is less marked when contrast is considered. There is a clear difference for *good*, *beautiful* and *ugly* where opposite contrasts were chosen more often.

Mood word	Dark	Intermediate	Light	Median-lightness x faces
Peaceful	20	45	35	**
Energetic	26	29	44	n.s.
Gentle	13	48	39	*
Ferocious	52	28	20	n.s.
Good	19	39	42	n.s.
Evil	52	26	22	n.s.
Beautiful	23	40	37	n.s.
Ugly	43	35	22	n.s.
Cold	26	24	50	n.s.
Hot	47	18	35	n.s.
Sad	42	36	22	n.s.
Нарру	23	33	44	n.s.

Table 3. Relative frequencies of median-lightness choices for each word

Note. The above gives the percentage frequencies with which portraits of the given median-lightness were chosen to represent the above mood words. Where the most frequently chosen version is consistent between the five faces this has been indicated by italicizing the figures. The x^2 test indicates whether there is statistical evidence of variation in median-lightness choices between faces. * p<0.05(df = 8); **p<0.01(df = 8). For each word 100% represents 235 choices made by 118 people.

DISCUSSION

Contrast appears to be the most important of the three stimulus variables manipulated. For the portraits *peaceful, gentle, good, beautiful, cold* and *sad* are represented most often by low-contrast choices while most of their opposites — *energetic, ferocious, evil, ugly* and *hot* — are represented by choices of high-contrast (Table 2). The distinction is particularly great *for peaceful-energetic* and *gentle -ferocious*. It could be argued that in one instance this was due to mere semantics, as it is possible to refer to a "gentle" contrast and *denote* a low contrast but in all the other cases the mechanism would appear to be one of association or *connotation. Happy* is alone in not being linked to either contrast.

Polarity is also particularly relevant for a number of words. *Peaceful, energetic, good, beautiful* and *happy* all prompt the choice of positive versions while *ugly* and *sad* are alone in consistently suggesting negatives (Table 1).

Median-lightness appears to be important for at least five words with *ferocious, evil* and *ugly* requiring dark tonalities, and *cold* and *happy* requiring light ones (Table 3).

It is clear that there are some differences between the results for the faces and the abstract picture. The most probable explanation may lie in the very large difference in distribution of tonal values. Table 1 shows that the darkest and lightest areas of the pictures take up between 55 and 79°70 for the portraits but only 11% for the abstract. Alternatively the discrepancy may reflect the difference in subject matter. *Good, beautiful* and *ugly* may be expected to take on significantly different connotations when applied to different subject matter and perhaps it is naive to expect a distribution of tonal values, for example, which best reflect *beauty* in a girl's face to be the same for those best reflecting *beauty* in an abstract, although this type of consistency appears to have been Graves' expectation.

From our results it is not possible to plot the positions of value keys in ^-dimensional semantic space as it would have been if each picture in every set had been rated on all bipolar adjectival scales. This approach was initially attempted and would certainly have returned elegant results if it had succeeded, but the pilot study suggested that the task was too onerous and likely to provide less reliable or valid results. The non-parametric approach adopted was less demanding for the subjects. It also has the advantage that fewer assumptions are required in interpreting the results. For example, it is not essential to assume that the adjective pairs form linear bipolar scales.

As explained before, the range of grey shades obtainable using this photographic technique is a restricted one, particularly towards the black end of the Munsell value scale. Our dark values are not as dark as Graves defines them (ca. N4/ compared with Nl/—N3/). However, intermediate and light values, and low and high contrasts are all within his definitions. We argue that the discrepancy with dark values is not as serious as it may appear from the above, as the *relationship* between dark, intermediate and light values remains as it was defined by Graves. Also we argue that people are familiar with the convention of regarding the dark grey areas of photographs as "black".

Graves (p. 276) argues:

Value key or tonality of a painting ... is of prime importance. It is the first impression received and immediately engenders an emotional response irrespective of subject matter or composition ... subsequent reactions to subject and composition may intensify or somewhat neutralise the first impression, but they cannot change it fundamentally.

Our results clearly support his view in part in that where the subject matter was similar and the distribution of light and shade not very different (the portraits) our results were very alike. However, where he argues that subject and composition cannot change the response he appears to be wrong. Our results suggest that in his zeal to educate he has made simplifications which overstate the case a little. We did find significant differences between the responses to the portraits and those to the abstract which we tentatively attribute to subject matter and/or distribution of shades of grey. The differences were perhaps most marked where contrast was concerned.

Despite these differences we should not lose sight of the considerable similarity in the responses to the portraits and indeed a degree of similarity between them and the responses to the abstract, single as it was. Statistically significant differences between the faces did not in the main reflect large differences — the modal responses were usually identical. It should also be noted that when subjects made their responses they were faced with random displays. The pictures were not laid out systematically as in Fig. 1. Layout

could not therefore have accounted for any similarity in the results and might well have made the task more difficult.

The choice of words in this experiment was not determined by Graves' assertions so we are unable at this stage to comment on the validity of some of his other statements. Graves appears to take an almost biological view (p. 276):

Like all animals, we are extremely sensitive to light . . . Sunlight stimulates, twilight calms and darkness depresses with fear and mystery. There are universal reactions to light and are as ancient as Adam. . . . the intensity of light reflected in the eye determines the primary emotional response.

Whatever the initial origins of the associations, we would assume that the language of tonality is one maintained by social conventions — traditions fostered by educational association.

CONCLUSION

This study extends previous experimental work on the psychology of art by showing how polarity and tonality, in the form of contrast and lightness, play an important role in determining a picture's mood. While not ruling out interactions with other aspects of a picture's composition or its subject matter, the results show a significant degree of consistency across the pictures used.

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REFERENCES

Graves, M. (1951) The Art of Color and Design. McGraw-Hill, New York.

Hogg, J. (1969) The prediction of semantic differential ratings of color. J. gen. Psychol. 80, 141 — 152. Lawler, C. O. and Lawler, E. E. (1965) Color-mood associations in young children. J. genet. Psychol. 107, 29 - 32.

Munsell Color Company (1963) Munsell Book of Color. Munsell Color Company, Baltimore. The Psychological Corporation (1948) Maitland Graves Design Judgement Test. The Psychological

Corporation, New York. Tannenbaum, P. H. and Osgood, C. E. (1952) Reported in C. E. Osgood, G. J. Suci and P. H. Tannenbaum

(1957) *The Measurement of Meaning.* University of Illinois Press, Chicago. Tucker, W. T. (1955) Experiments in aesthetic communications. Reported in C. E. Osgood, G. J. Suci and

P. H. Tannenbaum (1957) *The Measurement of Meaning*. University of Illinois Press, Chicago. Valentine, C. W. (1962) *The Psychology of Beauty*. Methuen, London.

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