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COLOUR
AS AN ENVIRONMENTAL EFFECT
ON
INTERPERSONAL AFFECTIVE
BEHAVIOUR

Richard Veale Peach

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CHAPTER 1
INTRODUCTION

The Concerns of the Present Study

The present study primarily concerns the relationship between coloured lighting (red and blue, with white as an achromatic control) and attraction toward another individual; an individual who may have similar or dissimilar attitudes to those of the subject. The question asked was whether the colour of a room's illumination affected interpersonal evaluation of another person whom the subject had not previously met. That is, will coloured illumination affect liking of the stranger either negatively or positively, over and above the effect that knowledge of the stranger's attitudes will have on the subject's judgement? Is attraction a function of colour of environmental illumination and attitude similarity?

Questions subsidiary to the above but of basic importance to the present study are; whether mood is affected positively or negatively by coloured room environment; whether concepts are more negatively or positively evaluated under different colour conditions and whether aspects of semantic meaning are differentially affected under different lighting conditions. Finally Berry's (1961) finding of different heat perception over colour environments was retested.

The Two Aspects of the Present Study

The first question posed above is couched in two assumptions,
one: the general assumption that seemingly psychologically "inert" factors of the physical environment can affect ongoing dynamic psychological processes and,
two: the specific assumption that attitude similarity has an effect on interpersonal attraction. These assumptions divide the theoretical and empirical background of the present study into two.

Because the first assumption affects a greater number of the questions being asked by the study, it will be discussed first.

Aspect One: Environmental Effects on Psychological Processes, and Specifically, the Effects of Colour

Relatively recent research has indicated psychologists' increasing interest in the psychological effects of the physical environment. They have been investigating these effects under the new banners of "environmental psychology", "architectural psychology" and "ecological psychology". Studies in these areas have considered the effects of the physical environment on physiological, psychological, and social processes. Reviews of the scope of environmental psychology are given by Rohles (1967) and Craik (1970).

As with the present study, the four studies reviewed below consider environmental effects present in a single room.

Depending on whether subjects were in a "beautiful", "average" or "ugly" room Maslow and Mintz (1956) found that student subjects made different ratings of the "fatigue-energy" and "displeasure - well-being" of facial photographs. Mintz (1956) also noted that the environmental effect continued over a three week interval without "adaptation" to the environment.

Sommer and Ross (1958) using experimentally derived rearrangement of furniture were able to double the amount of social interaction in what previously had been considered a "model" geriatric ward.

Griffitt (1970) tested the hypothesis that "If one is made to feel 'bad' (uncomfortable, unhappy, unpleasant, etc.), the evaluation of and attraction toward persons in such a context would be expected to be more unfavorable than in a situation in which one feels 'good' (comfortable, happy, pleasant, etc.)" (pp. 240-241).

Subjects were placed in either of two temperature conditions "normal" and "hot". The high effective temperature condition was rated as more unpleasant on measures of "feelings" and as warmer

than the normal condition, and these feelings and temperature ratings were negatively correlated for both first and second assessment periods. Importantly, mean attraction responses on the last two items of the Interpersonal Judgement Scale were shown to be significantly more negative in the "hot" than in the "normal" condition. Self ratings on the Nowlis Mood Adjective Check List items "elation", "concentration", "fatigue" and "vigor" were also found to vary as predicted by Griffitt's hypothesis.

Choice of the present Environmental Variable

These studies suggest that the single room is a viable place to study environmental effects. "Ugly" and "beautiful" in the context of Maslow and Mintz's work are not very meaningful terms. However, Griffitt's study indicates that the effect of single environmental variables can be meaningfully researched. Griffitt selected temperature, as it was an ambient environmental factor. Colour illumination particularly within the confines of a room was chosen for the same reason in the present study.

Apart from its ambient nature, both folk lore and psychological literature indicate that colour is a legitimate variable to consider for its effect on psychological processes.

Different colours through the centuries have had many different associations. These associations have been largely related to religious and mythological beliefs. Today there are still remnants of these beliefs exemplified in the continued allocation of different colours to the different signs of the Zodiac: red for Aries, dark green for Taurus, brown for Gemini, silver for Cancer, gold for Leo, variegated hues for Virgo etc.

In late nineteenth-century England, "quack" Colour Therapists or "chromopaths" such as Edwin Babbitt with his "Thermolume cabinet" flourished. Incredible claims were made for the healing powers of different coloured lights. Colour therapists still operate in most large centres in New Zealand and also claim diagnostic and healing powers. Colour enthusiasts such as Faber

Birren, while a little more sophisticated than his predecessors still have great faith in the effects of colour on human behaviour:

"Yet as will be clarified, physical effects of colour may take place independently of vision. Men and animals, like plants may be variously influenced by colour in their life-processes, their health, sickness, and well-being, whether or not the colour is actually seen by them." (Birren, 1961, p. 106).

What follows is a review of some of the findings reported in the psychology literature regarding the effects of colour. These findings will be discussed under six headings.

A Review of the Experimental Findings on Colour

1. Emotional Arousal

Projecting red, blue and white lights of equal brightness for 10 minutes on 24 normal adult subjects, Gerard (1958) found that the autonomic nervous system and visual cortex were significantly more highly aroused under red or white light than under blue illumination. The different colours also elicited significantly different feelings, that is, greater relaxation, less anxiety and hostility during blue and more tension and excitement during red illumination. Significant correlations between manifest anxiety level, physiological activation and subjective disturbance during red stimulation were found. The rejection of the null hypothesis of quiescence suggested that blue illumination might benefit individuals with chronic tension and anxiety.

The hypothesis that "there are more word-association disturbances under both red and green conditions than under grey conditions; and red conditions elicit more word-association disturbances than will green conditions" (Drechsler 1960, p. 324) were tested by Robert Drechsler. He projected homogeneous rectangles of bright red, green and grey onto a screen and followed each visual stimulus by an orally-presented word association test. "Several disturbance measures revealed statistically significant differences between colours, and all supported hypothesis one. Reaction time measures showed significant differences in support of hypothesis two." (Drechsler, 1960, p. 328). Drechsler

tentatively interpreted his results in terms of an intrusion hypothesis with different colours intruding differentially depending on the associations they roused.

Nourse and Welch (1971), tested the hypothesis suggested by Wilson in 1966 that "hues at the end of the visible spectrum are more arousing than those located toward the middle". (Nourse and Welch, 1971, p. 403).

Subjects sat in front of a glass screen 18 inches square behind which shone a green and violet light source in the form of a cross and a X respectively. After seven minutes light adaption, subjects were exposed to one minute of one set of lights and one minute of the other, for the next six minutes. While there was a decline in effect after the first change and an interaction effect between order and hue there was significant difference in galvanic skin response with violet scoring over green, thus supporting the hypothesis.

If, as these three studies indicate, the colours at the two ends of the visible spectrum are more arousing than those in the middle and red is more disturbing and creative of anxiety and hostility than blue light, it seemed logical that the present study employ these two colour conditions, to compare with responses under normal white light. These findings suggest that interpersonal evaluation might be expected to be more negative under red light than blue. Both the colour conditions could be expected to elicit different responses from those elicited under white light illumination.

2. Perception

Size. Using 20 subjects sitting 150 cm away from a screen, Sato (1955) obtained judgements of the comparative sizes of two pieces of Zimmermann's standard coloured papers. He compared red, orange, yellow, yellow-green, green, blue-green, blue, indigo, violet, purple, white and black each with the other.

With regard to the judged sizes of red and blue cards, red was found to be "unsettled" in its effect. It was overestimated in

relation to blue indigo, violet and purple and underestimated in comparison with yellow, yellow-green and orange. Blue cards were found to be generally underestimated. These findings fit well with those for the effect of colour on emotional arousal. However, the place that hue plays in these results is placed under question by Sato's correlation of 0.95 between ranked brightness and quantity of over-estimation. This correlation is supported by other findings concerning colour as an independent variable in perceptual research. In a review of the literature Payne (1964) states that luminance or brightness appears to be the major cue to apparent size, distance and weight.

However, Sato's correlation and Payne's conclusion that "there are no studies in the literature of the effects on apparent size of varying the hue under constant luminance conditions" (Payne, 1964, p. 202), point to the need for future research on the possible effect of hue on perceived size, unconfounded by differential levels of illumination. The present study attempted to avoid this absence of experimental control.

Time and latency of autokinetic effect. Smets (1969) found that an observer perceives the time interval spent before a red colour stimulus as shorter than an objectively identical time span before a blue colour stimulus. She concluded (in line with Gerard, 1958) the difference was due to different arousal levels, red creating greater arousal than blue.

Possibly related to the differential arousal explanation is the finding that colour was significant ($p < .005$) with red light having a longer latency than the other hues, blue, green and white, on the autokinetic phenomenon. This result by Marone and Coutu (1969), is a little under suspicion as out of eight occurrences of no movement seven were by four subjects during presentation of red light, and the eighth no-movement response was reported by a fifth subject in the blue light condition. When these five extremes scoring individuals were removed from the analysis, no significant results were found. A very similar study in 1970 by Reeves, Cogan and Cogan, found no reliable differences in the extent of movement among the four colours red, green, blue and yellow.

Taste. Also tentative but inconclusive are Pangborn's (1960) findings on the influence of colour on the discrimination of sweetness. Using trained and untrained panels of judges and a method of paired comparison in judging various aqueous and nectar solutions, Pangborn found that untrained panels had a slight tendency to ascribe greater sweetness and greater flavour to orange and red-coloured solutions containing apricot and cherry flavouring, especially when sucrose differences were very small. While sweetness discrimination was not influenced by red, green or yellow colouring in unflavoured aqueous solutions, there was a pronounced tendency to designate the green coloured samples as the least sweet in pear nectar solutions. Pangborn suggests that green is associated with tartness or lack of sweetness.

Temperature. In a thorough experiment where 25 subjects both male and female thought they were being tested on the effects of coloured lighting on driving skills, Berry (1961) demonstrated convincingly that while temperature tolerance across colour conditions did not differ significantly, the perception of which colour environment produced the most heat did. Thus, subjects ranked the room hottest when white, then yellow, amber and green, with blue the coolest. Berry concluded that coloured environments will not alter heat tolerance but despite this the belief that they do will still live on. The present study attempted to replicate this result.

Perceptual defense. Hammes (1961) presented high- and low-anxiety subjects, chosen on a scale of manifest anxiety with ambiguous drawings, tachistoscopically presented at 1/50 second through red and blue filters. Accepting a probability level of 0.08 he found by analysis of variance a tendency to avoid the selection of dangerous, aggressive or threatening objects under the red condition. This result was explained in terms of perceptual defense. Red illumination caused ambiguous stimuli to be perceived as dangerous and aggressive, thus more dangerous objects were perceived in the red condition despite the operation of perceptual defense which causes subjects not to perceive threatening objects when faced with ambiguity. Blue, because of its tranquilizing effects, caused perceptual defense to be

relatively less frequent than under red, and the selection of dangerous objects to be less frequent.

In terms of the present study these effects of colour on different aspects of perception, point to the need for methodological care, the breadth of colour effects on different aspects of perception (even given the tentative nature of some of these findings) and the usefulness of using red and blue conditions because of their opposing effects.

3. Motor Behaviour

One of the earliest pieces of research in this area, a quite comprehensive study by Pressey in 1921, was able to report no significant results. Pressey had looked for differences across equal brightnesses of red, yellow, green, blue and white coloured lighting environments for tapping rates, pulse and respiration recordings, estimates of pressure, judgements of the pleasantness of touch substances, rate of multiplying, rate of free association, immediate memory for nonsense syllables and the rate of continuous choice reactions.

However, Nakshian (1964), basing his hypothesis on Goldstein's (1942) theory of differential effects of red and green environments (in this case the subject sat in front of three coloured surfaces), obtained some significant results. He found greater hand tremor in the red condition than the green and that speed of movement on a motor inhibition task was significantly faster under red than under green. So it can be seen that efficiency of performance on tasks requiring relatively fine psychomotor coordination concerning inhibitory control will be greater under green colour conditions than red.

Pustel, Sternlicht and DeRespinis (1971) found that the tree drawings by retardates were larger when chromatic rather than achromatic drawing materials were employed.

These papers illustrate the problems of inadequate methodological and statistical procedures, the latter being Pressey's main and admitted weakness. Nakshian's and Pustel et al's work is interesting, pointing to alterations in physical

performance involving different colour conditions. The latter study warrants further investigation to find if particular hues have greater effects than others and if different subject matter influences performance with particular colours.

4. Colour Preferences

Lewinski (1938), using three five-point scales asked 50 subjects to rate coloured illumination, producing the rank order results shown in Table 1.

The cold/hot rankings are supported by Berry's (1961) findings (see Table 1).

More reliable data is presented by Eysenck (1941) who used data from 29 different studies involving 21,060 subjects. Eysenck produced the average rankings of colour preferences shown in Table 1. Eysenck concluded that colour preference was consistent across the population, and that this consistency was as high as that obtained by current tests of intelligence. Skin colour and sex were not found to be determinants of divergent colour preferences.

Kouwer (1949) found an order of preferences similar to those found by Eysenck (see Table 1).

More recently Simon (1971) asked 490 student subjects to write down a number between 0 - 9 and a name of a colour. The rank order of the colours with the respective percentage of subjects choosing it is shown in Table 1.

TABLE 1
Colour Preference Findings

<u>Lesinski</u>			<u>Berry</u>	<u>Eysenck</u>	<u>Kouwer</u>	<u>Simon</u>
Pleasant	Stimu- lating	Cold	Least (Heat trans- mitted)	Most Preferred		
Blue	Orange	Blue	Blue	Blue	Blue	Blue 48.57%
Green	Red	Green		Red	Red	Red 10.20%
Purple	Yellow	Purple	Green	Green	White Green	Green 9.80%
Red	Green	Yellow	Amber	Violet	Yellow Orange	Purple 7.76%
Orange	Blue	Orange	Yellow	Orange	Grey Purple	Yellow 7.35%
Yellow	Purple	Red	White	Yellow	Brown Black	Brown 6.53%
Un- pleasant	De- pressing	Hot	Most (Heat trans- mitted)	Least Preferred		

We can see from these studies some change in preference over time but a strong consistency exists for the three most recent studies. In these later preference studies we can see red ranked second to blue. Considering this closeness of preference one would not expect the divergence of response that has been reported in the present review. A key to this discrepancy lies in Simon's percentages. While 48% of the sample chose blue only 10.20% chose red as their colour. Thus in the present study it was expected that subjects would choose blue rather than red and evaluate blue more highly than red.

5. Mood and Other Associations

Ninety-four subjects, half of them male and half female, were asked by Wexner (1954) to select coloured cards from a pile which

they felt best expressed the feelings described by different selected groups of words or "mood-tones". Degree of association was then calculated. No sex differences were found.

Red was found to be very strongly associated with the mood-tones excited, stimulating, protecting, defending, deficient, contrary and hostile, and strongly associated with cheerful, jovial, joyful, powerful, strong, and masterful.

Blue was found to be very strongly associated with secure, comfortable, tender, soothing, calm, peaceful and serene.

Wexner suggested, quoting Guilford, that experimental results "point very strongly to a basic communality of color preferences among individuals. This communality probably rests upon biological factors since it is hard to see how cultural factors could produce, by conditioning, the continuity and system that undoubtedly exists". (Wexner, 1954, p. 434).

Lawler and Lawler (1965) argued for this biological hypothesis when they found that after being told a "sad" story, nursery children chose a brown rather than a yellow crayon and vice versa for a happy story. Wexner (1954) had found brown to be associated with despondent and yellow associated with optimistic mood-tones.

Research in Japan virtually identical in methodology to that of Lawler and Lawler was conducted by Yoshikawa, Yagishita and Matsuda (1970). Their results neatly confirmed the early findings and give greater weight to the biological communality argument which previously had not been tested in a non-European setting.

Murray and Deabler (1957) however show that socioeconomic and subcultural differences are also important. Using neuro-psychotic patients, nursing assistants in a southern U.S. hospital and students from Louisiana State University as subjects, the researchers presented eight stimulus colours and a list of eleven moods. They asked their subjects to pick a colour to go with each of the moods. The results were compared with those of students from Purdue University.

The same mood tone associations for red and blue were found as had been found by Wexner (1954).

Strong socio-economic differences were indicated; Purdue students saw orange as "distressed" and also as "defiant", while the other three groups rarely made these associations. The non-university groups related brown to "dignified", the university groups rarely doing this. The non-university groups thought of green as a "cheerful" colour while university students did not. While half of the Purdue students picked black as "powerful", less than 15% of each of the other groups made the association (possibly an absorption of Militant Black political propanganda not conceded to by Southern students).

Patients were particularly likely to associate colours not actually before them with mood tones while Purdue students, regardless of mood-tone, chose orange, purple and black more than the other groups and red and green far less. Patients and aides chose purple far less than other groups while aides chose green and blue far more. Perhaps the aides' preference was due to institutionalisation.

The mood association research fits well with the previously reviewed studies, showing as it does, red to be associated with mood-tones of aggressive buoyancy and blue with soothing mood tones. However, as there are socially "positive" mood-tones such as protecting, cheerful and masterful also associated with red, it could not be argued from this research that the present study would be expected to reveal negative mood and concept ratings in the red light condition although the previously reviewed research might tend to suggest this. Account has been taken of the biological and cultural arguments for colour mood-tone associations as can be seen in chapter 2 on Method. The subjects for the present study were drawn from a narrow age group at two institutions very similar in the socio-economic background of their pupils except for christian denomination. This difference was eliminated in the colour conditions as subjects were randomly drawn. Therefore, confounding effects of socio-economic background were not expected.

6. Personality and Disturbed States

A number of tests have been developed to measure personality

through colour preference and colour arrangement. These tests have the great advantages of being simple to administer, non-verbal and non-literate.

Riffenburg (1959) with 96 subjects, was able to show that the Woods Polychrome Index (P I) was a good predictor of responsibility and a fair predictor of social introversion as measured by the Minnesota Multiphasic Personality Inventory.

Schaie (1963) in a review of German research material on the Color Pyramid Test, CPT, concluded that the CPT is as reliable as most of the personality inventories in current use, is applicable over a wide range of ages, educational and cultural backgrounds, is useful for the gross differentiation of groups with deviant personality characteristics and for obtaining information on the control of affect and other behaviour traits in individual subjects.

Block and Caldwell (1959) found it a trend for subjects preferring chromatic rather than achromatic colours to have lower manic and depressed scores on the MMPI. Schapira, McClelland, Griffiths and Newells, (1970) found it a trend for patients with depressive symptoms to respond best to yellow rather than red or green tablets of the drug oxazepam (Serenid-D). This is interesting as it agrees with the optimist, cheerful mood-tones that Wexner (1954) found to be associated with yellow.

Strenski, Payson, Muzekari and Bohr (1970) found that their sample of 60 chronic schizophrenics chose different first, second and third colour choices from their sample of 60 factory workers. This was largely attributable to the "colour" black, which was chosen by 27% of the schizophrenics as one of their three favourites and by only 5% of the normal group. Black was the least liked colour for 37% of the factory workers and only 12% of the schizophrenics. The authors thought these results might be a possible effect of culturally defined norms of preference being broken down through institutionalisation.

This work points to a number of applications to which colour research has been and can be put. It also further illustrates the diversity of colour research.

It can be concluded that diverse environmental factors such as furniture arrangement and ambient temperature can have an

effect on human behaviour. It was on this evidence that the assumption made in the present study of the existence of environmental determinants of behaviour was based.

Colour too, in the form of either coloured illumination or coloured plates, can evoke differential emotional arousal having physiological and psychological bases. Research evidence suggests that the red and blue ends of the spectrum are more physiologically arousing than hues located in the centre of the spectrum. Red, in turn, has been shown to be more physiologically and psychologically arousing than white or blue, red creating more tension, hostility and disturbance than other colours. The possibility that blue objects may be perceived as smaller than identical red objects still exists, and some research has shown red to have a longer latency on the autokinetic phenomenon than blue or white lights. Solutions of apricot and cherry flavouring tend to be perceived as tasting sweeter when coloured red, and rooms are perceived to be hotter under white than blue light. (Red might have presumably fallen about half way between the two). Motor inhibitory control has been shown to be less in red environments than in green. The two colours red and blue are both highly preferred colours but blue is by far a more likely first choice than red. Blue has chiefly placid comfortable mood-tones associated with it where as red has mood-tones of aggressive buoyancy.

On the basis of such evidence and in the light of the diversity of colour research as illustrated in the above review it was hypothesized that "red", "blue" and "white" light would have differential effects on mood responses, ratings of different concepts, and perceptions of temperature. "Red" and "blue" colour conditions were chosen as these colours are commonly regarded as colour "opposites"; they are also at the opposite ends of the colour spectrum and as mentioned before have been found more arousing than the colours of the mid-spectrum. Both are colours very often discussed in the literature.

It was first intuitively thought that red, the colour most associated with party decorations and warmth, would have an enhancing effect on affective behaviour but the research literature

reviewed, points largely in the opposite direction. However as no research directly paralleling the present study has previously been conducted, thus enabling directional hypotheses, and because mood-tones associated with red are both positive (e.g. cheerful) and negative (e.g. hostile) the hypotheses of the present study are non-directional.

A white light condition was included to provide an achromatic control condition and to enable the replication of Berry's (1961) finding that a room with white illumination was perceived as hotter than the same room with coloured illumination.

The first major aspect mentioned in the introduction having been considered, the discussion now proceeds to the second aspect, attitude similarity and attraction.

Aspect Two: Attitude Similarity and Attraction

The primary question the present study is asking - to reiterate - is: is interpersonal attraction a function of colour of environmental illumination and attitude similarity? The assumption implied by this question is that attitude similarity has an effect on interpersonal attraction.

As the extensive literature on interpersonal attraction reveals, this assumption that knowledge of another's attitudes will affect interpersonal judgement is well founded.

Attitude similarity is one of three principle factors involved in the choosing of friends and is probably the most exhaustively investigated. The other factors are nearness and degree of interaction (Psychology Today, 1970).

Byrne (1961) found that a stranger expressing similar views, as the subject had expressed in completing an identical questionnaire, was liked better, evaluated as more intelligent, better informed, more moral and better adjusted than a stranger who had filled out the questionnaire in a manner dissimilar to the subject (reported in Byrne, 1966, p. 40). Byrne and Nelson (1965) using the same technique found that the proportion of similar attitudes

as opposed to merely the number of similar attitudes in a 4 x 3 factorial design was the significant factor related to attraction. Using their data and data from a number of other studies they were able to show by the least squares method that proportion of similar attitudes was in a linear relation to attraction.

Articles by Byrne and Nelson (1965) and Byrne and Wong (1962), Byrne (1961) and Clore and Byrne (1970) all develop the theme of agreeing statements being equivalent to punishment in their effects on affective states and this in turn affects subsequent judgements. It is argued particularly in Clore and Byrne (1970) that the evaluation of any given stimulus object is a positive linear function of the proportion of positively reinforcing stimuli associated with it. Stimuli with positive or negative reinforcement properties are hypothesized to act as unconditioned stimuli which respectively evoke positive or negative implicit affective responses.

If any discriminable stimulus, (it may be an individual), becomes associated with an unconditioned stimulus then such a stimulus becomes a conditioned stimulus which is capable of eliciting implicit affective responses. As mentioned above, these affective responses mediate overt evaluative responses, such as verbal assessments, preferences and approach/avoidance behaviours.

In the second part of Byrne and Nelson's (1965) study, data gathered by McDonald in 1962 was used. Subjects wrote stories in response to pictures being presented to them and then had these rated in different proportions of favourability by a confederate depending on the treatment groups they were in. This constituted different conditions of reward and punishment. Using this data Byrne and Nelson obtained a linear relationship by the least squares method between positive reinforcement (reward) and attraction. They then proposed a law of attraction, which stated that attraction toward a person is a positive linear function of the proportion of positive reinforcements received from that person.

To add credence to the notion of regarding attitude similarity-dissimilarity as negative and positive reinforcement, Golightly, as reported in Byrne (1966 p.51), got subjects to perform a task where they had to learn large/small discrimination. There were three

conditions: first, where subjects were simply reinforced with a spoken "right" or "wrong", the second, where the subjects were handed written statements of attitudes either similar or dissimilar to their own depending on performance, and thirdly a control group where subjects were simply handed neutral statements. Performance by the second group, while not quite as good as the first, was similar in direction and significantly better at producing the desired learning than the third condition. Thus, attitude statements can act as strong reinforcers.

From Social Comparison theory and from Newcomb's strain toward symmetry formulations is developed the rationale that the learned drive to be logical and to interpret incoming information correctly is reinforced by consensual validation and frustrated by negatively reinforcing invalidation. The reward/punishment aspect of degrees of attitude similarity has already been discussed, but to illustrate that people did in fact have a drive to logically structure ambiguous stimuli and were uncomfortable when they were confused and unaware of what others thought, Byrne and Clore (1965) screened both an ambiguous film, and an ordinary documentary film (reported in Byrne, 1966, p. 49). Significant differences were found in, feelings of unreality, feelings of uneasiness, feelings of confusion and desire to know what others thought, in the two groups. It was also found that subjects attempted to impose meaning on the film afterwards by "interpreting" it.

Griffitt's (1970) study on the effects of ambient temperature on interpersonal attraction, the results of which were reviewed earlier in this introduction, stands in the mainstream of attitude similarity-attraction theory and methodology. It is also a study which asked a very similar set of questions to these of the present study. The methodology advocated by Byrne and Griffitt (In Press) will be dealt with in detail in the method chapter. It is sufficient to say at this stage for the purposes of operationalising the hypotheses of the present study, that this study utilised essentially the same methodology as was employed by Griffitt. He used a number of semantic differentials to assess "feelings" as

well as the dimension hot/cold to assess sensations of warmth. He also used the Nowlis Mood Adjective Check List to assess mood and the Interpersonal Judgement Scale to assess degree of interpersonal attraction.

The Hypotheses

From the literature reviewed in this chapter and utilising the measures which Griffitt's study had shown to be appropriate, the following operational definitions were derived:

1. That "red", "blue" and "white" light environments will have differential effects on interpersonal attraction as measured by the Interpersonal Judgement Scale;
2. That "red", "blue" and "white" light environments will have differential effects on the rating of concepts as measured by semantic differentials;
3. That "red", "blue" and "white" light environments will have differential effects on mood as measured by the ratings on a short form of the Nowlis Mood Adjective Check List;
4. That "red", "blue" and "white" light environments will have differential effects on the perception of heat as measured by semantic differential Hot/Cold.

CHAPTER 2

METHOD

Subjects

Subjects were 54 male High-School students between the ages of 15 years and 18 years 4 months having a mean age of 16 years 8 months. They comprised fifth and sixth formers from a State Boy's High School and a private Catholic Boy's High School. These were selected from a pool of 87 students between the ages of 14 years 1 month and 18 years 4 months with a mean age of 16 years 8 months. Rejection was due to non-completion of protocols (13 subjects), colour blindness (5 subjects), late arrival for the experiment (2 subjects) and random selection to enforce equal cell size for analysis of variance (13 subjects).

All subjects were randomly allocated to one of three colour lighting conditions, Red, Blue or White and to one or other of two stranger manipulation conditions (see below).

The Experimental Settings

Testing took place in two settings. An attitude questionnaire, the Wilson Patterson Conservatism scale (Wilson and Patterson 1968), was administered to the subjects in their classrooms at school.

All other testing took place in room 34, ITB building, University of Waikato. This experimental room was 20 feet long by 9 feet 3 inches wide and had a stud of 8 feet 11 inches. The walls were a matt white colour and the ceiling cream. Down one side of the room were three six foot three inch by four feet six inch light fawn blinds which covered three one-way mirrors. At the far end of the room was another similar blind and one-way mirror next to which was a varnished door opening into the room. The room was furnished with a three feet three inch by two foot varnished children's table only one foot six inches in height. On the table were some children's nursery books and surrounding it were six easy chairs. Against the near wall was a six foot

steel filing cabinet painted fawn with light grey-brown doors. Next to it was a small varnished wooden bookcase with more nursery books on it. The experimenter sat in a stiff-backed steel chair with his back to the far wall. The thermostats on the "Heatway" heaters in the room were set at 70°F.

Coloured cellophane filters had been placed in the perspex covers of the four fluorescent lights. These filters provided the two colour conditions "red" and "blue" and their absence provided the "white" light condition. The intensity of light in the room was subjectively judged to be equal by 5 individuals. Actual intensity measurements were then taken and lighting was kept at this subjectively judged level of equality (See Appendix One for technical specifications of the lighting arrangements).

Measures

A list of measures obtained from each subject is shown in Table 2.

TABLE 2
A Summary of Information obtained
on each subject

Performance on:

- | | |
|---|---|
| 1 | Wilson-Patterson Conservatism Scale (50 items). |
| 2 | Nowlis Mood Adjective Check List (15 items). |
| 3 | Ten 7 point semantic differential rating scales for each of 8 concepts. |
| 4 | The Interpersonal Judgement Scale. |
| 5 | "Tests for Colour-Blindness" by S. Ishihara (the full 38 plates). |

Record of:

- | | |
|---|-----------------|
| 6 | Age and School. |
|---|-----------------|
-

Measure 1. The Wilson Patterson Conservatism scale (Wilson and Patterson, 1968) is an easily administered attitude scale of 50 items. It is almost a forced choice questionnaire there being only three possible responses for the subject (see Appendix 2). This scale had the advantage of forcing the Subject to make a definite decision or an obviously neutral one, an advantage which will become clearer shortly.

Measure 2. The Nowlis Mood Adjective Check List (MACL), in the present study is made up of 15 items, five weighted items in each of 3 groups measuring the three factors aggression, surgency and social affection (Nowlis, 1965, See Appendix 3). The MACL was scored on each variable as follows, $v=7$, $v=5$, $?=3$, $n=0$, thus n was as far from the "cannot decide" point (" $?$ ") as a point half way between v and v . The final mood score for each subject was the mean aggression score subtracted from the mean of the surgency and social affection scores, producing a pleasantness/unpleasantness or good/bad mood score.

Measure 3. The "Word Rating Form" (item 3 of Table 2, see Appendix 4) consisted of the concepts, "A Bottletop", "Blue", "Myself", "White", "University", "Red", "This Room" and "Experiment" which the subjects rated on ten 7-point semantic differential rating scales, four of which were highly weighted on the factor evaluation (that is, good-bad, beautiful-ugly, happy-sad, and clean-dirty). Three were highly weighted on the factor potency, that is, large-small, strong-weak, and thick-thin. The three others were scales highly weighted on the factor activity, being fast-slow, active-passive, hot-cold (Osgood, Suci and Tannenbaum, 1957, p.36). The semantic scales were alternated and randomly arranged in two different orders so as to prevent an habitual "ticking" pattern to develop and to prevent the subjects from clearly perceiving the different rating dimensions (See Appendix 4).

Measure 4. Subjects also filled in the Interpersonal Judgement Scale (IJS obtained from Byrne, 1966, pp. 41 - 42, See Appendix 5) the last two items of which were summed to yield a dependent measure of attraction ranging from 2 to 14 with a split-half reliability of .85 (Byrne and Nelson, 1965). Scores for the

first 4 items, and for the whole 6 were also obtained.

Measure 5. This was the "Tests for Colour-Blindness (Ishihara, 1960).

As a final piece of information subjects were asked to give their ages in years and months. Lists of subjects had been drawn up for the two schools so that each subject's school and form was known.

The Paradigm

The work of Byrne et al in developing procedures for research into attitude similarity was mentioned in the Introduction. It was influential in determining a research paradigm for the present study, and consequently is summarised in some detail in this section. Byrne, the most prolific and probably the most influential writer in this area has provided the prototype paradigm which to a large degree other researchers have followed with minor additions. This procedure and the value of paradigmatic study is spelt out in "Procedures in the Paradigmatic Study of Attitude Similarity and Attraction". (In Press) Griffitt and Byrne.

Griffitt and Byrne (p.33) state;

"A scientific paradigm is characterized by a specific body of research consisting of procedures, operations, measuring devices, empirical laws, and a theoretical superstructure - all accepted by a group of scientists."

Such an agreement, they argue, makes it possible to accumulate knowledge through attempts to increase the precision, reliability, and scope with which the facts are known and through the continual creation and modification of theoretical proposals put forward to account for the data.

The method advocated is:

1. To present the subject with an attitude scale before he takes part in the experiment proper;
2. To show the subject the same or a similar attitude scale supposedly completed by someone else. This scale is usually

completed by the experimenter so that it is in agreement with the subject's attitudes to a certain specified degree. To standardise this altering procedure Byrne and Griffitt advocate a 6 point scale so that degrees of discrepancy on the items chosen to be dissimilar to those of the subjects can be accurately maintained. Such standard alterations of each subject's attitude response they call the "unique stranger method";

3. The subject then examines the "stranger's" response and then rates him on the Interpersonal Judgement Scale which provides a measure of attraction.

This procedural paradigm has proven adequate and reliable in the past and Byrne and Griffitt maintain that it brings empirical consistency which allows research findings to become cumulative and comparable across experiments. Thus increased precision, reliability and scope is obtained.

This procedural paradigm was applied in Griffitt's (1970) study and because of the similarity of considerations was seen to be applicable with minor alterations, to the present study.

The Stranger - manipulation

The present study's Stranger - manipulation differs from that of Byrne and Griffitt owing to the use of the Wilson-Patterson Conservatism scale as an attitude measure. The subject's response to his protocol was examined and for each subject a bogus stranger's protocol was produced along the principles of the unique stranger technique laid down by Griffitt and Byrne (In Press). Having only the options of "Yes" "?" and "No" a disagreeing response was produced by making the stranger's response a complete opposite to that of the subject. If the subject had circled a "?" then the stranger was shown with the same response, therefore only issues on which the subject had a distinctly positive or negative view were changed.

Thus, for a subject in the agreeing condition, every fourth item of the bogus stranger's response to the Wilson-Patterson Conservatism Scale was altered negatively and for a subject in the disagreeing condition every fourth item was left unchanged.

So that there would be no tendency to have the same items changed or left unchanged, the first item to be left changed or unchanged was rotated from the first through to the fourth polar response of the subject. Thus it was hoped that for any stranger this system would provide as near to a random basis for selection of items to be changed as practicable.

Procedure

Subjects who had volunteered for the experiment were administered the Wilson-Patterson Conservatism scale in their classrooms at school. They had been told that they would be taking part in some "opinion and rating" research and that this was their first opinion questionnaire.

The stranger manipulation was then performed for each subject. Testing of subjects took three weeks with each week being allocated to one colour.

The first subjects in the red light condition were tested a week after completing the Wilson-Patterson Conservatism scale. Appointments were made at 6.30 p.m. and 7 p.m. on one of the first three week nights. Being winter these times meant that the subjects arrived at the university in the dark and then went into an artificially lit building, and while the corridor where they briefly waited was more brightly lit than the experimental room itself, the experimenter felt that the situation did not warrant an intensive consideration of dark-adaption, firstly because of the focus of the study being on social rather than physiological responses, secondly because of the brevity of the time subjects had to wait before coming into the experimental room and thirdly because of practical considerations involving time.

Apart from the above, no subject reported visual discomfort of any kind while doing the experiment. It was the experimenter's intention to test only five people at a time but due to subjects coming late or breaking appointments, group size ranged from 2 to 8 with a mean of 3.6.

On the door of entry to the experimental room was a note saying, "This room is used primarily for the interviewing and

observing of children. It is set up as a play room and should not be used as a tutorial or study room. Students requiring access to these facilities should make arrangements with D. R. Mitchell (Education)". It was thought that this note and further explanation (see Appendix 7) would divert the subjects' attention from the direction of the hypothesis being tested.

Subjects were ushered into the room, asked to sit and then left for three minutes to become adjusted to their surroundings and each other. The experimenter excused himself on the grounds that he needed to get some papers. He returned carrying the protocols - a bundle for each subject. After being instructed to read the instructions and to proceed until they had finished the "Word Rating Form" subjects first responded to a short form of the Nowlis MACL.

Following the MACL, subjects were presented with the Word Rating Form after which they read the Wilson-Patterson Conservatism Scale as filled out by the bogus stranger "Mr X". Subjects were asked to form an opinion of "Mr X" and to raise their hand when they thought that they had a mental image of what the stranger was like (See Appendix 7). Most subjects took approximately two minutes to make up their minds. A male accomplice who the subjects had been told was "Mr X" then came into the room and stood beside the experimenter for 30 seconds. The accomplice, who had shoulder length hair, was dressed in dark grey trousers, a white polo neck sweater, sports jacket and brown suede shoes for each night of the experiment.

It was decided to use an accomplice as a control for the differential imagination of individual subjects. It was thought that actually seeing "Mr X" would give their opinions a common physical anchor.

When the accomplice had retired the IJS was completed.

Subjects were then ushered into another room with one-man booths and were administered the "Number Line Discrimination Test"

(The Tests for Colour-Blindness by Ishihara). This was done by presenting each plate one by one to each subject requiring them to draw any number or line that they might see in the plate, in a circle provided on their form (Appendix 6).

After stating their ages, the subjects were requested to refrain from discussing the experimental procedure at school so that future subjects from the schools would not come with pre-conceived ideas. Certain queries as to the nature of the experiment were answered so as to dispel the wilder notions as to what was being investigated. Subjects were fully debriefed at their schools when they had all completed the experiment.

One or two subjects guessed that the "Number-line discrimination" questionnaire was, in fact, a colour blindness test, but the experimenter is confident that the subjects were unaware of the nature of the experimental hypotheses.

Statistical Analysis

The MACL scores were assumed to be normally distributed with homogeneous variances among the populations from which the samples are drawn. These two basic assumptions made, four one-way analyses of variance for independent groups (Ferguson, 1971, p. 217) were performed over the three colour conditions for each factor of the MACL employed and for the final mood score.

The same assumptions were made for the analysis of the Semantic differential ratings of the eight concepts across the three colour conditions. Here a "Split-plot design - factorial design with block-treatment confounding" (Kirk, 1968, pp. 245 - 247) was employed. Rather than test the variance-covariance matrices for equality and symmetry the Geisser-Greenhouse Conservative F test was employed (Kirk, 1968, p. 262). This alters the degrees of freedom employed when looking up F values.

It can be assumed that the degrees of freedom employed in calculating any F values reaching significance in the analysis of the semantic differential ratings have been previously adjusted by the Geisser-Greenhouse method.

It can also be assumed that any value regarded as significant in the statistical analysis will have a significance level of .05 or less.

Scoring on the semantic differentials was across three coloured environments and on three different aspects of semantic meaning (evaluation, potency and activity). Thus, there were independent groups across colour environments and repeated dependent measures over three aspects of semantic meaning. A 3 x 3 split-plot repeated measures design was therefore applicable as in this design "a subject receives all levels of some treatments but only one level of other treatments". (Kirk, 1968, p. 246).

Scoring on the IJS was also over three colour conditions and the two stranger manipulations, agreeing or disagreeing. Again assuming a normal distribution and homogeneity of variance an "Analysis of variance - two way classification" Mixed Model (Ferguson, 1970, pp. 223 - 241) was employed. The IJS total summed scores were first analysed, then the sum of the items 1 - 6 and lastly the sum of items 5 and 6.

The activity item Hot/Cold on the concept "This Room" was analysed across the colour conditions by a one-way analysis of variance.

A t test (Ferguson, 1971, p. 151) was used to test the following differences:

- (a) between mean IJS scores for those in the top and bottom quartiles of the scoring on the MACL.
- (b) between mean IJS scores for people who evaluated the concept "Red" more highly than the concept "Blue" and were in the red colour condition and people who evaluated the concept "Red" more highly than the concept "Blue" but were in the blue colour condition.
- (c) between mean IJS scores for subjects in the same situation as above but who more positively evaluated "Blue" over "Red".

A non-parametric test was employed when a χ^2 with Yate's correction for continuity (Ferguson, 1971, p. 105) was used to test whether there was a preference for "Red" rather than "Blue", as indicated by evaluation scores, among subjects in the red and blue colour conditions.

CHAPTER 3

RESULTS

In this chapter the results for each hypothesis will be discussed in turn.

Hypothesis 1

The last two items of the IJS summed, yielded a dependent measure of attraction ranging from 2 - 14. The two-way analysis of variance results are shown in Table 3.

TABLE 3

Analysis of Variance of Items 5 and 6
on the IJS.

Source	<u>df</u>	<u>F</u>
Rows (agreement/disagreement)	2/48	6.58 *
Columns (colour environments)	2/48	0.16
Interaction	2/48	0.64

* $p < .01$

These results mean that we cannot accept the hypothesis that red, blue and white light environments have differential effects on interpersonal judgement as measured by the interpersonal judgement scale.

However, the significant F for rows provides a further instance of the attraction paradigm.

Two further two-way analyses of variances were conducted using the first four items of the IJS summed and the whole six items summed to yield two dependent measures of positive judgement. No significant F ratios were gained for agreement/disagreement, colour of environment or interaction effects.

Hypothesis 2

The results of the 3 x 3 analysis of variances for the eight semantic differential rated concepts are presented in Table 4 below.

TABLE 4
Analysis of Variance of the 8 concepts across
Colour Environments and Factors (Evaluation,
Potency, and Activity).

Concept	Source	Conservative <u>F</u> test <u>df</u>	M.S.	<u>F.</u>
Bottletop	Environment (E)	1	0.19	0.10
	Factors (F)	1	14.73	14.92 ^{MM}
	E x F	2	0.55	0.55
	S:E (Error for E)	25.5	1.85	
	FS:E (Error for F and E x F)	51	0.99	
Blue	E	1	3.82	2.10
	F	1	35.31	24.30 ^{MM}
	E x F	2	0.51	0.35
	S:E	25.5	1.82	
	FS:E	51	1.45	
Experiment	E	1	1.92	1.54
	F	1	1.44	1.16
	E x F	2	0.28	0.22
	S:E	25.5	1.25	
	FS:E	51	1.25	
Myself	E	1	2.01	1.31
	F	1	10.92	18.60 ^{MM}
	E x F	2	0.54	0.92
	S:E	25.5	1.53	
	FS:E	51	0.59	

Concept	Source	Conservative		M.S.	<u>F.</u>
		<u>F</u>	<u>test</u> <u>df</u>		
This Room	E		1	0.45	0.46
	F		1	46.48	47.83 ^{XX}
	E x F		2	0.48	0.50
	S:E		25.5	0.99	
	FS:E		51	0.97	
University	E		1	6.15	4.45 ^X
	F		1	0.47	0.73
	E x F		2	0.37	0.57
	S:E		25.5	1.38	
	FS:E		51	0.65	
White	E		1	10.09	4.93 ^X
	F		1	68.99	59.17 ^{XX}
	E x F		2	1.51	1.29
	S:E		25.5	2.05	
	FS:E		51	1.17	
Red	E		1	2.21	1.00
	F		1	15.55	19.31 ^{XX}
	E x F		2	0.38	0.48
	S:E		25.5	2.20	
	FS:E		51	0.81	

^X $p < .05$

^{XX} $p < .01$

Two of the concepts (25%) were found to be significantly differently rated across environments ($p < .05$). They were "University" and "White".

Significant F values at ($p < .01$) indicate differing intensities of response on the three factors of semantic meaning for the concepts "Bottle-top", "Blue", "Myself", "This Room", "White" and "Red". "Experiment" and "University" failed to achieve any level of significance in differences of scoring over the three factors.

Only "Experiment" showed no significant F ratio for either colours of environment or factors.

Table 4 reveals that there are no significant interaction effects between colour of environment and the three factors of semantic meaning. Any significant results then are not confounded by interaction.

Tables 5 and 6 (below) show the results of t tests (Kirk 1968, pp. 266 - 267) between all the means for each significant F ratio.

The t test, an a priori procedure, was utilised as it would be expected that Osgood, Suci and Tannenbaum's (1957) three factors of semantic meaning would be scored differently according to environment and concept rated.

TABLE 5

Tests for Differences among Means
(Where F value for colour of environment
was found to be significant).

Concept	M e a n s			\underline{t}
	Red Condition	Blue Condition	White Condition	
University	3.03	2.46	2.44	$\underline{t}_{RB} = 2.54^*$ $\underline{t}_{RW} = 2.63^*$ $\underline{t}_{BW} = 0.09$
White	4.35	4.19	3.53	$\underline{t}_{RB} = 0.60$ $\underline{t}_{RW} = 2.97^{**}$ $\underline{t}_{BW} = 2.37$

* $p < .05$)
 ** $p < .015$) for a two tailed test with 102 df.

TABLE 6

Tests for Differences Among Means
(where F value for factors was found to
be significant).

Concept	M e a n s			\underline{t}
	Evaluation	Potency	Activity	
Bottletop	3.90	4.84	4.77	$\underline{t}_{EP} = -4.90^{NNN}$ $\underline{t}_{EA} = -4.54^{NNN}$ $\underline{t}_{AP} = 0.36$
Blue	2.79	3.27	4.36	$\underline{t}_{EP} = -2.06$ $\underline{t}_{EA} = -6.80^{NNN}$ $\underline{t}_{AP} = 4.74^{NNN}$
Myself	2.86	3.75	3.19	$\underline{t}_{EP} = -6.04^{NNN}$ $\underline{t}_{EA} = -1.77$ $\underline{t}_{AP} = 2.93^N$
This Room	3.12	4.43	3.80	$\underline{t}_{EP} = -6.91^{NNN}$ $\underline{t}_{EA} = -3.60^{NNN}$ $\underline{t}_{AP} = 3.32^{NN}$
White	2.72	4.68	4.67	$\underline{t}_{EP} = 9.43^{NNN}$ $\underline{t}_{EA} = -9.41^{NNN}$ $\underline{t}_{AP} = 0.02$
Red	3.25	2.67	2.17	$\underline{t}_{EP} = 3.32^{NN}$ $\underline{t}_{EA} = 6.21^{NNN}$ $\underline{t}_{AP} = 2.90^N$

$^{NNN} p < .003$)
 $^{NN} p < .01$)
 $^N p < .05$)

for a two tailed test with 102 df with error rates and thus critical \underline{t} values adjusted by the Bonferroni \underline{t} method (Hills, 1972, pp. 364 - 365).

Tables 4 and 5 indicate there is only partial support for hypothesis two. The bulk of the findings prevent the acceptance of the hypothesis that, red, blue and white light environments have differential effects on the rating of concepts as measured by the three dimensions of semantic meaning.

Hypothesis 3

The final MACL pleasantness/unpleasantness score revealed no significant effects due to colour of illumination ($F = 1.20, p > .05$). Separate analysis of the aggression, surgency and social affection factors also indicated nonsignificant effects of environment ($F = 0.36, p > .05$; $F = 0.79, p > .05$; $F = 1.03, p > .05$). The hypothesis that environments illuminated by red, white and blue light will differ in their effects on ratings on a short form of the MACL was not supported.

Hypothesis 4

To test the final hypothesis, that red, blue and white light environments will have differential effects on the rating of warmth for the concept "This Room", the hot-cold semantic differential ratings for "This Room" were used independently as a measure of perception of warmth. A one-way analysis of variance was performed over colour illumination conditions and a non-significant F of 2.69 with $df = 2.51$ was found. Thus Berry's (1961) findings were not confirmed and the hypothesis cannot be accepted.

Post hoc analysis results

Three post hoc analyses were then performed. It was thought that there might be differences in the scoring of items 5 and 6 of the IJS for subjects who evaluated "Red" over "Blue" and were in the red colour condition and subjects who favoured "Red" but were in the blue condition. The same was also hypothesised for subjects who evaluated "Blue" over "Red" and were in the blue condition rather than the red condition. However no significant differences were found between the mean scores for the respective groups ($t_{r-b} = 0.14, df, NS, t_{b-r} = -0.24, df = 8, NS$).

As can be seen from Table 4 the concept "Red" was rated higher on evaluation than the concept "Blue" so it was hypothesised that a greater number of people preferred "Red" than "Blue". Subjects

were taken only from the two colour conditions, red and blue. With subjects who evaluated the two colours equally, docked, a χ^2 of 2.66, $df = 1$, $p < .20$, NS, was obtained. Thus while a trend in favour of "Red" over "Blue" was present it was not significant to the .05 level.

Finally, it was hypothesised that high and low MACL scorers, (the top and bottom quartiles) would have corresponding high and low scores on the IJS. There were 13 subjects in the high scoring MACL group and 14 in the low scoring group. A t of -2.92, $df = 25$, $p < .01$, was found. To test whether this mood effect was not merely due to the stranger manipulation; that there was not a significantly greater proportion of subjects in the agree condition than in the disagree condition, for those in the top scoring quartile of MACL scores, a test for the significance of the difference between two independent proportions was performed. (Ferguson 1971, pp. 160 - 162). An insignificant z value of -1.38 was found, thus upholding the finding that a MACL score of feelings of pleasantness/unpleasantness is related to the degree of interpersonal attraction as measured by items 5 and 6 of the IJS.

CHAPTER 4

CONCLUSIONS, DISCUSSION AND SUGGESTIONS
FOR FUTURE RESEARCH

The findings of the present study indicate essentially that coloured illumination as an environmental effect on interpersonal affective behaviour is shown to be neither negative or positive as measured by the IJS. Attraction was again demonstrated as a function of attitude similarity. These results are quite surprising when one considers the pronounced effects, on emotional arousal in particular, found in research reviewed in the first chapter. From the obviously surprised looks of the subjects as they entered the red and blue illuminated room one also gained a subjective impression that this environment had certainly been noticed and might effect them in some way.

Possibly colour was having an effect but this effect was not strong enough or of the nature that it could transfer to the social situation of the stranger manipulation. That is, the technique of measurement might have been inappropriate for the effect that was there. A great deal of dependence is placed on the last 2 items of the interpersonal judgement scale as a measure of attraction in attraction research, and while it was sensitive to the attitude similarity effect as Table 6 shows it may be too specific a measure to pick up the influence of colour. Evidence of it's high degree of specificity was shown when variances in scores including the other 4 items of the IJS were found to be non-significant even for the two attitude conditions of the stranger manipulation. These other 4 rating items on inspection (see Appendix 5) would appear closely related to items 5 and 6.

The lack of support for hypothesis 4 (that "Red", "Blue" and "White" light environments will have differential effects on the rating of warmth) and consequent lack of confirmation of Berry's (1961) findings places a question mark over them. Berry's results are to a degree "forced" in that he required subjects to rank the coloured illumination which they perceived as "transmitting" the greatest amount of heat. Measurement of heat perception was a good deal less direct in the present study and may

have been to a degree subliminal. That is, subjects were using the dimension hot/cold as an item on the activity dimension, to rate other concepts than "This Room", so they were used to it, and as it was one of 10 items, their response to it in regard to the concept "This Room" was spontaneous and immediate. The rank-order of significantly different means which the present method would have allowed - had the F value proved significant - would have more accurately reflected real differences in heat perception than a forced ranking, such as in Berry's study. The very objectivity of the present measure may explain its results. While one would expect that the old association of red as a "hot" colour and blue as a "cool" colour would be "sparked off" when the subject was actually present in a room with coloured illumination, this clearly did not happen. Subjects simply made a judgement of temperature and there being no actual differences over the three conditions no significant differences were found. Only on reflection after the experience in the room did the associations of blue - cool and white and red - hot emerge, as Berry has shown with his ranking data.

Coloured illumination has also been shown to be without positive or negative effects on mood, again a surprising finding particularly considering Wexner's (1954) findings of mood-tone and colour associations.

However, possibly the most direct lead this study gives for future research is provided by the finding that "mood" and interpersonal attraction are linked. If one is in a "bad" mood then one is likely to be less attracted to a stranger than if one were in a good mood. This finding does not relate directly to the main hypothesis of this study but gives a hint as to what a useful tool the MACL could be in experimental work in social psychology generally. If interpersonal judgements of attraction are affected by mood then this information is of relevance to psychologists studying these and related judgements and to applied psychologists interested in interview procedures.

Researchers could also investigate the possibility of mood affecting colour preference.

A degree of support was given to the second hypothesis (that "red", "blue" and "white" light environments will have differential effects on the rating of concepts). This support came from the rating of the two concepts "University" and "White".

The t values for these significant F ratios are quite interesting. Looking at Table 5 it can be seen that the means can be ranked red, blue and white in both cases. For "University", ratings are significantly higher in red illumination than blue and white, there is no significant differences between the blue and white light ratings. It could be conjectured that universities because of staff and student commitment to "leftish" and liberal politics have become, to some extent, associated in the public mind with the far left and its symbolic label - "red" or "reds". Thus, subjects reacting to this concept in the red condition had this association heightened in comparison with those in the other two groups. An examination of the individual evaluation, activity and potency means (not tabled) recorded in each condition while rating "University" shows that the red condition has first ranking for all three of the dimensions of semantic meaning. This seems to support the above notion and the evaluation ranking may indicate a degree of association with the University by the subjects. This idea perhaps warrants some research.

Viewing Table 5 with regard to the rating of the concept "White" the chief influence would seem to be presence or absence of coloured illumination. The means for the red and blue colour conditions are not significantly different but both are higher than under the white condition, the red-white difference being significant and the blue-white difference almost significant. Possibly "absence makes the heart grow fonder".

Taking the individual means (not tabled) for evaluation, potency and activity in each colour condition when rating the concept "White" we have a red, blue white, condition ranking for each dimension of semantic meaning. Clearly the ranking across colour conditions is once again different from what one might expect from the literature, given the trend for a preference for blue over red.

As stated earlier these results provide only partial support for the second hypothesis. Twenty-five per cent of the concepts being rated as predicted does not allow acceptance of the hypothesis that "red", "blue" and "white" light environments will have differential effects on the rating of concepts as measured by semantic differentials.

The present study has shown insignificant findings; why? A number of possible explanations can be discussed in turn.

Possibly the study suffers from a methodological oversight. Some of the more current research on colour preference points to a possible confounding factor; the effect of differing saturation in the red and blue colour conditions. Preferences have been found to be positively related to degree of saturation in studies by McCormick, Blanchard and Karas (1957), Guilford and Smith (1959), Wright and Rainwater (1962), Helson and Lansford (1970) and Spiegel and Spiegel (1971).

Using Munsell cards of some 50 colours covering the gamut of hue brightness and saturation Wright and Rainwater (1962) obtained ratings by 955 men and 2705 women for each colour on two of 24 semantic differentials. Factor analysis produced four dimensions, happiness, forcefulness, warmth and elegance all of which were positively related to level of saturation. Wright and Rainwater in fact, ask whether there is not more of an underlying relationship between saturation and connotative meaning than between hue and connotation.

Reference to Appendix 1 shows that the red light was relatively pure having a range of wave-lengths of approximately 605nm to 680nm, "peaking" at 620nm. The blue light, however, was a good deal wider having a range of 410nm to 535nm with a peak at 620nm. Both these two colour conditions are, however, narrower "bands" of visible light than the 450-635nm, "peaking" at 535nm considered "pure" by Nourse and Welsh (1971). Thus the saturation for red was higher than it was for blue, accounting possibly for the trend of preference found for red. The preference trend is worth keeping in mind when one considers Helson

and Lansford's (1970) finding that men prefer cool colours over warm ones. Saturation in the present study may have caused the change in the usual order of preference found during post hoc analysis.

Hogg (1969) in a study of semantic differential judgements of single colours and colour pairs found in factor analysis that there was a coalescence of the potency and activity factors. He called this factor "impact" or "obtrusiveness" and found that "the more saturated the colour the more obtrusive it is". (Hogg, 1969, p. 133). A similar scoring trend would seem to be observable in Table 4. In the light of these findings then, the conclusions drawn about the non-significant results produced by this study can only accurately accepted in relation to the specific conditions specified in Appendix 1. Future research is badly needed to clear up the problem of the possibly confounding effect of saturation on effects previously found to be the result of colour differences. Most of the literature on colour other than that concerned with preferences and connotative meaning is exceedingly lax in specifying the exact colour conditions under which the study is proceeding, and so consequently replication of much of this otherwise sound research is impossible.

Worthy of consideration for future research is the "Purkinje phenomenon". This shift by the eye to higher sensitivity toward the shorter end of the spectrum under low illumination conditions could cause differences between day and evening experimentation and possibly differential reactions to illumination or objects at either, the end of increasing spectral sensitivity or, the end of decreasing spectral sensitivity. In the present study testing time was common to each condition so the Purkinje phenomenon was not a confounding factor. Intensity of lighting (see Appendix 2) was also controlled, as each colour environment condition was judged by a panel to be of equal intensity. This subjective luminance equivalence was measured and maintained by use of a light meter.

Amount of time in a coloured environment may be a significant factor and variation of this variable possibly warrants manipulation.

A measure of arousal before and after entry into a coloured environment could also prove rewarding.

Other approaches to explanation of the current findings are the possibility of no effect existing, or as has been discussed earlier regarding the IJS, an effect existing but different to the one hypothesised and consequently not measured by the particular tests employed in the experiment.

There is too great a bulk of evidence to accept the notion that colour has no effects on social behaviour but considering the methodological weaknesses of some of the Colour - Research, perhaps more effort needs to be made to consolidate prior research. The most likely areas for profitable further investigation would seem to be emotional and physiological arousal to colour stimuli, mood-tone and colour associations, and possible effects of mood on colour preference. Differences may exist in reaction toward an environment which is coloured through illumination and one which is coloured through surface treatment such as paint or varnish. Possibly investigation of people's reactions to objects should come before an examination of more complex interpersonal ratings.

The cultural differences in preference between New Zealand, British and United States samples need to be examined, as indeed do differences in preference of different socio-economic groups within New Zealand.

By setting up the hypotheses it did, this study may have extrapolated a little further than the reviewed findings warranted but it will definitely serve to crush some of the wilder claims that the "colour experts" and "colour therapists" in the community might like to make about colour and its effect on interpersonal and related behaviours.

APPENDIX 1

The Lighting Conditions

The room was illuminated by four 40watt cool white (Colour 33) fluorescent tubes, covered with two layers of red cellophane to produce the red lighting, uncovered for white lighting and covered with two layers of blue cellophane to produce the blue lighting.

The illumination was adjustable with a dimming control varying the operating voltage of the fluorescent tubes.

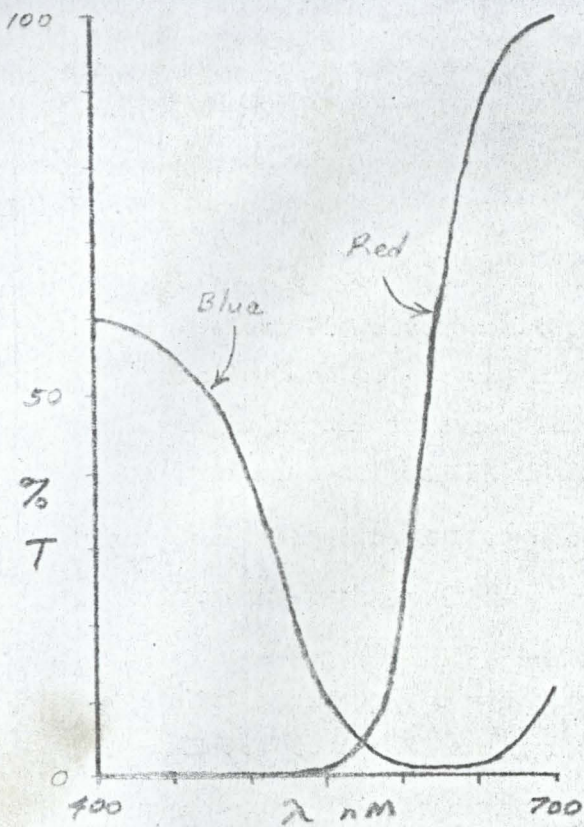
The dimmer was set at maximum in the blue lighting condition and in the white and red conditions adjusted with the dimmer to equal luminance to the blue by visual comparison (a group of five individuals).

A light meter reading was taken at a defined position in the room and used to reproduce the illumination during the experiments.

Diagram 1 shows the optical transmission % plotted against wavelength for two layers of each cellophane measured on a Beckman D.B., spectrophotometer.

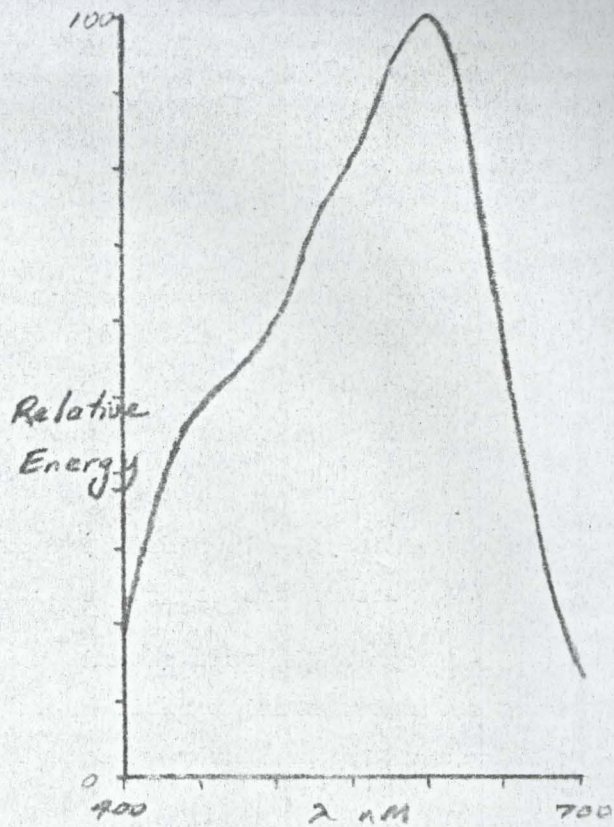
Diagram 2 is a plot of spectral energy distribution of the cool white (colour 33) fluorescent tube obtained from lamp manufacturers data and Helson and Lansford (1970, p. 1515).

Spectral energy distributions for the Blue and Red lighting conditions (diagrams 3 and 4) were obtained from diagrams 1 and 2 by plotting the product of the per cent transmission and the relative energy of the fluorescent source at a selection of wavelengths.



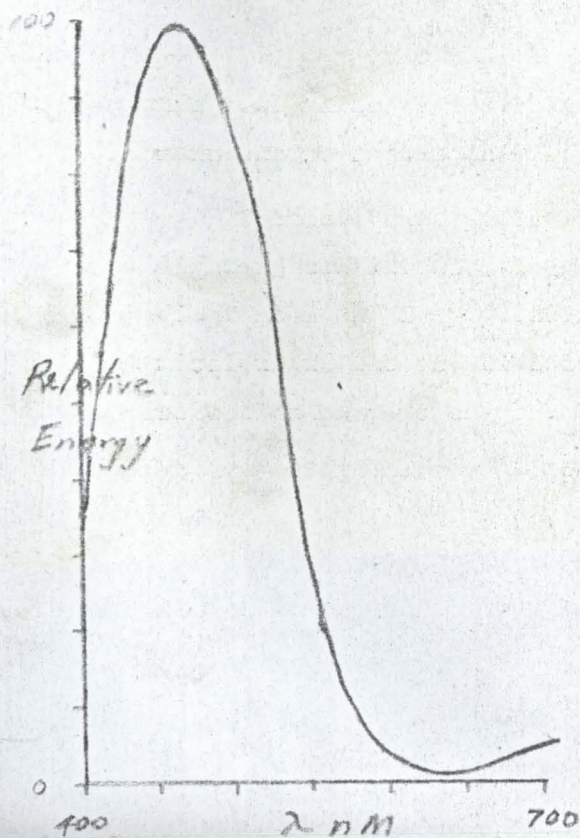
Transmission Curves - %T versus λ
(two layers of cellophane)

Diagram 1



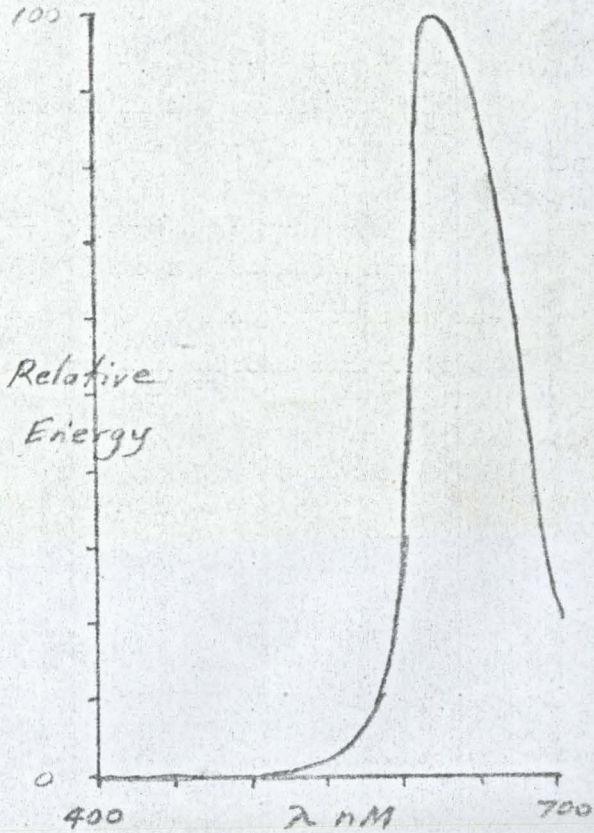
Light Source Energy
Spectral Distribution
(fluorescent tube colour 33)

Diagram 2



Blue Light Source Energy
Spectral Distribution

Diagram 3



Red Light Source Energy
Spectral Distribution

Diagram 4

APPENDIX 2

The Wilson-Patterson Conservatism Scale

Opinion Questionnaire

Which of the following do you favour or believe in?
 (Circle 'yes' or 'no', If you are absolutely uncertain,
 circle '?'. There are no right or wrong answers; do not
 discuss; just give your first reaction. Answer all items.)

Death Penalty	Yes ? No	Computer music	Yes ? No
Evolution theory	Yes ? No	Chastity	Yes ? No
School uniforms	Yes ? No	Fluoridation	Yes ? No
Striptease shows	Yes ? No	Royalty	Yes ? No
Sabbath observance	Yes ? No	Women judges	Yes ? No
Beatniks	Yes ? No	Conventional clothes	Yes ? No
Patriotism	Yes ? No	Teenage drivers	Yes ? No
Modern art	Yes ? No	Apartheid	Yes ? No
Self-denial	Yes ? No	Nudist camps	Yes ? No
Working mothers	Yes ? No	Church authority	Yes ? No
Horoscopes	Yes ? No	Disarmament	Yes ? No
Birth control	Yes ? No	Censorship	Yes ? No
Military drill	Yes ? No	White lies	Yes ? No
Co-education	Yes ? No	Birching	Yes ? No
Divine law	Yes ? No	Mixed marriages	Yes ? No
Socialism	Yes ? No	Strict rules	Yes ? No
White superiority	Yes ? No	Jazz	Yes ? No
Cousin marriage	Yes ? No	Straitjackets	Yes ? No
Moral training	Yes ? No	Casual living	Yes ? No
Suicide	Yes ? No	Learning Latin	Yes ? No
Chaperones	Yes ? No	Divorce	Yes ? No
Legalized abortion	Yes ? No	Inborn conscience	Yes ? No
Empire-building	Yes ? No	Coloured immigration	Yes ? No
Student pranks	Yes ? No	Bible truth	Yes ? No
Licensing laws	Yes ? No	Pyjama parties	Yes ? No

APPENDIX 3

The Nowlis Mood Adjective Check List

Each of the following words describes feelings or mood. Please use the list to describe your feelings at the moment you read it, circle the double check (vv) to the right of the word. For example, if the word is relaxed and you are definitely feeling relaxed at the moment, circle the vv as follows:

relaxed vv v ? no. (This means you definitely
feel relaxed at the moment.)

If the word only slightly applies to your feelings at the moment, circle the single check v as follows:

relaxed vv v ? no. (This means you feel slightly
relaxed at the moment.)

If the word is not clear to you or you cannot decide whether or not it applies to your feelings at the moment, circle the question mark as follows:

relaxed vv v ? no. (This means you cannot decide
whether you are relaxed or not.)

If you definitely decide the word does not apply to your feelings at the moment, circle the no as follows:

relaxed vv v ? no. (This means you are definitely
not relaxed at the moment.)

Work rapidly. Your first reaction is best. Work down the first column, then go to the next. Please mark all words. This should take only a few minutes. Please begin.

carefree	vv	v	?	no
rebellious	vv	v	?	no
angry	vv	v	?	no
lively	vv	v	?	no
playful	vv	v	?	no
annoyed	vv	v	?	no
warmhearted	vv	v	?	no
defiant	vv	v	?	no
fed-up	vv	v	?	no
witty	vv	v	?	no
talkative	vv	v	?	no
grouchy	vv	v	?	no
kindly ⁹	vv	v	?	no
affectionate	vv	v	?	no
forgiving	vv	v	?	no

APPENDIX 4

Semantic Differentials

WORD RATING FORM

NAME _____

This technique is designed to reflect the similarities and the differences in meaning which a specific word has for different people. Instead of asking for a definition, we are interested in the impressions and associations which each word brings to mind.

For this purpose, you are asked to judge each of a number of words against a set of scales like the following:

high ___:___:___:___:___:___:___ low

Examples

Suppose the word is BOY. If you feel that on the scale "Quiet Noisy", BOY is very closely associated with "Noisy", you would check as follows:

quiet ___:___:___:___:___:___:___ noisy

On the other hand if you feel that BOY is slightly associated with "Quiet", you would check as follows:

quiet ___:___:___:___:___:___:___ noisy

If BOY does not seem to you to be associated more with one end of the scale than with the other, you would check as follows:

quiet ___:___:___:___:___:___:___ noisy

There are no right or wrong answers. The meaning that a particular word has for you may be appropriately described by a check mark in any one of the seven spaces on each of the twelve scales.

Place your check mark in the middle of the space, not on a boundary.

DO THIS

NOT THIS

___:___:___

___:___:___

Work rapidly. Do not puzzle over individual items or worry about being consistent in your judgements. Just indicate your first reaction on each scale. Often a vague general impression will be all you have to go on. This is exactly what we want. Be sure to answer every item.

A BOTTLETOP

good _____ bad
small _____ large
fast _____ slow
ugly _____ beautiful
strong _____ weak
passive _____ active
happy _____ sad
thin _____ thick
hot _____ cold
dirty _____ clean

UNIVERSITY

weak _____:_____:_____:_____:_____:_____:_____ strong

passive _____:_____:_____:_____:_____:_____:_____ active

beautiful _____:_____:_____:_____:_____:_____:_____ ugly

thin _____:_____:_____:_____:_____:_____:_____ thick

hot _____:_____:_____:_____:_____:_____:_____ cold

sad _____:_____:_____:_____:_____:_____:_____ happy

large _____:_____:_____:_____:_____:_____:_____ small

slow _____:_____:_____:_____:_____:_____:_____ fast

good _____:_____:_____:_____:_____:_____:_____ bad

dirty _____:_____:_____:_____:_____:_____:_____ clean

APPENDIX 5

The Interpersonal Judgement Scale

INTERPERSONAL JUDGEMENT SCALEYOUR NAME: _____

1. Intelligence (check one)

- _____ I believe that this person is very much above average in intelligence.
- _____ I believe that this person is above average in intelligence.
- _____ I believe that this person is slightly above average in intelligence.
- _____ I believe that this person is average in intelligence.
- _____ I believe that this person is slightly below average in intelligence.
- _____ I believe that this person is below average in intelligence.
- _____ I believe that this person is very much below average in intelligence.

2. Knowledge of Current Events (check one)

- _____ I believe that this person is very much below average in his (her) knowledge of current events.
- _____ I believe that this person is below average in his (her) knowledge of current events.
- _____ I believe that this person is slightly below average in his (her) knowledge of current events.
- _____ I believe that this person is average in his (her) knowledge of current events.
- _____ I believe that this person is slightly above average in his (her) knowledge of current events.
- _____ I believe that this person is above average in his (her) knowledge of current events.
- _____ I believe that this person is very much above average in his (her) knowledge of current events.

3. Morality (check one)

- _____ This person impresses me as being extremely moral.
- _____ This person impresses me as being moral.
- _____ This person impresses me as being moral to a slight degree.
- _____ This person impresses me as being neither particularly moral nor particularly immoral.
- _____ This person impresses me as being immoral to a slight degree.
- _____ This person impresses me as being immoral.
- _____ This person impresses me as being extremely immoral.

4. Adjustment (check one)

- _____ I believe that this person is extremely maladjusted.
- _____ I believe that this person is maladjusted.
- _____ I believe that this person is maladjusted to a slight degree.
- _____ I believe that this person is neither particularly maladjusted nor particularly well adjusted.
- _____ I believe that this person is well adjusted to a slight degree.
- _____ I believe that this person is well adjusted.
- _____ I believe that this person is extremely well adjusted.

5. Personal Feelings (check one)

- _____ I feel that I would probably like this person very much.
- _____ I feel that I would probably like this person.
- _____ I feel that I would probably like this person to a slight degree.
- _____ I feel that I would probably neither particularly like nor particularly dislike this person.
- _____ I feel that I would probably dislike this person to a slight degree.
- _____ I feel that I would probably dislike this person.
- _____ I feel that I would probably dislike this person very much.

6. Working Together in an Experiment (check one)

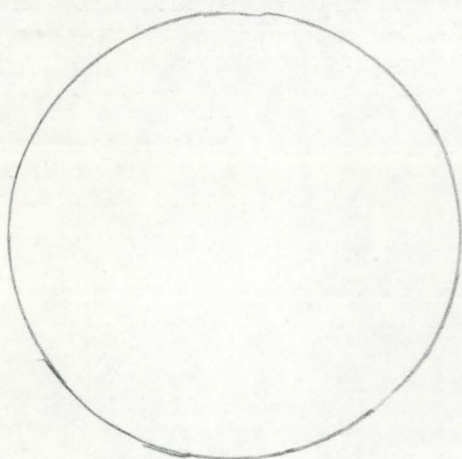
- _____ I believe that I would very much dislike working with this person in an experiment.
- _____ I believe that I would dislike working with this person in an experiment.
- _____ I believe that I would dislike working with this person in an experiment to a slight degree.
- _____ I believe that I would neither particularly dislike nor particularly enjoy working with this person in an experiment.
- _____ I believe that I would enjoy working with this person in an experiment to a slight degree.
- _____ I believe that I would enjoy working with this person in an experiment.
- _____ I believe that I would very much enjoy working with this person in an experiment.

APPENDIX 6

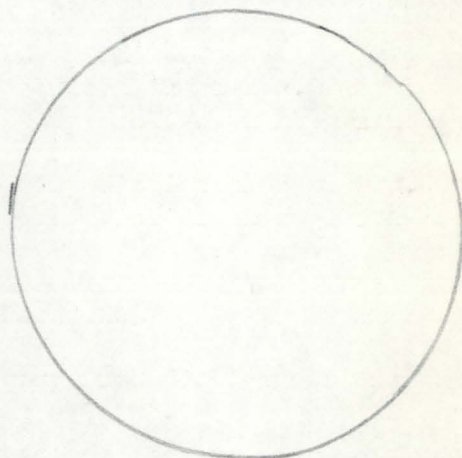
Form for Administration of Ishihara's Tests
for Colour-BlindnessNumber-Line Discrimination

You will now be presented with a series of places.
I want you to copy down what you see in the circle, whether
a number, a line or lines, or nothing at all. If you see
nothing in the circle then leave your circle blank. Don't
compare your work with your neighbour's.

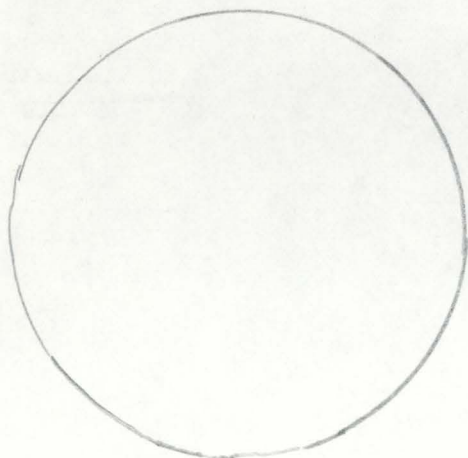
1



2



3 - 38 etc.



THANK YOU.

APPENDIX 7

The Verbal Experimental Instructions

1. "Would you all come into room 35 and be seated please."
2. "Would you sit down and get yourselves relaxed while I go out and get some papers." (Three-minute wait).
3. If the question "Why are we in this room with the coloured lighting?" is asked.
 "This is a room for the observation of children" - point to note on door and the nursery books on the table - "I have been asked to use it as it is the one least used at nights."
 Note: No subjects actually asked this question although most noted the message on the door and the presence of nursery books.
4. "Have you all got a pen? Would you please read the instructions for the first questionnaire. As soon as you have finished, go ahead. When you have finished that go straight ahead on through the Word Rating Form and when you have finished that I will tell you what to do next."
5. When all have completed their schedules:
 "You can see that you have in front of you a questionnaire similar to the one you have filled out at school. It has been completed by another person who has labelled himself Mr X. Would you read his responses carefully and when you think you have a fairly clear idea about what you think of him raise your hand. You don't need to rush!"
6. When all the subjects had made up their minds:
 "Now I am going to let you have a brief look at Mr X himself. I will ask him in and he will stand here for a space of 30 seconds. He's not going to do anything except stand here. Have a good look at him and when he leaves fill in the next questionnaire." (The IJS). "By the way, the alternatives for question five have been split in half by the typist."

7. "For the last part of the experiment we have to shift out of the room. Please follow me."
8. "Read the instructions to the number-line discrimination questionnaire. Are you ready?"
9. "Please write your age in years and months on the last page."
10. "Thank you. Have you any questions?" - pre-debriefing.

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