A Cross-Cultural Colour-Naming Study. Part I: Using an Unconstrained Method

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Abstract: Colour naming by panels of British and Taiwanese subjects (speaking English and Mandarin, respectively) was used to study colour categorization, and the results applied to investigate differences of usage between the two languages. Fifty British and 40 Chinese subjects took part in experiments using an unconstrained method with 200 ISCC-NBS colour samples. Data analysis was performed to calculate the frequency and codability of each colour name in each group and subgroup. These names were then grouped using 7-category and 4-category methods to find the culture and gender differences. It was confirmed that the 11 basic names found by Berlin and Kay were the most widely used for both languages. The results showed a close agreement between the two languages in terms of colour categories, but a large discrepancy in the use of secondary names due to cultural differences. The cross-cultural comparison revealed a clear pattern of the linkage between language and concepts of colour. © 2001 John Wiley & Sons, Inc. Col Res Appl, 26, 40–60, 2001

Key words: colour naming; colour categories; cross-cultural comparison; basic colour names; secondary names; colour codability

INTRODUCTION

Colour naming may be defined as "the description of a colour with a verbal expression." The use of colour names enables people to convey information about colours, and thereby to communicate with others. Colour naming also enables people to categorize objects and concepts, including different shades of colours. Categorization is one of the most important cognitive functions by which people learn about form, shape, and colour. Colour categorization allows a colour to be assigned to a specific colour group, by performing a mapping from a set containing a very large number of names for finely graduated colours into a set containing only a few well-differentiated colours. For example, all the thousands of tints and shades of red might be categorized simply as "red" in an application where it is necessary only to discriminate the colour from another category, such as "green" in a set of traffic lights.

In the following text, in order to clarify the distinctions between the actual colours and their corresponding names, the words for the colours themselves are written in the normal lowercase, whereas the words for the colour names are written in uppercase. Translations of Chinese names are attached to the English names and written in italics. Thus, "pink *feen-hong*" signifies the Chinese pink colour, while "PINK *FEEN-HONG*" represents the Chinese name for PINK.

Previous Studies

Many studies have been carried out to determine how people categorize colours. Nearly 300 years ago, Newton[1] classified the blue (short wavelength) region of the spectrum with the two English names "BLUE" and "INDIGO." According to Zimmer,[2] the German language identifies blue as "*BLAU* BLUE," but introduces a green-blue as "*TÜRKIS* TURQUOISE." Similarly, the Japanese prefer to use the term "*MIZU"* to represent a light blue and "*AO*" a dark blue.[3] For the same two colours, the Russians have the terms "*GOLUBOJ"* and "*SINIJ*," respectively,[4,5] although their categorization remains controversial.[6]

A comprehensive study to investigate the relationship between colour vision and the colour balance of natural daylight was carried out by Bornstein,[7,8] who compared

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blue vision among populations using 150 different languages around the world. The results showed that there was a greater proportion of blue colour-defectives for people living near the equator, as compared with Europeans, and a high probability that identical terms would be used for green, blue, and black. For instance, in South America nine of the twelve Indian cultures use one word for both green and blue, while three others use one word for blue and black.

Thus, significant variations can occur between different cultures in describing and classifying a colour and its neighboring colours in the spectrum, and there is a need to investigate colour naming across different cultural groups. The study of colour naming is one of the techniques by which colour categorization can be investigated.

Unconstrained and Constrained Methods

With the unconstrained method, subjects can freely name the colour samples, giving to the experimenters a broad colour vocabulary.[3,4,9-15] The unconstrained method was also used for linguistic research by Rich[16] and Sleight and Prinz,[17] who collected colour names from various sources, such as dictionaries and literature, both within and across cultures.

On the other hand, a constrained method provides subjects with specific names from which to choose. For instance, Boynton *et al.*[9] repeatedly presented subjects with monochromatic lights and asked them to judge the appearance by choosing from a set of given names. Only one or two specific names out of RED, GREEN, YELLOW, and BLUE could be used on each trial. The results indicated that opponent hues were virtually never seen together. Likewise, in the studies of CRT colour-name boundaries, Post and Greene[18] asked the subjects to choose one out of ten frequently-used names (modal responses) including WHITE, GRAY, RED, YELLOW, GREEN, BLUE, ORANGE, PURPLE, PINK, and AQUAMARINE for all 210 test colours. Their study showed that AQUAMARINE was widely used, but BROWN was seldom used in colour naming for the CRT display medium. The constrained method is a necessity when the meaning of colour names needs to be defined.[19,20]

Category Methods

In studying the interaction of gender across cultures, we have used two methods of colour-name categorization. A 7-category method enabled us to understand the uses of colour names for both cultures, whereas a 4-category method highlighted the structural importance of basic, modifier, and secondary names. In order to differentiate the two methods of colour-name categorization, the seven categories were expressed as C7-1 to C7-7 and the four categories as C4-1 to C4-4.

We followed the 7-category scheme of Simpson and Tarrant,[21] as follows†:

1. C7-1 (Basic) such as RED.
2. C7-2 (Modified basic) such as DARK RED.
3. C7-3 (Compound) such as BLUISH RED. This category includes achromatic and chromatic compound names. Therefore, WHITE(-ISH), GREY(-ISH), and BLACK(-ISH) are specifically included in this category rather than in the C7-2 category.
4. C7-4 (Qualified basic) such as DARK BLUISH RED.
5. C7-5 (Secondary) such as CARDINAL RED.
6. C7-6 (Idiosyncratic) no obvious pattern.
7. C7-7 (Unnamed) no name was given.

When considering the distribution of the basic colours in a perceptual colour space, a different categorization was necessary. To describe a colour, one basic name could be used alone, or with a modifier, or with a secondary term. For instance, the colour "red" may be named as RED, DARK RED, or BLOOD RED. When counting the total frequency of RED, it should include all the colours being named RED in the other categories, excluding the compound category (C7-3). Likewise, a modifier could be included in many categories in addition to C7-2. The four categories were, therefore, defined as:

1. C4-1 (Basic) includes any colour name ending with a basic term, such as RED, BRIGHT RED, and CHERRY RED.
2. C4-2 (Modifier) includes any colour name with a modifier, such as BRIGHT RED and BRIGHT CHERRY RED.
3. C4-3 (Compound) includes any colour name ending with a compound term, such as BLUE GREEN and DARK BLUE GREEN.
4. C4-4 (Secondary) includes any colour name using a secondary term, such as CHERRY RED, DARK CHERRY RED, and DARK CHERRY.

Using this method, some names would be classified in both C4-1 and C4-4, e.g., CHERRY RED is in C4-1 because "RED" is used, and also in C4-4 because "CHERRY" is used.

In summary, colour-name categorizations include basic colour terms, compound terms, modifiers, secondary terms, and others. The main problems are to determine how many basic terms there are, and to which colour categories they belong.

Focal Colours

Heider[22] showed that certain hues, drawn from the centers of colour categories for red, yellow, green, and blue,

† In their study, Simpson and Tarrant used the terms "basic-basic" for C7-3 and "elaborate" for C7-5.

were salient for young children and acted as anchors for their learning about colours. She termed these "focal colours," and confirmed her findings on the salience of these colours in several cognitive tasks carried out by adult groups. Andrix and Tager–Fluesberg[23] found that focal colours are more important for colour concept development than nonfocal colours, although they suggested that the boundaries of basic colour spaces and the mapping with names are culturally determined.

Rosch[24] proposed three levels of cognitive categorization: ·

- Superordinate: The whole concept of "colour" is on the same level as other concepts, such as number, vegetable, animal, furniture, vehicle, etc.
- Basic: The most general level at which people spontaneously name objects. The focal colours red, yellow, green, and blue are on the basic level in the "colour" superordinate category.
- Subordinate: A finer subdivision of the basic level. Salmon pink, rose pink, and lilac pink are on the subordinate level in the "pink" basic category.

Because people tend to use the basic level of colours (focal colours) as cognitive reference points, British and Chinese focal colours should be similar, but the range covered by each colour might not be the same between individuals or between cultures.

Cultural Differences

Some familiar notions of colour category are deep-seated within cultures. Many English-speaking school children, for example, learn the Newtonian sequence of colours from describing the spectrum by the mnemonic "Richard Of York Gave Battle In Vain" (Red, Orange, Yellow, Green, Blue, Indigo, Violet). A similar arrangement of the seven colours in the rainbow can also be found in Mandarin textbooks and is used in primary schools in Taiwan and China.

Thorndike and Lorge[25] found that RED, YELLOW, GREEN, BLUE, ORANGE, PURPLE, BROWN, and PINK are the most frequently appearing colour terms in English. In addition, according to Zimmer,[2] the German colour names used most frequently in descending order are: *ROT (*RED), *GELB (*YELLOW), *GRÜN* (GREEN), *BLAU* (BLUE), *ORANGE* (ORANGE), and *TÜRKIS* (TURQUOISE). Another example is from the study of Corbett and Morgan,[5] who investigated five Russian–English dictionaries to take account of seventeen Russian basic colour terms. Russian WHITE, BLACK, GRAY, RED, YELLOW, ORANGE, GREEN, and PINK have unique equivalents in English. However, there are two basic terms for blue, two for brown, and five for purple. None of the words for purple corresponds exactly to the English term.

The Chinese language has developed over a period of more than 4000 years. Some colours were originally used by special social classes and later became symbolic of each class. In ancient China, they employed "five colours to make five types of clothing to grade the rank of government officers."[26] Ordinary people were not allowed to use certain colours, especially highly chromatic ones; thus, "yellow" was the imperial colour, and so became a symbol of nobility and royalty. In English, however, the connotation may be very different — to describe somebody as "yellow" means that he/she is a coward.

A 7-stage theory was proposed by Berlin and Kay[4] to define the sequential development of the language of colour, in which a chronological order of the lexical encoding was used. This order was interpreted as a sequence of seven evolutionary stages:

Stage I: BLACK and WHITE are the only basic colour terms.
Stage II: RED is added.
Stage III: GREEN or YELLOW, but not both, are added.
Stage IV: both GREEN and YELLOW are added.
Stage V: BLUE is added.
Stage VI: BROWN is added.
Stage VII: PINK, ORANGE, PURPLE, and GRAY are added.

The language is said to enter Stage VII as soon as it has these first seven basic colour terms and at least one of the other four basic terms. A primitive language would have a smaller number of basic terms. For instance, in Navajo (North American Indian), *toott'iz* refers to a continuum of colour stimuli ranging from green through blue into purple.[27]

In the Berlin and Kay study, the Chinese language was classified as a Stage V language with only six basic colour terms. Guan[28] and Lü[29] investigated Chinese traditional colour naming, and collected more than 1600 names. Lü used the same paradigm as Berlin and Kay and confirmed that the Chinese language has more than eleven basic colour terms.

English achromatic basic terms include WHITE, BLACK, and GRAY, which are different from chromatic terms such as RED or ORANGE. In German and English, most native speakers use the words "*farbe*" and "colour" to describe colours in which a hue is exhibited to some degree, as distinct from achromatic values. The most notable example is in the labels of "white" and "coloured" people. However, there is a semantic problem with the word "colour."[30] In Japanese, "*iro*" (colour) generally includes both chromatic and achromatic hues, therefore "*shiro*" (white) and "*kuro*" (black) are "*iro*" as well. The Japanese consider black-and-white television to be a two-colour process, not a colourless process. When colour television was introduced in Japan, it was called "*tennenshoku terebi*" (natural television). A similar situation occurs in the Chinese language. Whenever a colour is named, the word "*sur*" (colour) always follows that word, thus "*hei-sur*" (black colour). Hence, Japanese and Chinese colour terms are phrases, not single words. In our study, white, black, and gray are all classified as "colours."

Gender

The ability to name colours can be measured in many ways. Woodworth[31] and Wells designed the Woodworth–Wells colour-naming test to compare the speed of recognition of standard colours between women and men in a college. They found that women did better at the recognition task than men in terms of speed and accuracy. When Ligon[32] later carried out the same test on children from Grades 1–9, the finding was the same. Other studies have shown that: (a) girls named colours better than boys at each age in early childhood[33,34]; and (b) women tended to use more elaborate vocabularies than men.[16,17,35,36] In addition, it was found that men tended to use more modifiers, more compound terms, and fewer elaborate names than women.

Although there is a range of colour names derived from various studies, similarities in colour-name categorization and basic colour categorization across cultures are found. People instinctively tend to identify colours by focal colours and then spread the terminology to the other colours. All results indicate that the basic colours are universal, and, therefore, the use of basic colour names across cultures should be very similar. However, some variations might occur in the number of basic terms due to linguistic conventions.

EXPERIMENTAL SETUP

In the present study, an unconstrained method was used to establish a database of English and Chinese names. Through this colour-to-name database, the number of colour names, the codability of each colour, and the categorization of basic colours were investigated.

Sample Preparation

Two hundred samples were selected from the full set of 267 ISCC-NBS colours. Each sample on glossy paper was 150 × 115 mm in size, and was mounted on medium-gray matt card ($L^* = 55.12$), 300 × 260 mm in size. All 200 samples were measured twice using a Macbeth MS2020+ spectrophotometer, both before and after the 2-year experimental period, and the CIELAB values for each colour were calculated using CIE D65 Illuminant and 1964 CIE standard colorimetric observer. The measuring conditions used were large aperture, specular included, and UV included. The ΔE^*_{ab} values between the two sets of measurements for 200 colours were:

Minimum: 0.12 (black)
Maximum: 4.60 (gray)
Mean: 1.28
Medium: 1.08
Standard Deviation: 0.87

The results showed that the sample colours changed slightly during the 2-year period due to extensive usage and transport between Taiwan and UK. However, a mean of 1.28 ΔE^*_{ab} is considered to be acceptable in this sort of experiment in which high precision is not desired.

The 200 sample colours covered a large colour gamut. In Fig. 1 their coordinates are plotted on the CIELAB diagram in five different lightness ranges: $L^* \leq 30$; $30 < L^* \leq 40$; $40 < L^* \leq 60$; $60 < L^* \leq 80$; $80 < L^*$.

Experimental Procedure

The viewing conditions used by the British and Chinese subjects were different. The British experiment used natural daylight entering through a classroom window. The Chinese experiment used a GE fluorescent tube (D65 artificial daylight) placed above a table. This was intended to provide a constant viewing condition to simulate normal daylight conditions.

All subjects were tested using the Ishihara colour-vision test to ensure normal colour vision. The 200 samples were divided into five lightness groups, each group covering the full range of hues, and then randomly mixed within each group. Each subject was presented with all five groups of colours in a random order, and was asked to observe each sample and write down its number and colour name. It took approximately 30 s to name each colour, and the whole process lasted about 2 h for each subject.

Subjects

The subjects from the two cultures were divided into four groups: British females, British males, Chinese females, and Chinese males. Altogether 50 British subjects (24 males and 26 females) and 40 Taiwanese subjects (20 males and 20 females) participated in this experiment. The British subjects spoke English and the Taiwanese subjects spoke Mandarin. The subjects in both groups were students or staff of the University of Surrey in UK and of Chon-Chen University in Taiwan, respectively. Their ages ranged from early to late adulthood, with an average of 26 years old.

Data Analysis

Some issues arise when certain colour names in one language are mapped onto colour names in other languages. For instance, according to Heider and Oliver,[12] the New Guinea Dani language has only two colour terms: "*MILI*" and "*MOLA*." It is thus unlikely to find a one-to-one mapping into English. There are at least two sources of confusion in using colour names: one is between academic terms and natural language; the other is between different cultures in which languages have progressed with time. Therefore, a study was carried out to clarify these issues and the validity of the translation from Chinese names to English. This study aimed to break the language barrier through translation into a common language. Since English is a *de facto* international language, it was decided to translate Chinese colour names into English, and then to compare them with the English names. The problem then arose whether the Chinese names translated into English had the same meaning as the

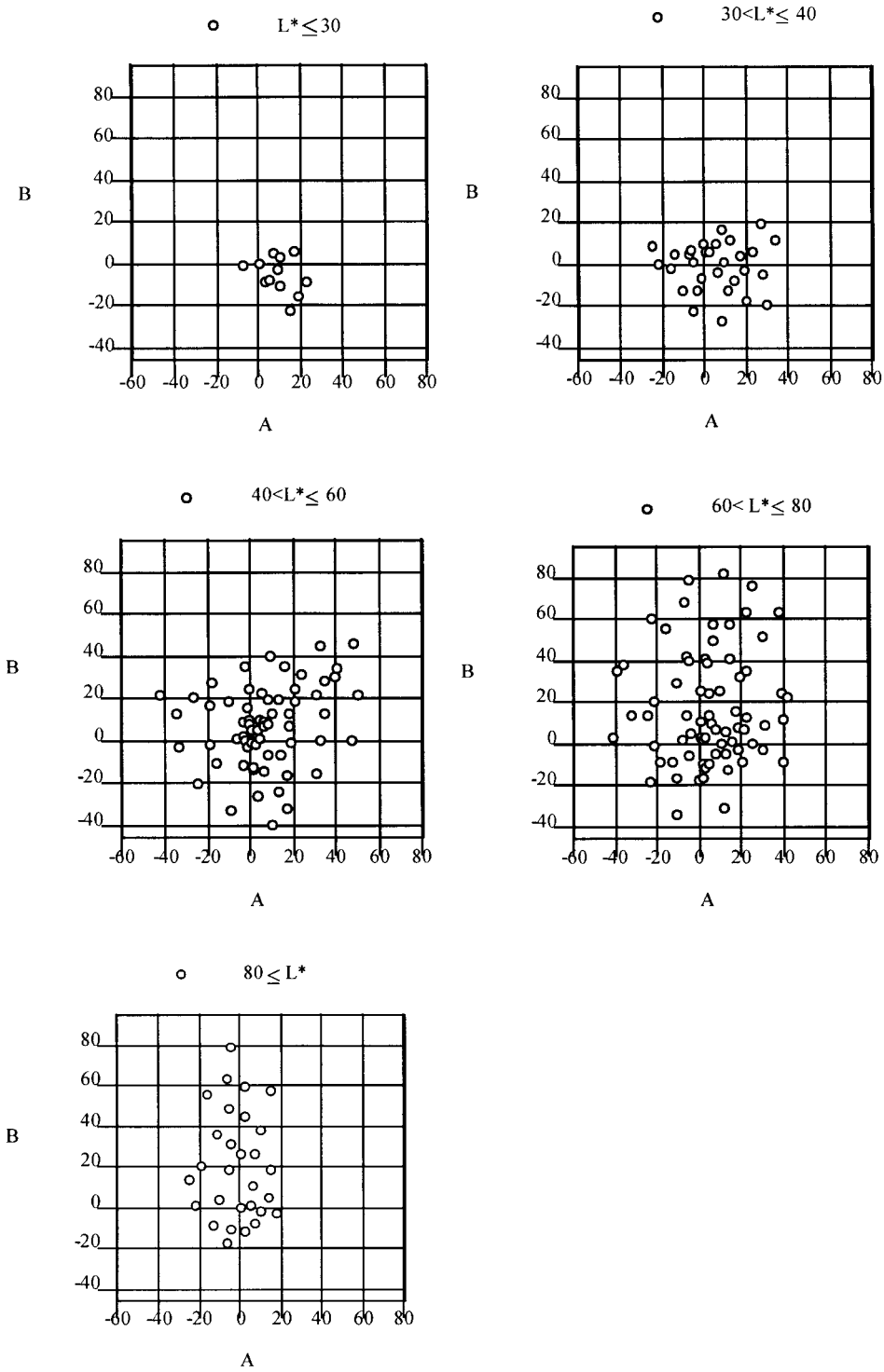

FIG. 1. 200 ISCC-NBS colours plotted on the CIELAB diagram.

original Chinese names. It took two steps to confirm the validity of translation: first to ensure that there was a one-to-one mapping, and second to ensure that the mapping was reasonably correct. Some Chinese names proved to be quite imprecise and difficult to translate, necessitating reference to several Chinese–English and English–Chinese dictionaries[37-39] and consultation with linguists and colour scientists.

Validity of Translation

Five questionnaires were constructed by a random selection from the Chinese naming responses. Each questionnaire was first translated into English by the authors with reference to dictionaries, and each included a different number of colour names ranging from 56–141. The names in each questionnaire were then translated by five Chinese subjects (staff or students at the University of Derby) from

TABLE I. An example of Chinese and British colour names.

ISCC-NBS Name: Strong Pink (1.2R 6.9/8.2)			
English Name	%	Chinese Name	%
1. BLUEY PINK	2	*1. BRIGHT PINK	2.5
2. BRIGHT DUSKY PINK	2	2. BRIGHT POWDER REDDISH WHITE	2.5
*3. BRIGHT PINK	16	3. CORAL PINK	2.5
4. BRIGHT ROSE PINK	2	4. DEEP RED POWDER WHITE	2.5
5. BRIGHT SALMON	2	5. FLUORESCENT PINK	2.5
6. CREAMY PINK	2	6. FLUORESCENT POWDER ORANGE	2.5
7. DARK FLESH PINK	2	7. FLUORESCENT ROSE	2.5
8. DARK PINK	4	8. FRESH PINK	7.5
9. DARK ROSE	2	9. GREYISH WHITISH RED	2.5
10. DEEP PINK	2	10. LIGHT PINK	5.0
11. DEEP ROSE PINK	2	11. LIPSTICK PURPLE	2.5
12. LIGHT BRIGHT PINK	2	12. MILK PINK	5.0
13. LIGHT SALMON PINK	2	13. ORANGE PINK	2.5
14. PALE PINK	2	14. ORANGE RED	2.5
*15. PINK	36	15. PALE FLESH RED	2.5
16. PINKY SALMON	2	16. PEACH PINK	2.5
17. ROSE PINK	6	17. PEACH RED	2.5
18. SALMON	2	18. PINK	35.0
19. SALMON PINK	2	19. POWDER ROSE RED	2.5
20. SHOCKING PINK	4	20. POWDER WHITISH RED	2.5
21. SUGARY PINK	2	21. RICE PINK	2.5
22. VIVID PINK	2	22. SILVER LIGHT PINK	2.5
		23. ? (NO RESPONSE)	2.5

Note: The name having the highest frequency is underlined and the name appearing in both cultures is marked with *.

English back into Chinese. The results were expressed in terms of consistency percentages, i.e., the number of words for which the translated and the original Chinese names agreed, divided by the total number of colour names in each questionnaire.

Database of Colour Names

Lists of English and Chinese names were compiled for the 200 colour samples studied, specified by the Munsell notation. For each colour, both English and Chinese colour names were arranged in alphabetical order, together with the frequency percentage of each name given by subjects. Table I, for example, shows the wide range of names given for the colour (1.2R 6.9/8.2). It was named PINK by the majority of both British and Chinese subjects, followed by the name BRIGHT PINK. None of the subjects used the term STRONG PINK as specified by the ISCC-NBS system.

The total number of colour names used for each group was calculated in order to investigate the difference in usage between the two cultures.

Codability Analysis

The codability of each colour was used to indicate the level of consensus among a group of subjects. This procedure was originally adopted by Brown and Lenneberg[40] from communication theory, and was also used by Zollinger[30] in his colour-naming study.

The codability was calculated according to Eq. (1), with a value ranging from −100 to +100, regardless of the size of the sample:

$$\text{Codability} = 100 \times (P_i - N_i)/(K - 1), \qquad (1)$$

where P_i is the number of subjects giving the most frequently used colour name for sample i, N_i is number of different names given by all subjects, and K is total number of subjects.

For the previous example in Table I, the codability for British subjects would be $100\times(18-22)/(50-1) = -8.16$; and for Chinese subjects $100\times(14-22)/(40-1) = -21.0$. If many similar names were used by both subgroups, the overall codability would increase. Hence, in conducting the gender comparison, a t-test was used rather than an F-test, because the codability for male, female, and overall groups for each colour might not be the same.

To compare codability between two cultures and between the gender groups within each culture, the means of the codability values for 200 colours between two groups were compared using a 2-tailed t-test at the 0.05, 0.01, and 0.001 levels. In each comparison, the results were marked by the symbols (∗), (∗∗) and (∗∗∗), if they were significantly different for 0.05, 0.01, and 0.001, respectively. The cognitive structures of colour names for the two languages were initially presented using the 7-category method. These were then compared by using the 4-category method.

RESULTS

Before commencing the data analysis, all Chinese names were translated into English to compare with English names. A validation of the translation was conducted.

TABLE II. The translation table of Chinese colour names.

Roman Pronunciation	English	Chinese Character
a. Basic Terms		
BAI	WHITE	白
HEI	BLACK	黑
HUEY	GREY	灰
HONG	RED	紅
JU	RED	朱
HUANG	YELLOW	黃
LIUH	GREEN	綠
CHING	GREEN	青
LAN	BLUE	藍
DIANN	BLUE	靛
JYU	ORANGE	橘
CHEN	ORANGE	橙
ZI	PURPLE	紫
ZONG	BROWN	棕
HUR	BROWN	褐
FEENHONG	PINK	粉紅
B. Modifiers		
SHEN	DEEP	深
ANN	DARK	暗
CHEAN	LIGHT	淺
DANN	PALE	淡
NONN	THICK	濃
SHEAN	FRESH	鮮
YANN	VIVID	艷
ZUO	DIRTY	濁
LIANG	BRIGHT	亮
ZUON	MID	中
C. Secondary Terms		
DAI	JADE	黛
BE	JADE	碧
ZAN	DYE	蒼

Validity of Translation from Chinese into English Colour Names

Table II shows the correspondence between the Chinese and English colour names. To prevent confusion, throughout this article, English phonetic spellings of Chinese names are attached to the English terms and typed in italics. Thus, "*BAI* WHITE" represents the Chinese name for "WHITE," whereas "*bai* white" signifies the Chinese white colour.

Subject 5 wrongly translated "PINK" to "POWDER." Chinese "*feen* powder" is often paired with basic names, such as "*FEEN LAN* POWDER BLUE." Chinese "PINK" is written in two characters "*FEEN HONG*," i.e., "POWDER RED," but its usage is more common than other combinations such as "*FEEN LIUH* POWDER GREEN."

The mean percentages of consistency for each subject and each questionnaire were calculated. The results are considered to be highly satisfactory, ranging from 70–94% with an overall mean of 86%. The largest discrepancy occurred when translating the modifier "strong" into Chinese.

Frequently Used Colour Names for Chinese and British Subjects

Colours and colour names do not all map one-to-one within a language. One colour may have several names; or conversely one colour name may cover many shades of colour. The experimental results were, therefore, compiled into a large database, in which each colour has both English and Chinese colour names collected with frequencies attached. The most frequently used colour names for Chinese and British are listed in Table III. Results are shown only from the top three categories: Basic, Modifier, and Secondary.

First, five basic names that caused confusion for the Chinese subjects were noted: *JU* RED, *CHEN* ORANGE, *CHING* GREEN, *DIANN* BLUE, and *HUR* BROWN. It was suspected that *CHEN* ORANGE might be the synonym of *JYU* ORANGE, *HUR* BROWN of *ZONG* BROWN, and *JU* RED of *HONG* RED; and also that *CHING* GREEN might represent the colours with hues between green and blue, and *DIANN* BLUE between blue and purple. These names were further studied using a constrained method, and will be discussed in Part II of this article.

Second, it was found that the number of modifiers in common use is larger than the number of basic terms. Several modifiers need to be clarified, such as *SHEN* DEEP, which might mean *ANN* DARK or English FRESH. In addition, *DANN* PALE might imply *CHEAN* LIGHT; and *YANN* VIVID might be *SHEAN* FRESH. The most confusing modifier seems to be *JONG*, which could be translated to HEAVY. However, this word "heavy" was not used by the British subjects at all. The authors decided instead to translate *JONG* to STRONG, which is consistent with the interpretation "thick colour" for *JONG*. In the second experiment, reported in Part II, these modifiers were verified.

Third, the number of secondary terms is much greater than the other categories. Some secondary names are unlikely to have a direct mapping between Chinese and English, e.g., "jade."

When subjects were asked to name colours, they tended to choose from three main categories to describe a colour, viz. the basic, modifier, and secondary categories. This is consistent with the framework previously mentioned, in which colour naming shares a similar cognitive structure with family naming:

- Personal name = First name + Family name
- Colour name = Adjective + Basic colour

The adjective for a colour name is frequently a modifier (strong, bright, dark, etc.), or another basic colour, or an object (animal, metal, plant).

Although Berlin and Kay[4] formulated a Stage V theory for the Chinese language, it would be more appropriate to treat the Chinese language as Stage VII, because it has eleven basic colour terms. The results shown in Table III confirm that the Chinese language appears to have not only the eleven basic colour terms, but also five additional basic

TABLE III. List of principal Chinese and British colour names.

A. Basic Colour Terms

A1. Chinese

1. BAI WHITE	2. *CHEN* ORANGE	3. *CHING* GREEN
4. *DIANN* BLUE	5. *FEEN-HONG* PINK	6. *HEI* BLACK
7. *HONG* RED	8. *HUANG* YELLOW	9. *HUEI* GREY
10.*HUR* BROWN	11. *JU* RED	12. *JYU* ORANGE
13. *LAN* BLUE	14. *LIUH* GREEN	15. *ZI* PURPLE
16. *ZONG* BROWN		

A2. British

1. BLACK	2. BLUE	3. BROWN
4. GREEN	5. GREY	6. PINK
7. ORANGE	8. PURPLE	9. RED
10. WHITE	11. YELLOW	12. INDIGO+

B. Modifiers

1. BIG*	2. BRIGHT	3. BURNT
4. CLASSIC*	5. CLEAR*	6. DARK
7. DEEP	8. DIRTY	9. FLUORESCENT
10. FRESH	11. LIGHT	12. MID
13. PALE	14. SAD*	15. SLIGHT*
16. STRANGE	17. STRONG	18. SUPER*
19. THICK	20. VIVID	21. WEAK

C. Secondary Terms

1. ALUMINUM*	2. AUBERGINE	3. BE*
4. BEAN-PASTE*	5. BLACK-INK*	6. BLACK-MAN (AFRICAN)*
7. BLOOD	8. BRITISH+	9. BURGUNDY+
10. BUTTER	11. CHAMPAGNE*	12. CHERRY
13. CHROME	14. COFFEE	15. CONCRETE
16. COPPER	17. CREAM	18. CRIMSON+
19. CYAN+	20. DAI*	21. DIAMOND
22. EARTH	23. EGG	24. EMERALD
25. FLAMINGO*	26. FLESH	27. FRIED-EGG*
28. GOLDEN-YELLOW	29. GRASS	30. IODINE*
31. IRON*	32. IVORY	33. JADE
34. KHAKI	35. LEAVES*	36. LILAC+
37. LIPSTICK*	38. MAGENTA+	39. MAGNOLIA+
40. MAROON+	41. MAUVE+	42. MILK
43. MINT	44. MUSTARD	45. OCHRE
46. OIL	47. OLIVE	48. OXFORD+
49. PAPAYA*	50. PERSIMMON*	51. RICE*
52. PIG-LIVER*	53. POWDER	54. ROYAL+
55 RED-MAN (INDIANS)*	56. RUST*	57. SEAWEED*
58. SILVER	59. SKIN	60. SKY
61. TAN+	62. TEA	63. TIBET*
64. TREE	65. VANILLA	66. VEGETABLE*
67. VIOLET	68. WATER*	69. WHITE-MAN* (CAUCASIAN EUROPEAN)
70. WINE	71. WOOD	72. WOOD-BITS*
73. YELLOW-MAN (ORIENTAL)		

Note: * indicates Chinese-specific colour words, for instance CLEAR*.
+ indicates British-specific colour words, for instance LILAC+.

colour terms: *JU* RED, *CHEN* ORANGE, *CHING* GREEN, *DIANN* BLUE, and *HUR* BROWN. Amongst these, *CHING* GREEN and *JU* RED are ancient words from the Chinese 5-colour theory, an early framework related to the five basic elements of wood, fire, metal, water, and earth.[26] The symbolism implies that wood denoted green, fire denoted red, and so on. These colour words were gradually differentiated through the years and some became obsolete and were replaced.[41]

It is interesting to consider why the Mandarin language names some basic colour categories with two terms each. It has been argued that coextensive naming of basic colour categories is common place (Ref. 42, especially Chapter 6), and that one term may be dominant while the other is recessive. The terms may take on slightly different meanings, because they name different points of view on the same perceptual reality, forming a cognitive overlay. In such a framework, only the dominant term would be basic, the recessive term nonbasic, and this would reduce the number of Mandarin basic colour terms from sixteen to eleven. For a study of the two "red" terms in Hungarian that takes this position, see Almasi, MacLaury, and Koveces.[43] Likewise Japanese does not have two basic terms for light and dark blue: "*AO*" is basic, while "*MISU*" is secondary.[3,30]

Chinese basic terms were examined against the definition of basic terms given by Berlin and Kay, who set out the following four criteria:

TABLE IV. Total numbers of colour names used in four subgroups.

	British			Chinese		
	Males	Females	Total	Males	Females	Total
Total responses	4752	5148	9900	4000	4000	8000
No. of names	1246	1408	2214	1122	1248	1920

1. A basic term should be mono-leximic.
2. The significance of a basic term should not be included in that of any other form.
3. The application of a basic term should not be restricted to a narrow class of objects.
4. A basic term should be relatively salient for informants.

With this in mind, the sixteen Chinese terms were investigated to determine whether they qualify as basic terms. Consideration was given, as Boynton and Olson[44] suggested, as to whether there should be an extra basic term corresponding to any of the names PEACH, TAN, BROWN, SALMON, ORANGE, or PINK, none of which is similar to the Chinese names *CHING* GREEN, *DIANN* BLUE, or *JU* RED; or to the English INDIGO.

Comparing the use of basic names, there exist more modifiers and secondary terms in the Chinese and English languages than are given in Table III. Both Chinese and British subjects used many different secondary words. For instance, Chinese subjects liked to use several names for skin colours, such as black-man, white-man, yellow-man, and red-man, whereas British subjects used only "skin" or "flesh" to name such colours.

Number of Colour Names

The numbers of responses and names produced by each subgroup are summarized in Table IV. There were 1408 names from 26 British females and 1246 names from 24 British males, plus 1248 names from 20 Chinese females and 1122 names from 20 Chinese males. In total, there were 2214 and 1920 names for British and Chinese subjects, respectively. Detailed inspection showed that some colour names were used by both language groups.

The total number of names indicates the accuracy and variety of naming. In order to cover a large range of colours, some subjects chose to give a more accurate description. When a difficulty in naming colours arose, e.g., with less commonly seen colours, people would typically invoke an object colour (secondary name) or combine two or more colours into a compound name, which inevitably produced a large number of names.

Codability Study

Codability analysis was applied to identify the most commonly used colours. Since a low codability value indicates a high difficulty in naming a colour, those colours were also investigated. The results are useful for colour-naming selection. The principal high and low codability colours are shown in Figs. 2 and 3, respectively. Each plate includes the most frequently occurring 25 colours for the British and Chinese groups.

The mean (M) and standard deviation (S) of the codability values and the number (N) of colours for each subgroup were calculated. They are given in Tables V and VI comparing the two language groups and the two gender groups, respectively. Only 197 colours were named by British males and 198 colours by British females, because some colours could not be named. In general, the colours named by Chinese subjects were of lower codability than those of British subjects. There was a significant difference at the 0.001 level between the two cultures. No gender difference of colour codabilities was found for either language, as shown in Table VI.

High-Codability Colours

Eleven common colours were found for British and Chinese cultures out of the top 25 high-codability colours. They include three achromatic colours (white, black, and gray), plus dark green and purple. Among the top 25 British high-codability colours, there were eight modifier-basic names and two secondary terms (LILAC and SKY). The British high-codability colours were seldom named in a compound (basic-basic) category. British subjects used "DARK" more often than "DEEP," and "BRIGHT" more often than the Chinese subjects. Neither "red" nor "pink" was included in the top 25 British high-codability colours.

Chinese naming had a lower codability than British nam-

TABLE V. Codability comparison between two cultures.

British			Chinese			*t*	*P*
M	S	N	M	S	N		
−33.95	27.19	200	−50.01	25.83	200	6.06***	.0001

Note: *** indicates the alpha level <0.001, very significant.

COLOUR PLATE 1A

CHINESE HIGH-CODABILITY COLOURS

FIG. 2. (A) Chinese high-codability colours; (B) British high-codability colours.

COLOUR PLATE 1B

BRITISH HIGH-CODABILITY COLOURS

FIG. 2. (*Continued*)

COLOUR PLATE 2A

CHINESE LOW-CODABILITY COLOURS

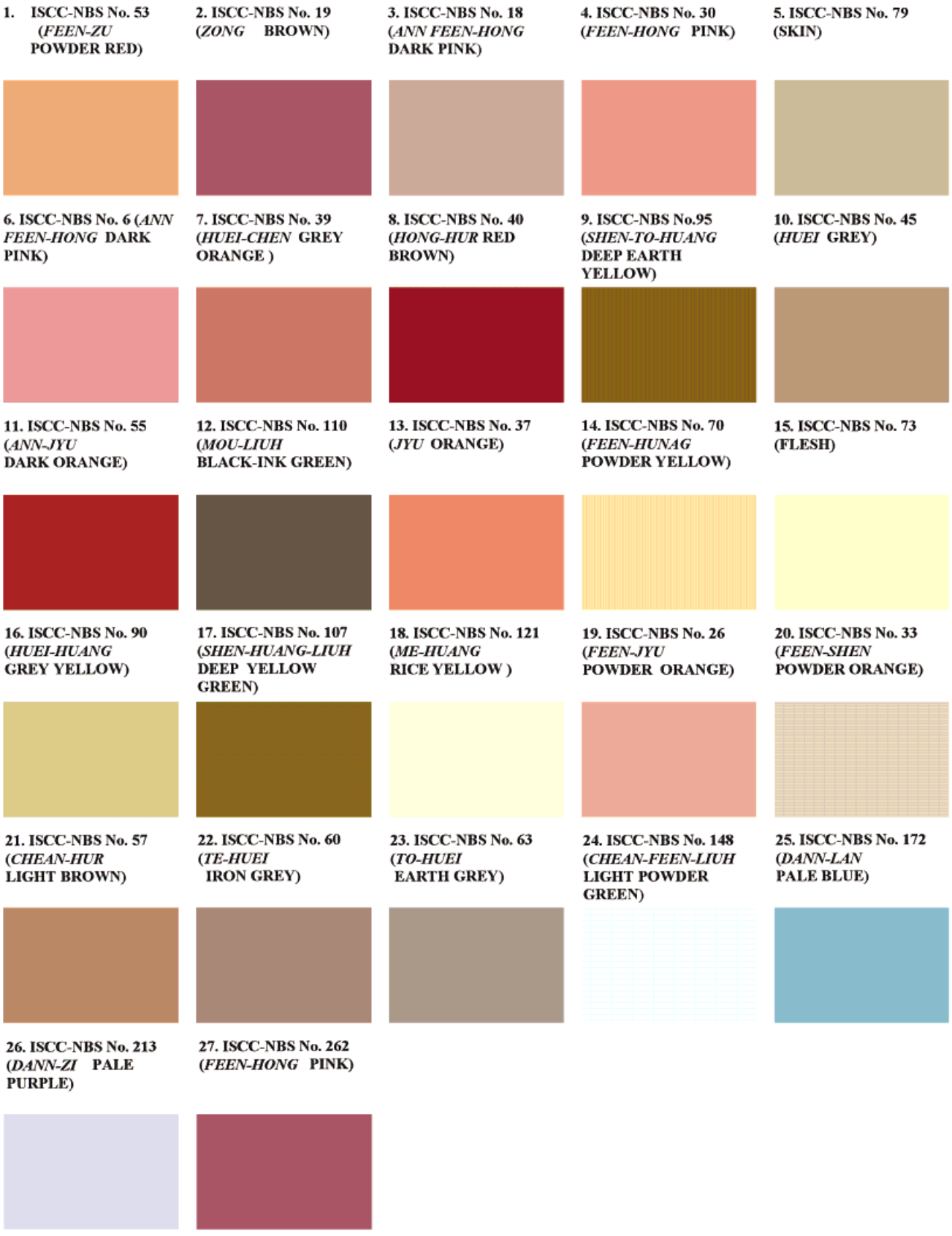

FIG. 3. (A) Chinese low-codability colours; (B) British low-codability colours.

COLOUR PLATE 2B

BRITISH LOW-CODABILITY COLOURS

FIG. 3. (*Continued*)

TABLE VI. Gender comparison of codability for British and Chinese subjects.

	Males			Females			*t*	*P*
	M	S	N	M	S	N		
British	−42.64	29.26	197	−43.98	29.87	198	0.45	.6528
Chinese	−57.24	27.85	200	−58.11	27.52	198	0.31	.7539

ing except for the achromatic colours. Among the top 25 Chinese high-codability colours, 15 (60%) were basic names; 4 (16%) were basic-basic; 4 (16%) were modifier-basic; and 2 (8%) were secondary-basic names. Chinese subjects used more basic-basic (compound) terms, such as GRAY WHITE and PURPLE RED, than did British subjects.

It was noted that "brown" and "orange" were not among Chinese high-codability colours, because these two colours were named inconsistently by Chinese subjects. This was perhaps caused by the prevalence of some secondary names, as shown in Table III, such as COFFEE and EARTH. Moreover, because *JYU* ORANGE and *CHEN* ORANGE were used interchangeably, the frequency of ORANGE was reduced. Similarly, the frequency of BROWN was reduced by the usage of both "*HUR*" and "*ZONG*."

Regarding the use of modifiers, Chinese subjects used "DEEP" more often than "DARK." This was opposite to the usage found in the British group. The secondary term SKY was used by both cultures. However, it was noted that British SKY BLUE is less saturated than Chinese SKY BLUE.

Low-Codability Colours

The results show that the low-codability colours were predominantly those of low-to-medium chroma and low-to-medium lightness, which were described with compound terms. Both cultures had difficulty in naming these colours. There were eight common colours for two cultures out of the top 25 low-codability colours, as shown in Fig. 3.

Eleven Basic Colour Terms

Out of the full set of 200 colours, the eleven colours that subjects named with a single basic term and that had the highest codability are shown in Table VII. When these eleven basic colour names were compared in terms of codability between the two cultures, it was found that British subjects used 8 with higher codability than Chinese subjects, with the exception of RED, PINK, and BLUE. British subjects chose PINK more often in comparison with Chinese RED, YELLOWISH RED, and PURPLISH RED.

Amongst these eleven basic colours, the most consistently named were the three achromatic colours (white, black, and gray) for both British and Chinese. Both cultures were consistent in naming the chromatic basic colours, but the ranking order of codability for the eleven colours was different between the two cultures, as shown in Table VII. RED was ranked in tenth place for the British, whereas it was in fourth place for the Chinese. ORANGE and BROWN were inconsistently used by Chinese subjects, but were popular for British subjects.

Distribution with the 7-Category Method

Table VIII shows the percentages of colour names derived by the 7-category method. Good agreement between the Chinese and British groups was found. Both groups preferred to describe colours using secondary names, comprising 42% of all colour names given. However, these names were diverse, showing a cultural difference. Chinese subjects tended to use more compound names and fewer basic names than British subjects.

The gender difference was more evident in the British results. British females used a larger percentage of secondary names than the males, the difference being greater than for Chinese females. This was consistent with previous findings that females tend to use a more elaborate (nonbasic) vocabulary. British males tended to use more modified-basic and compound terms, with fewer secondary names

TABLE VII. Comparison of codability of 11 basic colour terms.

	British			Chinese		
Names	ISCC-NBS Card no.	Codability	Ranking	Card no.	Codability	Ranking
1. WHITE	263	69.39	1	*263	69.23	1
2. BLACK	267	59.18	2	*267	30.77	2
3. GREY	265	36.73	3	*265	10.26	3
4. PURPLE	219	34.69	4	*219, 238	−10.26	8
5. YELLOW	83	18.37	5	97	−2.56	5
6. BROWN	78	14.29	6	59	−33.33	10
7. ORANGE	50	6.12	7	48, *50	−35.90	11
8. PINK	247	−6.12	9	*247	−5.13	6
9. GREEN	132, 142	−6.12	9	*142	−7.69	7
10. RED	11	−12.24	10	*11	5.13	4
11. BLUE	169	−18.37	11	178	−17.95	9

Note: * indicates that both groups chose the same colour for the basic names.

TABLE VIII. Percentage of colour names in seven categories.

	British (%)			Chinese (%)		
Category	Males	Females	Total	Males	Females	Total
1. Basic	15.55	15.83	15.70 (3)	11.15	10.18	10.66 (4)
2. Modifier-B	26.49	20.16	23.20 (2)	18.52	16.20	17.36 (2)
3. Compound	13.66	7.25	10.32 (4)	18.60	17.58	18.09 (2)
4. Qualifier-B	7.53	6.86	7.18 (5)	8.82	10.82	9.82 (5)
5. Secondary	35.12	48.93	42.30 (1)	40.08	44.78	42.42 (1)
6. Idiosyncratic	0.51	0.17	0.33 (7)	0.03	0.28	0.15 (7)
7. Unnamed	1.14	0.80	0.96 (6)	2.80	0.17	1.49 (6)

Note: Numbers in brackets are the ranking orders.

than the females. For Chinese subjects, it was mainly in the C7-5 (secondary) category where Chinese males used fewer secondary names than the females.

Distribution with the 4-Category Method

Basic Colour Names. Table IX shows that the frequencies of the twelve basic colour names used by British males and females accounted for over half of the total responses (59% for males, 58% for females). The most frequently used basic names for British males, in decreasing order of occurrence, were: GREEN, PINK, BLUE, GRAY, PURPLE, YELLOW, BROWN, ORANGE, RED, WHITE, BLACK, and INDIGO. It is interesting to observe that the use of RED was remarkably low ($N = 71$) and that INDIGO was the least used name ($N = 4$).

There was a good agreement between British males and females: GREEN, PINK, and BLUE were the top three, and INDIGO was the last. GRAY was more frequently used by British males than females. A minor hypothesis of this study was that INDIGO might be a twelfth basic colour. Both sets of results confirm, however, that INDIGO was seldom used by British subjects, which suggests that INDIGO ought not be considered as a basic colour name. It probably should instead be included in the secondary (C7-5) category, along with other object names such as VIOLET, LILAC, and MAUVE.

The results also show that British subjects used more

TABLE IX. Frequency of the 12 British basic colour names.

	C7-1 (B)	C7-2 (M-B)	C7-4 (M-M-B)	C7-5 (S-B)	C7-5 (M-S-B)	C7-6 (I-B)	Total
Males							
1. WHITE	36	8	0	7	0	0	51 (10)
2. BLACK	20	0	0	4	0	0	24 (11)
3. GREY	108	135	4	45	12	1	305 (4)
4. RED	12	32	1	23	3	0	71 (9)
5. YELLOW	70	107	6	73	16	1	273 (6)
6. GREEN	99	303	32	156	54	3	647 (1)
7. BLUE	46	149	10	112	48	0	365 (3)
8. ORANGE	55	93	3	16	2	1	170 (8)
9. PURPLE	128	133	1	11	2	0	275 (5)
10. BROWN	75	101	18	54	2	0	250 (7)
11. PINK	88	190	7	66	27	0	378 (2)
12. INDIGO	4	0	0	0	0	0	4 (12)
Total	741	1251	82	567	166	6	2813 (59%)
Females							
1. WHITE	32	20	0	7	0	0	59 (9)
2. BLACK	25	0	0	1	0	0	26 (11)
3. GREY	72	99	1	58	12	0	242 (7)
4. RED	11	19	2	16	2	0	50 (10)
5. YELLOW	67	86	2	83	15	0	253 (5)
6. GREEN	144	256	34	254	68	0	756 (1)
7. BLUE	49	107	8	179	44	0	387 (3)
8. ORANGE	82	76	4	33	2	1	197 (8)
9. PURPLE	143	93	3	18	3	0	260 (4)
10. BROWN	82	81	8	66	10	0	248 (6)
11. PINK	94	200	15	118	44	0	471 (2)
12. INDIGO	14	4	0	0	0	0	18 (12)
Total	815	1041	77	833	200	1	2967 (58%)

Note 1: Numbers in brackets are the ranking orders.
Note 2: B is Basic, M is Modifier, S is Secondary, and I is Idiosyncratic.

TABLE X. Frequency of the 16 Chinese basic colour names.

	C7-1 (B)	C7-2 (M-B)	C7-4 (M-M-B)	C7-5 (S-B)	C7-5 (M-S-B)	C7-6 (I-B)	Total
Males							
1. WHITE	16	0	0	27	4	0	47 (13)
2. BLACK	12	3	0	2	0	0	17 (16)
3. GREY	34	30	1	62	6	0	133 (7)
4. *HONG* RED	19	63	5	64	14	0	165 (5)
5. *JU* RED	1	23	1	0	5	0	30 (14)
6. YELLOW	41	72	4	156	24	0	297 (3)
7. *LIUH* GREEN	51	150	7	195	50	0	453 (1)
8. *CHING* GREEN	14	26	0	37	1	0	78 (8)
9. *LAN* BLUE	30	98	2	89	31	0	250 (4)
10. *DIANN* BLUE	11	9	0	2	5	0	27 (15)
11. *JYU* ORANGE	17	28	1	15	3	0	64 (12)
12. *CHEN* ORANGE	18	21	1	23	5	0	68 (11)
13. PURPLE	72	123	0	114	25	0	334 (2)
14. *ZONG* BROWN	21	33	0	14	0	0	68 (11)
15. *HUR* BROWN	16	24	0	28	2	0	70 (9)
16. PINK	73	57	0	14	1	0	145 (6)
Total	446	760	22	842	176	0	2246
Females							
1. WHITE	18	1	0	24	11	0	54 (11)
2. BLACK	16	2	0	1	2	0	21 (16)
3. GREY	44	44	0	48	20	0	156 (6)
4. *HONG* RED	11	52	4	66	43	0	176 (5)
5. *JU* RED	14	21	0	14	2	0	51 (12)
6. YELLOW	34	58	3	114	64	0	273 (3)
7. *LIUH* GREEN	40	106	8	175	83	0	412 (1)
8. *CHING* GREEN	24	21	0	15	4	0	64 (10)
9. *LAN* BLUE	27	64	5	96	39	0	231 (4)
10. *DIANN* BLUE	7	12	2	3	4	0	28 (15)
11. *JYU* ORANGE	29	15	4	38	10	0	96 (8)
12. *CHEN* ORANGE	14	20	0	14	2	0	50 (13)
13. PURPLE	56	127	8	78	37	0	306 (2)
14. *ZONG* BROWN	15	11	0	14	6	0	46 (14)
15. *HUR* BROWN	25	30	1	19	6	0	81 (9)
16. PINK	47	65	4	16	5	0	137 (7)
Total	421	649	39	735	338	0	2182

Notes 1: Numbers in brackets are the ranking orders.
2: B is Basic, M is Modifier, S is Secondary, and I is Idiosyncratic.

modifiers with basic terms (C7-2 category) rather than using basic terms only (C7-1 category). INDIGO, WHITE, and BLACK were exceptions. Adding a secondary term in front of a basic colour name (C7-5 category) was also common.

For the Chinese group, sixteen basic names accounted for over half the total responses (56% for males, 55% for females) as shown in Table X. This result agreed well with that of the British group. The most frequently used basic terms, in decreasing order of occurrence, were *LIUH* GREEN, followed by *ZI* PURPLE, *HUANG* YELLOW, *LAN* BLUE, *HONG* RED, *FEEN-HONG* PINK, *HUEI* GRAY, *CHING* GREEN, *HUR* BROWN, *ZONG* BROWN, *CHEN* ORANGE, *JYU* ORANGE, *BAI* WHITE, *JU* RED, *DIANN* BLUE, and *HEI* BLACK. PINK dropped from second place for British subjects to sixth for Chinese; and RED moved up from ninth place for British subjects to fifth for Chinese.

The frequencies of YELLOW and GREEN in the secondary-basic category (C7-5) were extraordinarily high. Chinese males frequently compounded a secondary term with these two basic colours, such as "grass green" and "earth yellow."

Again, the results from Chinese females agreed well with those of Chinese males, i.e., the top five (*LIUH* GREEN, *ZI* PURPLE, *HUANG* YELLOW, *LAN* BLUE, *HONG* RED) and the bottom two (*DIANN* BLUE, *HEI* BLACK) are identical. Comparing British and Chinese results, the British BROWN was described by the Chinese as either *ZONG* BROWN or *HUR* BROWN, terms that were used equally by Chinese subjects. In addition, *FEEN-HONG* PINK was used much less often by Chinese subjects. The frequency of the 12 colours in the modifier-basic (C7-2) category was also generally larger than in the basic (C7-1) category for Chinese subjects. This tendency was similar to the British results, suggesting that all subjects preferred to use modified basic names, rather than using basic names alone.

In Table XI, all basic colours are compared for the four subgroups of language and gender. Some general trends can be found; for example, GREEN occurred most frequently in all subgroups. All subgroups exhibit a high frequency of the eleven basic names, as found by Berlin and Kay, which confirms that these eleven basic colour terms are universal. As mentioned earlier, RED and PINK colours did not have high codability for the British. RED had a much lower

TABLE XI. Frequency of the basic colour names for four subgroups.

	British			Chinese		
	Males	Females	Total	Males	Females	Total
1. WHITE	51	59	110 (10)	47	54	101 (13)
2. BLACK	24	26	50 (11)	17	21	38 (16)
3. GREY	305	242	547 (5)	133	156	289 (6)
4. RED (*HONG*)	71	0	121 (9)	165	176	341 (5)
5. RED* (*JU*)	0	0	0	30	51	81 (14)
6. YELLOW	273	253	526 (7)	297	273	570 (4)
7. GREEN (*LIUH*)	647	756	1403 (1)	453	412	865 (1)
8. GREEN* (*CHING*)	0	0	0	7	64	142 (10)
9. BLUE (*LAN*)	365	387	752 (3)	250	231	581 (3)
10. BLUE* (*DIANN*)	0	0	0	27	28	55 (15)
11. ORANGE (*JYU*)	170	197	367 (8)	64	96	160 (8)
12. ORANGE* (*CHEN*)	0	0	0	68	0	118 (11)
13. PURPLE	275	260	535 (6)	334	306	640 (2)
14. BROWN (*ZONG*)	250	333	583 (4)	68	46	114 (12)
15. BROWN* (*HUR*)	0	0	0	70	81	151 (9)
16. PINK	378	471	849 (2)	145	137	282 (7)
17. INDIGO+	4	18	22 (12)	0	0	0
Total ([17])	2813	3053	5866	2246	2182	4428
Total ([11])	2809	3034	5843	2141	2090	4231
No. of responses	4752	5148	9900	4000	4000	8000

Note 1: Italic word in brackets indicates the Chinese basic name.
Note 2: Total (11) indicates the total number of basic names.
Note 3: * indicates additional Chinese basic names.
Note 4: + indicates additional British basic names.
Note 5: Number in brackets indicates the ranking order.

frequency for British subjects, whereas it was one of the names most frequently used by Chinese subjects. BROWN, on the other hand, had lower codability for Chinese subjects, and it was named less consistently and used less frequently by the Chinese than by the British.

To summarize, the findings of the study were: (1) the gender difference was minimal in both cultures; and (2) the British used PINK and GRAY more frequently than the Chinese, but vice versa for RED.

Modifiers. The Modifier category includes all colour names beginning with a modifier. As can be seen from Table XII, the list of British and Chinese modifiers agrees reasonably well — the top five terms most frequently used by both groups were DARK, PALE, LIGHT, BRIGHT,

TABLE XII. Cultural and gender comparison of percentage of frequent modifier use (%).

	British			Chinese		
Modifiers	Males	Females	Total	Males	Females	Total
1. DARK	10.77	8.92	9.81	7.13	5.43	6.28
2. PALE	9.07	9.17	9.12	7.18	5.55	6.36
3. LIGHT	9.85	6.62	8.12	8.30	9.25	8.78
4. BRIGHT	3.22	5.61	4.46	2.53	2.43	2.48
5. DEEP	3.51	3.09	3.29	10.60	10.35	10.48
6. MID	3.98	2.72	3.32	0.33	0.20	0.26
7. DULL	2.88	1.90	2.37	0.00	0.00	0.00+
8. DIRTY	0.59	0.99	0.80	0.00	0.03	0.01
9. DUSTY	0.30	0.89	0.61	0.00	0.00	0.00+
10. PASTEL	0.34	0.62	0.48	0.00	0.00	0.00+
11. RICH	0.23	0.45	0.34	0.00	0.00	0.00+
12. MEDIUM	0.06	0.00	0.02	0.00	0.00	0.00+
13. WARM	0.36	0.10	0.22	0.00	0.00	0.00+
14. MUDDY	0.11	0.25	0.18	0.00	0.00	0.00+
15. SOFTY	0.00	0.00	0.00+	0.00	0.00	0.00+
16. FAINT	0.25	0.00	0.12	0.00	0.00	0.00+
17. STRONG	0.04	0.00	0.02	0.03	0.00	0.01
18. VIVID	0.19	0.00	0.09	0.28	0.30	0.29
19. FLUORESCENT	0.11	0.14	0.12	0.33	0.10	0.68
20. FRESH	0.00	0.00	0.00+	0.65	3.08	1.86
21. THICK	0.00	0.00	0.00+	0.23	0.03	0.13
Total	45.86	41.47	43.49	37.59	37.72	37.62

Note: + indicates that none of the subjects used the name.

TABLE XIII. Cultural and gender comparison of the percentage of frequent secondary colour names.

	British			Chinese		
Secondary	Males	Females	Total	Males	Females	Total
1. MAUVE	2.08	5.23	3.72	0.00	0.00	0.00+
2. LILAC	2.61	2.66	2.64	0.00	0.00	0.00+
3. TURQUOISE	1.16	1.40	1.28	0.00	0.00	0.00+
4. VIOLET	1.68	1.03	1.34	0.00	0.00	0.00+
5. SKY BLUE	1.07	1.24	1.16	0.62	0.73	0.68
6. MUSTARD	0.95	1.44	1.20	0.00	0.15	0.08
7. OLIVE	1.05	1.17	1.11	1.02	1.20	1.11
8. CREAM	2.00	1.03	1.49	0.00	0.00	0.00+
9. BEIGE	0.90	0.85	0.88	0.00	0.00	0.00+
10. FLESH	1.05	0.72	0.88	0.57	0.62	0.60
11. LIME	0.53	1.07	0.81	0.00	0.00	0.00+
12. SALMON	0.82	0.76	0.79	0.00	0.00	0.00+
13. LAVENDER	0.63	0.74	0.69	0.00	0.00	0.00+
14. PEACH	0.27	1.05	0.68	0.52	1.73	1.12
15. MAROON	0.76	0.39	0.57	0.00	0.00	0.00+
16. BOTTLE GREEN	0.13	0.85	0.51	0.00	0.00	0.00+
17. TAN	0.59	0.93	0.77	0.00	0.00	0.00+
18. JADE	0.23	0.72	0.48	0.00	0.08	0.04
19. MAGENTA	0.69	0.16	0.41	0.00	0.00	0.00+
20. DUCK EGG	0.48	0.21	0.34	0.00	0.00	0.00+
21. NAVY	0.36	0.33	0.34	0.00	0.00	0.00+
22. EMERALD	0.15	0.58	0.37	0.03	0.28	0.15
23. CRIMSON	0.21	0.35	0.28	0.00	0.00	0.00+
24. BURGUNDY	0.08	0.41	0.25	0.00	0.00	0.00+
25. INDIGO	0.08	0.33	0.21	0.00	0.00	0.00+
26. SCARLET	0.13	0.27	0.20	0.00	0.00	0.00+
27. MINT	0.31	0.41	0.21	0.03	0.00	0.01
28. MAGNOLIA	0.13	0.16	0.14	0.00	0.00	0.00+
29. COFFEE	0.00	0.41	0.21	3.17	4.30	3.74
30. MILK	0.06	0.19	0.13	4.40	3.30	3.85
31. RICE	0.02	0.00	0.01	2.33	0.47	1.40
32. EARTH	0.02	0.12	0.07	5.62	4.10	4.86
33. SKIN	0.15	0.29	0.22	1.77	1.35	1.56
34. POWDER	0.27	0.16	0.21	11.38	12.88	12.12
35. BLOOD	0.02	0.10	0.06	0.00	0.10	0.05
36. TEA	0.00	0.02	0.01	1.17	1.12	1.15
37. WATER	0.00	0.00	0.00+	1.45	1.20	1.33
38. CONCRETE	0.02	0.00	0.01	0.00	0.05	0.03
39. IVORY	0.15	0.12	0.13	0.25	0.25	0.25
40. IRON	0.00	0.00	0.00+	0.93	1.77	1.35
41. LIPSTICK	0.00	0.00	0.00+	0.68	0.08	0.38
42. WOOD	0.04	0.14	0.09	0.28	0.15	0.21
43. PIG LIVER	0.00	0.00	0.00+	0.20	0.20	0.20
44. GRASS	0.34	0.37	0.35	1.42	2.10	1.76
45. BUTTER	0.06	0.19	0.13	1.02	0.10	0.56
46. WINE	0.04	0.02	0.03	0.20	0.05	0.12

Note: + indicates that none of the subjects used the name.

DEEP. However, the ranking orders were different, e.g., DARK was more likely to be used by British subjects and DEEP by Chinese subjects. We suspected that DEEP may mean DARK and that LIGHT may mean PALE, and this hypothesis was investigated in the second part of the study, described in Part II.

Compound Names. Compound names were used more often by Chinese subjects than by British subjects, as shown in Table VIII. A typical example was that Chinese subjects used a variety of names such as PURPLE GRAY, PURPLE WHITE, PURPLE RED, or GRAY PURPLE, whereas the British subjects instead named a colour simply "GRAY" or "PURPLE." The former used a Compound (Basic-Basic) category; the latter a Basic category. It would seem that a cultural difference exists, wherein the Chinese are inclined to use more compound names and fewer basic names than the British.

Secondary Colour Names. Munsell[45] disagreed with the use of object names as colour names, such as ORANGE, VIOLET, and OLIVE. Brown and Lenneberg,[40] however, suggested that culturally important colours should often be employed in language and frequently appear in direct speech, although each individual culture might differ with respect to the areas of colour space to which they paid the most attention because of different cultural ecology. In our study, the two cultures used many different secondary words.

Table XIII lists the most frequently used secondary colour names. The results show that Chinese subjects used much the same proportion of secondary words as British

subjects, although very few were common to both languages. Detailed analysis showed a cultural difference in the use of secondary words. Chinese subjects rarely used some common English secondary names, such as MAUVE, LILAC, TURQUOISE, VIOLET, BEIGE, LIME, SALMON, and MAROON, while British subjects rarely used some Chinese secondary words, such as IRON, WATER, PIG-LIVER, and LIPSTICK. Many frequently used Chinese secondary names were related to food, such as milk, butter, coffee, tea, and rice.

Considering gender differences, British females used certain secondary terms more often than males, such as MAGENTA, MAROON, etc. In contrast, Chinese males used certain secondary terms more often than females, such as RICE, EARTH, MILK. This suggests that cultural background also has an impact on colour-naming differences between genders.

SUMMARY

The first part of this article reports the construction of an extensive database of British and Chinese colour names for each of 200 colour samples. Subsequently, the frequencies of colour names were analyzed, in terms of their codability and distributions, allowing differences between the two cultures to be compared regarding the consistency of naming colours. Additionally, the names were categorized in order to understand the entire naming structure. This knowledge will be helpful for further psycholinguistic studies, allowing the universality of colour names in the different cultures to be examined.

Colour-Name Database

The 1000-plus colour-name database could provide a useful reference when a professional, such as a colour designer, needs to consider names of colours in these two languages. The analysis showed that British subjects used more names than Chinese subjects. In addition, female subjects used more names than male subjects in both cultures.

Eleven basic terms were confirmed, suggesting that most people tend to categorize colours and to use similar colour categorization. Perhaps because of their cultural background, Chinese subjects were inclined to use more than 11 basic names in comparison with British subjects. In addition to the 11 basic names, Chinese subjects commonly used five others: *JU* RED, *CHING* GREEN, *DIANN* BLUE, *CHEN* ORANGE, and *HUR* BROWN, which greatly increased the confusion in colour naming and thus reduced the overall codability.

Codability Analysis

Chinese subjects not only used a smaller number of colour names, but the names they used also showed lower codabilities than those of British subjects. This evidence suggests that Chinese people have a lower consensus for colour concepts. It is noted that brown and orange were low-codability colours for Chinese subjects, because Chinese subjects used both "*ZONG* BROWN" and "*HUR* BROWN" for brown; and both "*JYU* ORANGE" and "*CHEN* ORANGE" for orange.

Eleven (44%) out of 25 high-codability colours were common to both cultures. Two hues (PURPLE and GREEN) were included in the common high-codability colours. The only two secondary names in British high-codability colours were LILAC and SKY; similarly there were only two secondary names amongst the 25 Chinese high-codability colours, namely BLACK-INK and SKY. Thus, the word SKY was common for both British and Chinese subjects, although the actual colour envisaged may not have been exactly the same for the two cultures.

Category Analysis

Four categories of colour names were identified as being used by both cultures: Basic, Modifier, Compound, and Secondary. The Basic names are most commonly used in the two cultures, followed by the Modifiers, while Compound names are used in conjunction with Modifiers or Secondary names.

The eleven basic colour terms used by British subjects for 200 assorted colours were (in descending order of frequency): GREEN, PINK, BLUE, BROWN, GRAY, PURPLE, YELLOW, ORANGE, RED, WHITE, and BLACK. It was noted that PINK was used very frequently, while RED was used less often. Chinese subjects used sixteen basic colours in a different order: *LIUH* GREEN, PURPLE, YELLOW, *LAN* BLUE, *HONG* RED, GRAY, PINK, ORANGE, *HUR* BROWN, *CHING* GREEN, *CHEN* ORANGE, *ZONG* BROWN, WHITE, *JU* RED, *DIANN* BLUE, and BLACK. PINK and GRAY had higher frequency ranking for British than Chinese, but the converse for RED.

Although secondary names were used by two-fifths of all subjects, most were rarely repeated and should, therefore, be excluded from the development of the colour-naming model in Part II. The ISCC-NBS dictionary of colour names lists in total more than 7,500 colour names. For describing light purple or mid purple, it includes such names as DAY-BREAK, DESERT GLASS, SOPHISTICATED LADY, SURRENDER, WHIMSICAL, HEPATICA, MIGNON, NUNCIO, NYMPHEA, POMP, and POWDER, all of which are nonintuitive.

General

The positive evidence from the study shows that the eleven basic colour names could span over half of all colour names. The results of codability and category analysis confirm that the basic colour schemata act as an intellectual basis for learning colour names and categorizing colours, and that these schemata enable people to integrate colour names with the rest of the language. For instance, in everyday parlance people are likely to use colours associated with objects, saying "as blue as the sky," or "as green as the grass."

Most people, irrespective of their culture or gender, tended to use modifiers in front of basic names rather than using basic names alone. The more frequent use of COFFEE and TEA rather than *ZONG* BROWN in Chinese shows that the concept of brown is still rather confused.

An important implication of the study is that all secondary names need to be added to a basic colour. British high-codability colours do not include any secondary names except LILAC and SKY. It seems that a great number of secondary names are culture-specific. For example, Chinese subjects used few British secondary words, such as MAUVE, LILAC, SALMON, and MAROON, preferring instead to use different secondary words, such as IRON, WATER, PIG-LIVER, and LIPSTICK.

Further Questions

Several issues concerning the use of basic names arise from the results of the study. First, because RED was used less often by British subjects than by Chinese subjects, does this mean that the red focal colour is different between the two cultures? What differences are there between other focal colours in the two cultures?

Second, seven modifiers were used most often (>2%) by British subjects: DARK, PALE, LIGHT, BRIGHT, DEEP, MID, and DULL; while five of the same modifiers were used by Chinese subjects: DEEP, LIGHT, PALE, DARK, and BRIGHT. How does a DEEP colour differ from a DARK one? Since STRONG has often been used by colour specialists, which part of the colour space is STRONG? How about the other modifiers, such as PALE and LIGHT?

Third, only a small proportion of secondary terms was common for both cultures, e.g., SKY. British subjects used many names that were not used at all by Chinese subjects, such as VIOLET, CREAM, BEIGE, LIME, etc. Similarly, some Chinese secondary names, such as LIPSTICK, PIG LIVER, and WATER, were not used at all by British subjects. Why is the cultural difference in the usage of secondary names far greater than that of basic names and modifiers?

Evidently some colour names are universal, whereas others are not. Is it possible for a colour-naming model to contain the same colour categories and link the same basic terms? Such a naming model based upon colour order systems would be ideal as a vehicle for colour communication between different cultures. The criterion for a better naming model is that it should be accepted, used, and understood by the majority of people — a language not actively used is moribund. In Kelly's UCL system,[46] colour names appear only in Levels 1–3, whereas numerical designations appear in every level. The higher the level, the more precise these numbers are. Level 1 has 13 divisions of the colour solid, which include generic hue names and neutrals. Level 2 has 29 divisions of the colour solid and includes all hue names and neutrals. Modifiers are added to the hue names used in Levels 1–2 to form a designation at Level 3. However, the results of our study show that Kelly's systematic specification of colour names is different from the way that ordinary people name colours in practice.

Having found the most salient colour names and the most consistently named colours in our study, the next issue to be addressed is: what are the focal colours of these names? There is no universal rule or standard to describe colours in every situation. A verbal specification might cause more trouble than a visual one if described inaccurately. Besides, some fuzzy colours cannot be readily named. In our study, physical samples of a colour order system were used to provide evidence for both the inconsistency and the lack of consensus in colour naming. In order to map the colours for the selected set of colour names in colour space, further experiments were conducted using a constrained method, based on the NCS Colour Atlas. In part II we describe the production of colour charts and basic focal colours in terms of the CIELAB colour space, which reveals the nature of the cultural differences and leads to a rational colour-naming model, described in Part III.

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