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An Empirical Study of Basic Color Terms in Chinese

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ABSTRACT

Previous philological and empirical investigations have shown inconsistencies regarding the quantity of Basic Color Terms (BCTs) in Chinese, particularly in relation to Berlin and Kay's established definition. This investigation identified the number of BCTs through a comprehensive online survey encompassing 90 native speakers from mainland China. This survey has employed a methodological framework that includes a free recall task devoid of visual stimuli and a color chip naming task utilizing 330 Munsell color chips. The research examines the ranked weights and distributions of color terms collected from Chinese in both tasks. The findings reveal the existence of eleven BCTs in Chinese: *Hong (红, red), Cheng (橙, orange), Huang (黄, yellow), Lu (绿, green), Lan (蓝, blue), Zi (紫, purple), Fen (粉, pink), Hei (黑, black), Bai (白, white), Hui (灰, grey)* and *Zong (棕, brown)*. Notably, while the traditional macro-category qing (*青, cyan*) exhibited psychological salience, its variable interpretations among participants hindered its identification as a basic color term. Additionally, the identification of synonymous BCTs pair for orange *(Cheng, 橙; Ju, 橘)* and brown *(Zong, 棕; He, 褐)* indicates a necessity for further exploration into the semantic breadth and focal points of these synonymous color terms. The findings have practical applications in teaching Chinese as a foreign language and offer a solid foundation for future research into cross-cultural color perception.

Keywords: Basic Color Terms; Chinese; Mandarin; Munsell; Survey

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1. Introduction

Basic Color Terms (BCTs) refer to the concept rooted in linguistic and anthropological studies, particularly in the seminal work of Berlin and Kay in 1969, which explored the universality and evolutionary aspects of color terminology. Berlin and Kay defined BCTs as monolexemic terms; their meanings remain consistent, they are prominent in the cognitive frameworks of individuals, and they are not subordinate to other color terms [1]. Their extensive research, encompassing the analysis of ninety-eight different languages, unveiled significant insights into how various cultures categorize and conceptualize color. The findings revealed that while a shared biological basis underpins color perception, a complex interplay of biological factors, cultural contexts, and linguistic structures influences the formation of BCTs [1]. Their study identified eleven universal BCTs within the English language and scrutinized the evolution of these terms across disparate linguistic frameworks. However, studies have revealed that some languages carve up blues into light blue and dark blue, such as Russian, Italian, Turkish, Greek, and Thai [2–7], which indicate that those languages may have more than eleven BCTs. In Chinese, the classification of the color spectrum through color terms exhibits distinctive characteristics [8,9]. Does the number of BCTs vary accordingly?

2. Literature Review

Berlin and Kay have investigated five Chinese participants residing in the San Francisco Bay Area, concluding that the Chinese language encompasses only six BCTs [1]. However, Mandarin, the most popular Chinese dialect, is spoken as a second language by speakers of other dialects, and presents distinct color categorization systems that do not entirely align with the quantity of BCTs and the proposed universal framework. Berlin and Kay's findings have sparked an ongoing debate among Chinese scholars and Sinologists, prompting them to seek further clarification regarding the implications of these results for understanding the nature of BCTs within the Chinese linguistic context. In response to these inquiries, researchers have employed both philological and empirical methodologies to assess or refine Berlin and Kay's conclusions regarding the quantity and nature of Chinese BCTs.

2.1. Philological Studies

Philological studies indicate that Chinese possesses over six BCTs, and the sequence of their evolution does not fully align with Berlin and Kay's evolutionary hypothesis. Yao identified ten BCTs in Chinese and found that the quantity and evolution of Chinese BCTs are inconsistent with B&K's findings in the BCTs survey [10]. Liu Danqing has shown that Chinese has eight color terms that can be categorized as BCTs [11]. Wu has disclosed that the development of Chinese BCTs fits into the updated evolution hypothesis [12]. Xie found that the ancient Chinese BCTs have a lower level of codability compared to Putonghua (Mandarin Chinese) and Chinese dialects. There are similarities and differences in the evolutionary sequence between Putonghua (Mandarin Chinese) and Chinese dialects. Contrary to Kay and McDaniel's evolutionary sequence of BCTs, the Chinese color term *Zi (紫 purple)* arises earlier than *He (褐 brown)* [13].

2.2. Corpus Studies

Corpus studies have revealed how the usage of color terms has changed in contemporary Mandarin. Research into Mandarin color terms has uncovered systematic patterns in their frequency, collocational tendencies, semantic scope, and historical shifts in usage. For instance, Franck identified key trends in the historical evolution of Chinese color terminology by analyzing the frequencies of color terms in classical texts such as the Twenty-Five Dynastic Histories and the Thirteen Classics [14]. Similarly, Bogushevskaya focused on the term qing (青, cyan) as a case study, showing that it originally encompassed a wide range of hues—those now categorized as blue, green, and black — before undergoing semantic narrowing as more distinct color terms emerged over time [15]. The Center for Chinese Linguistics (CCL) Corpus, an extensive database of modern Mandarin texts primarily from the twentieth century onward, serves as a vital resource for contemporary linguistic research. Scholars have used the CCL Corpus to explore the semantic domain of modern qing (青, cyan), tracing its processes of semantic narrowing, differentiation, and transformation [16]. In another study, an analysis based on the CCL examined the term Lu (绿, green), exploring its grammatical roles, usage patterns, and semantic evolution. This research revealed that reduplicated forms of lǜ have undergone significant shifts from ancient to modern Chinese, with some forms retained and others newly created [17]. Moreover, cross-linguistic corpus studies have compared the semantic prosody and collocational patterns of BCTs across languages. For instance, researchers compared the English word black with its Chinese counterpart, Hei (黑, black), using both the British National Corpus (BNC) and the Lancaster Corpus of Mandarin Chinese (LCMC). Their findings indicate that while there are differences in how these terms collocate, there are also cross-linguistic similarities rooted in their shared reference to the objective world [18].

2.3. Empirical Studies

Empirical research has identified specific features of the Chinese BCTs. Statistics indicate that the number of BCTs exhibits minor variations across various studies. It is noteworthy that various locations may employ distinct BCTs to identical colors or use identical color terms to label different colors [19–24]. Lu gathered data from various regions of Taiwan, revealing that Mandarin Chinese has more than eleven BCTs defined by B&K [21]. Gao and Sutrop utilize fieldwork methodologies, employing free-recall tests and color-naming tasks to investigate BCTs in Mandarin Chinese. The inference drawn from their findings suggests that Mandarin Chinese has the potential to evolve, ultimately incorporating eleven BCTs, aligning with the equivalents found in English [19]. Fan Yingping revealed that the BCTs encompass all eleven terms, indicating advancement to Stage VII, contrary to B&K's Stage V proposition [24]. Sun and Chen explore the phenomenon of multiple synonyms within a singular category in Mandarin Chinese. The results show that eight color categories are situated in identical locations on the WCS chart as their corresponding English counterparts. Nevertheless, color terms such as *Mo(墨 ink)* and *Cai (菜 vegetable)* exhibit a significant variation in their term maps and are used inconsistently across different subjects [23]. Hsieh endeavors to establish the framework of Mandarin lexical color categories by collecting empirical data from native Mandarin speakers. The research utilizes color naming tasks to elicit the contemporary Mandarin color nomenclature and the prevalence of commonly used color terminology. It was observed that the boundaries between green and blue significantly differ from a similar study involving Japanese speakers. The empirical investigation revealed a consistent identification of twelve Mandarin color terms and eight tone modifiers [22,25]. Xu et al. analyzed the basic color terms in Mandarin and compared with Spanish, revealing that Mandarin has nine basic color terms. The study also found that Mandarin speakers show less consistency in using specific color terms [26]. Chang and Lai found that the factors influencing Chinese English learners' use of color terms vary based on their language proficiency. The higher proficiency in L2 leads to better alignment with L2 color term norms, while lower proficiency results in reliance on L1 categories or hybrid systems [27]. **Table 1** summarizes various studies on Chinese BCTs and presents the corresponding Chinese color terms alongside their English translations.

Table 1. BCTs in mandarin Chinese by different scholars.

	Berlin & Kay, 1969	**Yao, 1988**	**Hsieh, 2010**	**Liu 1990 & Wu, 2011**	**Lu 1997&Fan, 2015**	**Gao & Sutrop, 2014**	**Sun, 2018**	**Xu & Zhu, 2023**
White	白	白	白	白	白	白	白	白
Black	黑	黑	黑	黑	黑	黑	黑/墨	黑
Red	红	红	红	红	红	红	红	红
Yellow	黄	黄	黄	黄	黄	黄	黄	黄
Green	绿	绿	绿	绿	绿	绿	绿	绿
Blue	蓝	蓝	蓝	蓝	蓝	蓝	蓝	蓝
Brown	-	褐&棕	咖啡	-	褐	-	棕/褐	
Purple	-	紫	紫	紫	紫	紫	紫	紫
Gray	-	灰	灰	灰	灰	灰	灰	灰
Pink	-	-	粉红	-	桃	粉	桃/樱	粉
Orange	-	橙	橘	-	橙	-	橙	
Peach	-	-	桃红	-	-	-	-	
No. of BCTs	6	10	12	8	11	9	11	9

2.4. Reasons Behind the Inconsistent Findings

The inconsistencies observed in Chinese BCTs may arise from unique characteristics of the language, such as having multiple synonyms for individual colors, for instance, the terminology *Chi (赤), Hong(红), Zhu(朱), Dan(丹), Xie(血)* and *Zhe(赭)*all refer to red [23]. Another possible source of these inconsistencies is the confusion between basic color categories and basic color terms [28]. While color categories relate to cognitive understanding, color terms belong to the linguistic domain. Additionally, factors such as the geographical location of participants, the blending of regional dialects with standard Mandarin in mainland China, and variations in research methodologies may influence the findings.

2.5. Literature Gaps

Despite extensive research on Chinese BCTs, the exact number of these terms remains a matter of debate. To address this gap, the present study developed an online platform to conduct a BCT survey aimed at determining the precise inventory of BCTs in Mandarin. Accordingly, the central research question guiding this study is: How many basic color terms (BCTs) exist in Chinese?

The research design includes online surveys that combine a free-recall task using unstimulated materials with a color-naming task using stimulated materials, targeting native Mandarin speakers from mainland China. The methodological approach allows for collecting extensive data from a large sample of participants. It facilitates the elicitation of color terminology from participants' semantic memory, as well as their lexical responses when exposed to a wide range of chromatic (color) and achromatic (non-color) stimuli. Additionally, this protocol enables systematic cross-participant analyses of color-naming patterns and linguistic categorization in response to standardized stimuli. These features provide a solid framework for investigating the quantity and characteristics of BCTs in Mandarin Chinese.

3. Methods

3.1. Participants

The survey was conducted among the Chinese Han ethnic group and the participants anonymously completed the survey. Ninety Chinese native speakers (mean age 22, age range 18–26, female 45, male 45) participated in the Mandarin Chinese BCTs survey. Participants were recruited from Sichuan University of Arts and Science (SASU) and Southwest University (SWU), and the survey was conducted on both campuses. All participants were native Mandarin speakers with normal color vision, as assessed by the Ishihara Test. Participants could decline to sign the consent form without facing any consequences. This study collected both the hard copies and soft copies of the participants' consent forms. The soft copies were collected from the online website, which is available at https://dai.tanfushishang.xyz/.

3.2. Materials

The survey is a semi-replication of Berlin and Kay's WCS [29,30]. Three substantial variations exist between the Mandarin Chinese BCTs survey and the WCS. Firstly, the initial part of the Chinese BCTs survey website is designed to collect basic information from the participants. For instance, gender, age, L2 (English) proficiency, etc. Secondly, the Chinese BCTs survey shifted from B&K's field investigation mode to an online approach, wherein stimuli were presented through the website, and the backend system of the website systematically records and stores participants' responses during the survey. Thirdly, a combination of Berlin and Kay's color survey (1969) and the WCS elicitation technique was employed to investigate Chinese BCTs. Specifically, participants were prompted to freely recall Chinese BCTs without stimuli materials before individually identifying 330 color chips. The aim was to elicit all color words from participants' memories, identify the Chinese BCTs, enlist a maximum number of participants and explore the numbers and characteristics of Mandarin Chinese BCTs.

In color chips naming task, standardized color stimuli were utilized to conduct the survey. Each image was resized to 300 * 300 pixels, positioned against a pristine white (RGB value 255, 255, 255) background, and an outer background, which was a shade of soft gray (RGB value of 250, 250, 250), was chosen to complement the overall display. The stimuli set included a series of 330 computer-simulated color chips, extracted by using the eyedropper tool in PowerPoint software from the WCS Munsell stimulus array (**Figure 1**).

The original Munsell stimulus array was derived from Lenneberg and Roberts' (1956) cross-cultural study of English and Zuni color terminology and was later revised (including the addition of the neutral hue series) for use in cross-cultural color surveys by Berlin and Kay (1969) and other scholars [2,29,31–35]. **Figure 2** illustrates the Munsell and World Color Survey coordinates for the stimulus palette.

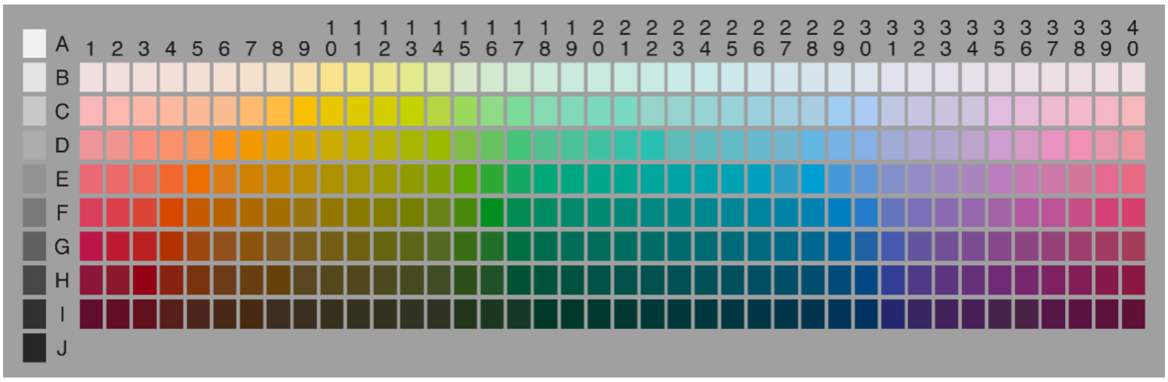

Figure 1. The WCS Stimulus Array [29].

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
A	0																																									9.5
B	0	2	2	2	2	2	2	2	2	4	6	6	6	6	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	9.0
C	0	6	6	6	6	6	6	8	14	16	14	12	12	12	10	10	8	8	6	6	6	6	4	4	4	4	4	4	4	6	6	4	4	4	4	6	6	6	6	6	6	8.0
D	0	8	8	10	10	10	14	14	14	12	12	12	12	12	12	10	10	10	8	8	8	8	8	6	6	6	6	6	8	8	8	6	6	6	6	8	8	10	10	8	8	7.0
E	0	12	12	12	14	16	12	12	12	10	10	10	10	10	10	12	12	10	10	10	10	8	8	8	8	8	8	8	10	10	10	8	8	8	8	10	10	10	10	12	12	6.0
F	0	14	14	14	16	14	12	10	10	8	8	8	8	8	8	10	12	12	10	10	10	10	8	8	8	8	8	8	10	12	12	10	10	10	10	10	12	12	12	14	14	5.0
G	0	14	14	14	14	10	8	8	6	6	6	6	6	6	6	8	8	10	10	10	10	8	8	8	8	6	6	8	8	10	10	12	10	10	10	10	10	10	10	10	10	4.0
H	0	10	10	12	10	8	6	6	6	4	4	4	4	4	4	6	6	8	8	10	8	6	6	6	6	6	6	6	8	10	10	12	10	10	10	10	10	10	10	10	10	3.0
I	0	8	8	8	6	4	4	4	2	2	2	2	2	2	2	4	4	4	6	6	6	4	4	4	4	4	4	6	6	6	8	10	8	8	8	6	6	8	8	8	8	2.0
J	0																																									1.5
		2.5	5	7.5	10		5		10		5		10		5		10		5		10		5		10		5		10		5		10		5		10		5		10	
			R				YR				Y				GY				G				BG				B				BP				P				RP			

Figure 2. Munsell and WCS Coordinates for Stimulus Palette [29].

3.3. Procedures

The Chinese BCTs Survey website is structured into four sections. The online survey involved two types of tasks, namely color naming and color mapping tasks. The former required participants to recall basic color terms without any visual cues and subsequently identify 330 computer-simulated color chips one by one. In contrast, the mapping tasks involved focus mapping (best example) and boundary mapping tasks. The participants were prohibited from consulting any reference materials or books throughout the survey. If they felt uncomfortable, they could withdraw from it at any time without providing a reason.

3.3.1. Free Recall Color Naming Task

The utilization of the free recall task for color naming has the advantage of allowing researchers to elicit color terms without any visual stimuli. This method helps identify the psychologically salient aspects of each basic color term by analyzing "the tendency to appear at the beginning of elicited lists of color terms" [1]. In some studies, psychological saliency was measured by semantic saliency [36,37]. Before taking part in the free recall color naming task, all participants were required to complete a color plate test. Participants with normal color vision were prompted to supply personal information such as their email address, date of birth, place of birth, gender, and nationality. Further inquiries were made regarding participants' experiences with English language acquisition, including the age at which they commenced learning English, the length of time they had been studying English, their frequency of using English, their degree of exposure to English-speaking cultures, and whether they had studied or worked in English-speaking countries, as well as the duration of their stay in such countries. Additionally, participants were required to provide information about other language learning endeavors they may have undertaken. Exploring participants' efforts in linguistic development aims to investigate the potential connections between second language acquisition processes and color perception mechanisms.

Following the completion of the personal information section, the researcher delivered a presentation utilizing slides to elucidate the structure and objectives of the survey while deliberately avoiding using specific color terminology. Participants were instructed to abstain from using prefixes such as *Sheng (深 dark)* and *Qian (浅 light)*, as well as the suffix *Se (色 color)*. The usage of compound color words was strictly prohibited. The researcher placed particular emphasis on the importance of enumerating monolexemic color terms and encouraged participants to recall freely and list as many BCTs as possible. The instruction for free recall color naming task is "Please list the basic color terms you can think of and separate them with commas". This methodology guarantees eliciting maximum basic color terms from participants' memory.

3.3.2. Color Chips Naming Task

In the color chips naming task, participants were assembled in the laboratory and instructed to use simplified monolexemic Chinese characters to name various color chips without referring to any material or discussing their answers with others. In Chinese Mainland, simplified characters are widely used, but in Hong Kong, Macau, and Taiwan Province China, traditional Chinese characters are extensively used. The study was conducted through an online platform instead of using face-to-face field research. The full set of chips was presented pseudo-randomly by the Mandarin Chinese color survey website. The instruction for the color chips naming task is "Please name the following color chips, preferably with a single word or phrase". Participants had complete control over the color chip naming process. During the color naming task, participants could take breaks as needed if they found a large number of color chips overwhelming. Once a naming task was completed, participants could click the "Next" button to proceed. The back-end data system automatically recorded the pertinent data. However, participants could not click "refresh" or go back to revise their responses after they had been submitted.

The experimenter notified the participants in advance that they may struggle to identify specific color chips during the color chips naming task. Nevertheless, participants were encouraged to make an effort to use monolexemic color terms to a greater extent. Participants were free to reuse the same color terms as many times as they needed to during the color chips naming task. This methodology uses a tremendous number of color chips as visual stimuli which can help to elicit almost all of the basic color terms from participants.

4. Results of Mandarin Chinese BCTs Survey

Following completion of the survey by all participants, the data were extracted from the online database platform and prepared for subsequent statistical analyses. An analysis was conducted on the frequency and ranking outcomes of BCTs. The results indicate that in Mandarin Chinese, basic color terms include *Hong* (*红*, red), *Cheng* (*橙*, orange), *Huang* (*黄*, yellow), *Lu* (*绿*, green), *Lan* (*蓝*, blue), *Zi* (*紫*, purple), *Fen* (*粉*, pink), *Hei* (*黑*, black), *Bai* (*白*, white), *Hui* (*灰*, grey), and *Zong* (*棕*, brown). The number of basic color terms in Chinese is roughly equivalent to that in English, with the exception of the color term *Qing (青, cyan)* in Chinese, which lacks a direct equivalent in English.

4.1. Results of the Free-Recall Tasks

The free-recall tasks elicited twenty-six qualified Chinese color terms. The top 12 color terms identified in these tasks were *Hong (红, red), Huang (黄, yellow), Lan (蓝, blue), Lu (绿, green), Cheng (橙, orange), Zi (紫, purple), Bai (白, white), Hei (黑, black), Qing (青, cyan), Fen (粉, pink),* and *Hui (灰, grey).* Among the color terms ranked from 13 to 26, *He (褐, brown)* was another version of *Zong (棕, brown)*, although they may not be simple alternatives for each other. *Ju (橘, orange)* is synonymous with *Cheng (橙, orange*), and *Dian (靛, indigo-blue)* is a synonym for *Qing (青, cyan)*. *Chi (赤, red)* and *Zhu (朱, red)* are archaic versions of *Hong (红, red)* but are rarely used in daily communication today. Similarly, *Zhu (朱, black)* and Mo *(墨, black)* are archaic versions of *Hei (黑, black)*. Moreover, the compound word *Fen Hong (粉红, pink)* is synonymous with Fen *(粉, pink)*. **Table 2** presents the total frequency of these color terms from the free-recall tasks, the percentage of each term among the 90 participants, and the weighted rank for each color term.

Table 2. Frequency, percentage and weighted rank for free re-call color terms.

No.	Color Terms	Frequency of Occurrence	Percentage	Weighted Rank* (Psychological Salience)
1	Blue *蓝*	89	98.89%	122.1
2	Red *红*	87	96.67%	141.4
3	Yellow *黄*	86	95.56%	122.9
4	Green *绿*	85	94.44%	117.1
5	Purple *紫*	79	87.78%	89.4
6	White *白*	79	87.78%	87.3
7	Black *黑*	75	83.33%	86
8	Orange *橙*	68	75.56%	90.8
9	Cyan *青*	53	58.89%	62
10	Gray *灰*	39	43.33%	32.5
11	Pink *粉*	38	42.22%	36.5
12	Brown *棕*	25	27.78%	22.2
13	Brown *褐*	17	18.89%	13.7
14	Indigo-blue *靛*	11	12.22%	10.9
15	Gold *金*	10	11.11%	6.8
16	Silver *银*	10	11.11%	6
17	Orange *橘*	6	6.67%	4.6
18	Beige *米*	4	4.44%	2.4
19	Red *赤*	2	2.22%	2.2
20	Pink *粉红*	2	2.22%	1.4
21	Spotted *花*	1	1.11%	1.4
22	Red *朱*	1	1.11%	1

Table 2. *Cont.*

No.	Color Terms	Frequency of Occurrence	Percentage	Weighted Rank* (Psychological Salience)
23	Black 乌	1	1.11%	0.8
24	Black 墨	1	1.11%	0.7
25	Yellowish pink 肉	1	1.11%	0.5
26	Khaki 卡其	1	1.11%	0.1

* The lists contain a maximum of seventeen color words and a minimum of four. To calculate ranks among lists with varying numbers of terms across different participants, each term in a list was assigned a value from 1.7 to 0.1. The first term was assigned a value of 1.7, the second term 1.6, the third term 1.5, and so on, down to 0.1 for the seventeenth term. The weighted rank of a category was calculated by summing the values assigned to each term in the lists.

The highest weighted scores were *Hong (红, red), Huang (黄, yellow), Lan (蓝, blue), Lu (绿, green), Cheng (橙, orange), Zi (紫, purple), Bai (白, white), Hei (黑, black)* and *Qing (青, cyan),* indicating that these colors were typically listed at the top of the lists. Conversely, color terms like *Hui (灰, grey), Fen (粉, pink)* and *Zong (棕, brown)* had lower weighted scores and were more likely to appear at the end of the lists. It's interesting to note that the frequency of occurrence does not always correspond to the weighted rank. For instance, *Lan (蓝, blue)* has the highest frequency of occurrence (89), but its weighted rank score (122.1) is only third among all the color terms. Additionally, 58.89% of the participants listed *Qing (青, cyan)* as a basic color term, with a weighted score of 62, ranking ninth in both percentage and psychological salience. This indicates that *Qing (青, cyan)* is more psychologically salient among Chinese participants compared to color categories as *Hui (灰, grey), Fen (粉, pink)* and *Zong (棕, brown)*. **Table 2** also presents the frequency, percentage, and weighted rank information of non-basic (secondary) color terms such as *Jin (金, gold), Yin (银, silver), Mi (米, beige), Rou (肉, yellowish pink)* and *Kaqi (卡其, khaki).*

4.2. Results of the Color Chips Naming Tasks

A total of 330 Munsell color chips were used in the color chips naming tasks, resulting in 43 unique color terms. **Table 3** shows the frequency of each color term and the number of color chips it represents. The predominant color terms in common use were Lu *(绿, green), Lan (蓝, blue), Zi (紫, purple), Huang (黄, yellow), Fen (粉, pink), Hong (红, red), Hui (灰, gray), Zong (棕, brown), Cheng (橙, orange), Bai (白, white), Hei (黑, black), Qing (青, cyan), He (褐, brown)* and Ju *(橘, orange)*. Lu *(绿, Green)* was the most frequently named color, occurring 6,761 times and assigned to 156 color cards. *Qing (青, Cyan)* appeared 598 times on 111 distinct color chips. Additionally, the compound word *Fen Hong (粉红, pink)* was used 29 times to label 21 color chips, disregarding the stipulation to use only monosyllabic color terms. In general, BCTs were used more often and included a wider range of color samples, while non-basic color terms were used less often and encompassed a smaller number of color samples. Nevertheless, the correlation between the quantity and regularity of BCTs assigned to color chips was not always linear. Several non-basic color terms, such as He *(褐, brown),* Qing *(青, cyan)*, and Dian *(靛, indigo-blue),* also included a substantial range of color samples.

Table 3. Results of Munsell color chips naming task.

Rank	Term	Gloss	Total Frequency	No. of Color Chips
1	绿	green	6761	156
2	蓝	blue	5624	133
3	紫	purple	4187	98
4	黄	yellow	2539	83
5	粉	pink	2234	82
6	红	red	1850	82
7	灰	gray	1195	96
8	棕	brown	963	72
9	橙	Orange	761	40
10	白	white	694	43

Table 3. *Cont.*

Rank	Term	Gloss	Total Frequency	No. of Color Chips
11	黑	black	685	52
12	青	cyan	598	111
13	褐	brown	598	70
14	橘	orange	124	25
15	米	beige	89	15
16	肉	yellowish pink	87	29
17	银	silver	47	25
18	靛	indigo blue	41	32
19	土	soil	30	24
20	粉红	pink	29	21
21	金	gold	28	25
22	肤	skin	23	11
23	杏	apricot	21	14
24	裸	flesh-colored	10	10
25	酒	wine	10	9
26	赤	red	10	9
27	桃	peach-blossom (pink)	10	9
28	咖	coffee	10	9
29	玫	rose	9	8
30	朱	red	5	5
31	梅	plum-colored	4	4
32	蜜	honey-colored	4	4
33	草	grass	3	3
34	绛	crimson	3	3
35	黛	dark green	2	1
36	湖	light green	2	2
37	酱	dark reddish brown	2	2
38	柠	lemon	2	2
39	赭	ochre	1	1
40	桔	orange	1	1
41	乌	black	1	1
42	靓	bright sapphire blue	1	1
43	藏	dark blue	1	1

It is worth noting that when naming color chips, different participants consistently used the same color name for a given color stimulus chip. For instance, all participants identified the color card with code F16 as *Lu (绿, green)*. The survey demonstrated that subjects exhibited convergent identification of prototypical exemplars within each basic color category. However, a systematic inverse correlation was observed between stimulus typicality and inter-participant naming consensus, such that diminishing prototypicality of color stimuli corresponded with increased variability in categorical assignments across respondents. Therefore, there were instances where the same color chip was labeled with multiple color names in Mandarin Chinese. For example, the color chip with code C21 was referred to as *Lan (蓝, blue)* by 36 participants, Qing *(青, cyan)* by 13 participants, and *Lu (绿, green)* by 39 participants. This study established a database that allows for the convenient and rapid retrieval of each color chip names and their frequencies, facilitating the statistical analysis of the color chips naming tasks. Additional information about the database is available in the Supplementary Materials (**Table S1**).

5. Discussion

The Chinese BCTs survey comprehensively analyses the distribution and quantity of BCTs in Chinese. The color naming tasks primarily investigate the nomenclature and quantity of color terms in Mandarin Chinese. The results of the Chinese BCTs survey demonstrate that Chinese BCTs differ from basic English color terms, although the number of basic Chinese color terms is essentially the same as that of English. Differences in color perception have been observed between Chinese and English speakers. Furthermore, this comprehensive survey has provided a robust foundation for the selection of stimulus materials for experiments on the color perception of Mandarin Chinese speakers.

The color naming task in this study employed two distinct methodologies: free recall without stimulating materials and a structured approach utilizing 330 Munsell color chips. This dual-pronged strategy yielded several significant findings that warrant further discussion. The results challenge the monolexemic criterion for BCTs as proposed by Berlin and Kay (1969). A substantial number of participants consistently used the compound phrase *Fen Hong (粉红, pink)* as a basic color term, despite explicit instructions to use single-word descriptors. This phenomenon is particularly noteworthy in the context of contemporary Chinese, where the suffix *Se (色, color)* is frequently appended to color terms, e.g., *Hong Se (红色, red)* for red, *Hei Se (黑色, black)* for black. This observation suggests that the theoretical framework may not adequately capture the linguistic nuances of BCTs in Chinese and potentially other non-Indo-European languages. Consequently, there is a need to reevaluate and potentially refine the definition of BCTs to accommodate such cross-linguistic variations.

Furthermore, the investigation into the quantity of BCTs in Mandarin Chinese revealed significant overlap in high-ranking and high-frequency color terms across both methodologies. However, a notable discrepancy emerged in the total number of color terms elicited: 26 terms from free recall tasks versus 43 terms from the color chip naming tasks. The latter method not only yielded a more comprehensive set of color terms but also encompassed nearly all terms identified through free recall. The number of BCTs retrieved during the unconstrained recall condition was significantly lower compared to the color chip identification tasks, suggesting that the presence or absence of stimuli material substantially influences participant response patterns in the experimental paradigm. This finding underscores the efficacy of using stimulating materials in eliciting a broader spectrum of color terms. However, this approach is resource-intensive and requires stringent control of environmental variables to ensure data reliability. Conversely, while free recall offers greater convenience and flexibility, it may not capture the full range of each participant’s color lexicon due to the absence of visual stimuli.

In this study, the analysis of Mandarin Chinese BCTs focused on two key metrics: the sequence of recall (measured by weighted rank scores) and the frequency count of color terms. While high frequency generally corresponds to high psychological salience, the case of Qing *(青, cyan)* presents an intriguing anomaly. Despite its low frequency (ranking 12th), Qing *(青, cyan)* demonstrates relatively high psychological salience (ranking 9th), surpassing BCTs such as *Fen* (*粉*, pink), *Hui* (*灰*, grey) and *Zong* (*棕*, brown). This discrepancy likely stems from the term’s historical significance and its evolving semantics. Historically, Qing *(青, cyan)* was considered a BCT encompassing both blue and green. However, with the introduction of *Lu* (*绿*, green) and *Lan* (*蓝*, blue) as distinct BCTs, the semantic range of Qing *(青, cyan)* has narrowed. Nonetheless, its persistence in the general color vocabulary accounts for its higher psychological salience in free-recall tasks, despite its infrequent use in color chip naming. The survey revealed that while Chinese participants memorize the color term Qing *(青, cyan)*, they often exhibit uncertainty regarding its precise color boundaries. In other words, individuals may hold diverse or inconsistent mental representations of Qing *(青, cyan)*. The color term Qing *(青, cyan)* originates from the ancient Chinese color lexicon and remains a significant component of contemporary usage. However, with the introduction of the more specific color terms *Lu* (*绿*, green) and *Lan* (*蓝*, blue), the semantic scope of Qing *(青, cyan)* has evolved into a macro-category in modern Chinese. This linguistic shift reflects the dynamic development of Chinese color terminology in response to societal and cultural advancements [12].

Moreover, the results of this survey diverge from some of the previous studies. Paul and Kay (1969) examined five Chinese participants residing in the San Francisco Bay area and identified only six Chinese BCTs: *Hei (黑, black), Bai (白, white), Hong (红 red), Lu (绿, green), Huang (黄, yellow)* and *Lan* (*蓝*, blue). This discrepancy can likely be attributed to the limited representativeness of the subjects and the small sample size. “Paul and Kay acknowledged the need for additional data on Mandarin Chinese in future research, categorizing Chinese as an anomalous case requiring further investigation” [1]. Moreover, the usage of Chinese BCTs exhibits regional variations. Empirical research conducted by other scholars has also produced conclusions that diverge from those of philological studies [19–24]. Comparative analysis of previous studies and this online Mandarin Chinese BCTs survey reveals that variations in the nomenclatures and quantities of color terms could be attributed to the extensive range of Chinese usage and differing regional conventions. Moreover, Chinese possesses a vast array of synonyms for each color category and can be used interchangeably to refer to the same color [23]. For instance, the color term for pink is referred to as *Tao (桃, peach)* or *Ying (樱, cherry)* in Taiwan Province, China. Similarly, *Cheng (橙, orange)* and *Ju (橘, orange)* can be used interchangeably, as can *Zong (棕, brown)* and *He (褐, brown)*. This interchangeability leads to discrepancies in results, with different scholars listing different terms as BCTs, resulting in variations in the number of Chinese BCTs identified across studies.

Sinologists have employed quantitative research methodologies to examine color terms in both ancient and modern Chinese, revealing that the distribution and quantity of Chinese BCTs have evolved over time [10–13]. However, in analyzing the evolution of Mandarin Chinese BCTs, it is imperative to emphasize that this study adopts a synchronic rather than a diachronic approach. Consequently, the historical evolution of Chinese BCTs falls outside the purview of this investigation. Extant literature, profoundly influenced by Berlin and Kay’s seminal 1969 work on BCTs, has predominantly focused on these BCTs’ universality and evolutionary trajectory. In order to ascertain the degree of congruence or divergence between the emergence of the BCTs and the paradigm proposed by Berlin and Kay, it would be necessary to undertake a comprehensive analysis that integrates both diachronic and synchronic perspectives. Such an approach would entail a thorough examination of color nomenclature in both ancient and modern Chinese linguistic contexts, thereby yielding more robust and reliable conclusions.

Furthermore, this study is subject to certain limitations regarding both the sample and the stimulus materials. Restricting the sample to young adults (aged 18–26) from mainland China may limit the generalizability of the findings, particularly with respect to generational and regional (dialectal) variations. Future research would benefit from including a broader demographic range to explore potential differences across age groups and dialect regions. Additionally, while the Munsell array used in this study provides standardized control for cross-linguistic comparisons, it may not fully capture culturally specific color categories such as *Dai-qing (黛青, a grayish blue)* and *Yanzhi-hong (胭脂红, a particular shade of rouge-red)*, among others. Future studies should incorporate culturally salient color stimuli to more accurately reflect the richness of color categorization in Chinese.

6. Conclusion

The Mandarin Chinese Color Survey of ninety participants identified 11 basic color terms (BCTs) with consistent prototype recognition: *Hong* (红, red), *Cheng* (橙, orange), *Huang* (黄, yellow), *Lu* (绿, green), *Lan* (蓝, blue), *Zi* (紫, purple), *Fen* (粉, pink), *Hei* (黑, black), *Bai* (白, white), *Hui* (灰, grey) and *Zong* (棕, brown). While the macro-category Qing *(青, cyan)*, encompassing the spectral range of green, blue-green, and blue, demonstrates substantial psychological salience among Mandarin speakers; however, the considerable inter-participant variability in color sample designation suggests that *qing 青* does not fulfill the criteria for BCTs in Mandarin Chinese. Moreover, the study revealed that compound terms like *Fen Hong (粉红, pink)* can function as BCTs, challenging conventional analytical frameworks for BCTs. Additionally, the existence of synonymous basic color term pairs for *(Cheng, 橙; Ju, 橘*) and brown *(Zong, 棕; He, 褐)* suggests the need for further exploration into the semantic breadth and focal points of these synonymous color terms within the Mandarin Chinese lexicon.

Supplementary Materials

Table S1: Color Terms and Frequencies of 330 Color Chips as Reported by Ninety Native Chinese Speakers. The supplementary materials can be downloaded at: https://journals.bilpubgroup.com/public/FLS-8797-Supplementary-Materials-Table-S1.pdf.

Author Contributions

Conceptualization, A.Z.Z. and S.D.; methodology, S.D.; software, S.D.; validation, A.Z.Z., and S.D.; formal analysis, S.D.; investigation, S.D.; resources, S.D.; data curation, S.D.; writing—original draft preparation, S.D.; writing—review and editing, A.Z.Z.; visualization, S.D.; supervision, A.Z.Z.; project administration, S.D.. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of Faculty of Languages and Linguistics, University Malaya (protocol code 0398_001 and date of approval is 1 March 2020).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Conflicts of Interest

The authors declare no conflict of interest.

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