Content analysis on the potential significance of color in dreams: A preliminary investigation

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Summary. The potential significance and stimulus of color in dreams was postulated from a content analysis of color in spontaneously recalled dream reports. The analysis was performed on a total of 38,063 dream reports: 25,222 dream reports in the DreamBank.net database, plus 12,841 dream reports from eight long-term dream journals. The focus was not on reporting the presence or absence of color, as in most prior studies, but rather on the relative frequency of specific colors reported. The objective was to determine, to the degree possible from content analysis, whether dream color reports simply reflect our waking visual experience or if the colors reported are influenced by physiological or psychological factors or both. The conclusion from the observed data was that the specific colors recalled from a dream is not dominated by the waking visual experience nor by personal preferences, but rather dream color appears to align with neurological mechanisms involved in the perception of color as well as psychological factors including the human emotional response to color.

Keywords: Dream content, colors, personality

1. Introduction

Most dreams appear to originate in color, or at least contain some color content, even though we rarely recall the color upon awakening. A study by Schredl et. al. (2008c), where the dreamer was asked immediately upon waking up to record the color of all dream elements, resulted in 100% of the dream reports containing some color (although not all of the dream elements contained color). Schredl further notes that if dreamers were asked explicitly about color, the percentage of dream reports containing color increased to about 80% (Kahn et al.,1962 and Snyder ,1970 in Schedl 2008b). In contrast, the Kahn (1962) study indicated that color recall dropped to 25% in spontaneous reports (normal daily dream recall). A study by Hall on 3,000 spontaneous dream reports (Hall, cited in Van de Castle,1994, p. 298) also found only 29% contained reports of color. A summarization by Schredl (2008b) of seven studies further indicated that spontaneous dream reports typically mentioned color only 11% to 46% of the time. It is apparent from these studies that dreams contain a great deal of color content. However, the recall of that content has much to do with when and how the dream report is collected and, immediate attention to color detail upon awakening.

Most all of the studies on color recall were interested in the presence or absence of color in the reports. Little attention has been given to the specific colors reported, with the possible exception of studies using colored goggles to alter daytime experience (Roffwarg et al, 1978) and observ-ing how the goggle color appears in the dreams through successive REM stages. The color in most dream reports is observed to reflect the norms of waking perception (grass is typically green and the sky is usually blue for example) in accordance with the continuity hypothesis (Schredl, 2003). However, some colors are explicitly reported where there is no typical color assignment nor recent recall of seeing such an object (such as a bright red hat), or where the color combination is irrational (such as a blue dog). Creation of such a specific color in a dream, and the subsequent attention to and recall of that color, might be meaningful. On one hand, dream color may be a reflection of our waking experience with color or personal color preferences. Van de Castle hypothesizes, however, that there is a strong correlation between the emotional significance of a dream and the intensity of the color appearing in it (Van de Castle, 1994, p. 255). As will be discussed in the later sections of this article, in the waking state we react to color physiologically and emotionally, and that reaction is different for different colors (Lüscher,1971; Birren, 1961). It is therefore possible that psychological factors, such as emotion or emotional intensity, may have the dominant influence on the recall of a specific color or colors from a dream.

The objectives of this study, therefore, were to explore the apparent influence of the waking environment, as well as neurological and psychological factors, on dream color recall to the degree that content patterns could shed some light on each of these areas. Although a content analysis alone cannot provide definitive answers, it was hoped that comparing dream colors recalled from large diverse populations, as well as from individual long-term journals, would identify patterns which might weaken or strengthen the following five hypotheses: 1) recall of specific dream colors reflects our waking visual experience; 2) recall of specific dream colors reflects personal color preference; 3) recall of dream color is influenced by the neurology of color perception; 4) recall of specific dream colors is influenced by archetypal manifestations; 5) recall of specific dream colors is influenced by emotion and is a reflection of specific emotional states.

2.   Methods and Results

Content analyses were performed on two large dream databases. The studies looked for common patterns in the relative frequencies of each reported color. The content analyses were performed on a combination of two databases together, totaling 30,063 dreams. One database used in the analyses included 25,222 dream reports from the DreamBank.net database (Schneider & Domhoff, 1999), which consisted of a large population of male and female dreamers of varied demographics primarily from the US, but also samples from Europe and South America. This original analysis was updated in February of 2010 for the purposes of this report. The second database included 12,841 dream reports from a small male and female population of eight long-term journaling subjects from the US and UK. A content analysis was performed on the total combination of dreams from both databases, as well as each individually. Also, each of the eight long-term journal data sets were analyzed in order to study individual differences, in comparison with each other, as well as to the composite results from the whole population.

2.1. Color Naming and Search Criteria

One of the more difficult variables in such a content analysis search is the naming of colors, which can vary by culture, gender and personal experience with color (artists for example may have more names for subtle color hues and combinations than others). An initial examination of the collected journaling data, plus trial naming searches on the DreamBank.net database, indicated that identification of colors with a "minor" term (for example "scarlet", "saffron", "hazel" or "flesh") occurred very infrequently (typically much less than 1%) in comparison to the use of more primary terms. It may have improved the accuracy a percent or so to try to collect these minor terms into the closest primary color, however this could also add a subjective variable where the match was unclear. It was decided to proceed with sorting on primary color naming since the occurrence of any one minor color term across a large database was so small. Yellow and purple were two exceptions where a "minor" name was combined into the count, due to the higher frequency of occurrence and the common tendency to use alternate names based on the context. Yellow counts included "blond" since it was most often used when dreamers were describing yellow hair (Western speech being more inclined to use the term "blond" than yellow when naming hair color). "Golden" was often used to describe a yellow glow but was eliminated from the yellow count since it shared characteristics with the term "gold". "Violet" was included in Purple counts since this was a commonly interchanged word for the same color.

The second problem was color combinations, for example "teal" as a blue-green combination, or "tan" as a yellow-brown combination. With minor exceptions, such as "pink" (which occurred about as frequently as orange) these combination names also typically occurred much less than 1% of the time.

Although the sum of all the minor color terms could add up to a noticeable percent in some individual reports, the study was not focused on total color count but rather dominant discrete colors which form patterns that appear well above the levels of "minor" color names. The low levels of occurrence provided confidence that looking for color patterns
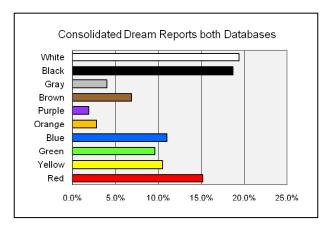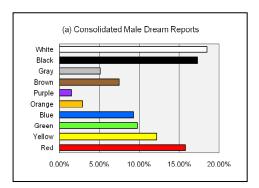

Figure 1. Color recall from spontaneous dream reports from the combined databases, n = 38,063 dreams

using more primary color names was reasonable. A search of both databases resulted in the dominant color names to be: red, orange, yellow, green, blue, purple, brown, gray, black, white, gold, silver and pink. This set of dominant colors was used to compare color recall rates. Although it is not inclusive of all colors (minor terms, mixed colors, "rainbow" colors, and non-specific colors) the purpose was not to establish a total color recall rate in this paper but to compare recall for a fixed set of colors. Silver, gold and pink were dropped from the graphs herein since the intent was to look for patterns and the occurrence of those minor colors was low and the explicit color identification less discrete. The remaining colors are termed the "standard color set." Word count was therefore plotted and compared for the following color terms: red, orange, yellow/blond, green, blue, purple/violet, brown, gray, black and white.

2.2. Composite Database Trial

The dream reports in both the Long Term Journaling and DreamBank.net databases were searched for discrete color words using the "standard color set." The combined search of 30,063 dream reports resulted in a count of 12,227 for these color terms. The relative frequency between the colors reported is illustrated in Figure 1 as a percentage of the "standard color set." The analysis found that on average black and white (as colors) are reported most often (approximately 20% each) and with approximately equal frequency. This is followed by the next dominant frequency grouping of the colors red, blue, yellow and green. Within this grouping, red tended to appear a larger percentage of the time (15%) in comparison to the other three colors (which occur about 10% of the time). Other colors were reported less than 5% of the time with the possible exception of brown, which was reported in the 6-7% range. This color pattern is significant, since it is observed to exist in some form in a majority of the large and many small data sets that will be discussed below.

Figure 2 illustrates the composite contribution by gender. This resulted in the same basic pattern, but with a few percentage variations in the relative frequency of red, yellow and blue between males and females. However, the differences were not statistically significant, although female reports contained 3% more blue than males in both databases.
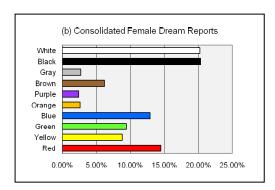
Figure 2. Contribution of spontaneous color dream reports to figure 1, the composite database, from: (a) males, n= 22,600; and (b) females, n = 15,463

2.3. Large Population Database

Figure 3 illustrates the contribution of the DreamBank.net database alone, which provided a count of 4555 of the dominant color terms in 25,222 dreams. The search for the "standard color set" resulted in the same pattern as evidenced in the composite analysis within 1% to 2%. This database represented a broad, but primarily US base with some samples from Europe and Latin America. It contained 55% reports from males and 45% from females. The database included a diverse population: individual adolescent and adult male's and female's journals (various ages and professions); group samples of girls in grades 4 through 9; groups of male and female teenagers; female wedding dreams; male and female blind dreamers; a transvestite and a lesbian; a male child molester; college women in the late1940s and college women from 1996; a sample of male and female German dreams; a sample of male and female Swiss children's dreams; a group of male and female Peruvian dreams; two groups of laboratory subjects; and samples representing the male and female Hall-Van de Castle norms.

2.4. Small Population Long-Term Journaling Database

Figure 4 illustrates the contribution of the Long-Term Journaling database. This database, summarized in table 1, consisted of 7,891 "standard color set" counts from approximately 12,841 dream reports, from a small population of 8 subjects, 3 male and 5 female, who were long-term journalists (Hoss & Hoffman, 2004). Color count was 62% male and 38% female. These were computer based journals, but of a personal nature, so the subjects were asked to do the color word counts based on the naming criteria provided, and to submit the count data.

Comparing this result with Figure 3 for the large population DreamBank.net database, we can see that the two contain the common pattern within a 1% to 2% variation (except for yellow which varied by 3%). The variation between the Red, Yellow, Blue and Green patterns were less than 1% (not shown) when the data from the Long-Term Journal database was normalized for overall dream color count by dreamers. This close result and common pattern is notable considering the different populations and sample sizes, plus the inability to strictly control the count from the journals..

2.5. Content Analysis of Individual Journals

A content analysis was performed using the "standard color set" for each of the eight subjects making up the Long-Term Journal database. Results from three of the subjects are plotted in Figure 5 as a representative result so that the nature of the pattern similarities and differences can be illustrated. The color count relative to the "standard color set" is represented as a percentage for each subject. Note that all eight subjects showed the same dominant pattern as observed in the composite database analysis in figure 1. All subjects, with one minor variation, recorded dominant and a
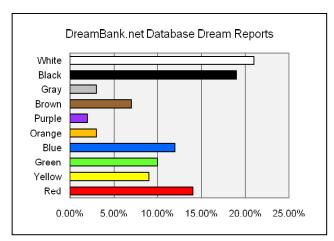

Figure 3. Color recall from spontaneous dream reports in the DreamBank.net database, n = 25,222 dreams
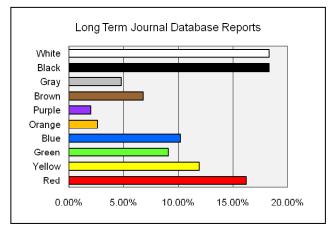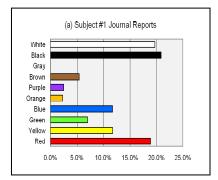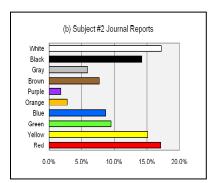

Figure 4. Color recall from spontaneous dream reports in eight long-term journals, n = 12,841 dreams
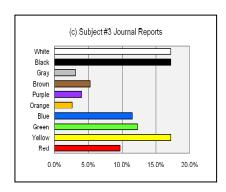
Figure 5. Color content from three of the eight LTJ database subjects: (a) n = 2787 dreams; (b) n = 4791 dreams; n = 233 dreams (Hoss & Hoffman, 2005)

near equal grouping of black and white (one subject recorded a lesser percentage of white than black). Also each of the eight profiles (with the possible exception of yellow being low in two subjects) illustrated a dominant color grouping of red, yellow, green and blue. Of note, however, is that there is a significant variance in the relative frequencies of those four colors, from individual to individual.

3. Conclusions

A fairly common pattern seems to emerge when dream color recall is studied across large populations, as well as within individual dream journals. This pattern, which I will term the "dominant pattern" herein, consists of a dominant pairing of black and white (named as colors) appearing with approximately equal frequency, followed by a grouping of the "primary" hues red, yellow, green and blue (with red appearing about 50% more frequently than the others). This grouping is followed by brown which often appears twice as frequently as the lesser colors. This pattern appears fairly consistent between the two databases, and appears as well in the journals of individual dreamers, but with a wider variation between the relative color counts between individuals. These results lead to the speculation that there may be a common neurological or psychological factor influencing dream color creation or recall on average, which is in turn in-

fluenced by other factors at an individual level. The discussion below compares the data to each hypothesis in order to determine if it strengthens or weakens each hypothesis as a contributing factor.
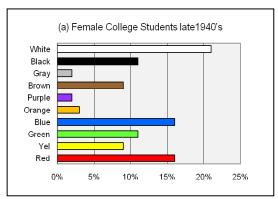
3.1. Hypothesis #1: recall of specific dream colors reflects our waking visual experience

There is little data available on what might be considered the typical waking color environment, since we live in various environments and have different experiences. There is some commonality, however. The more general experience or "natural" scene tends to contain a dominance of blue, green and brown to tan tones with variations of gray. Wroblewski (2003) states, "we are used to backdrops composed of blues, yellows, and grays because we see them every day." Those who live in a city or spend the majority of the time indoors, may have an experience that varies from this. However, as we look across a large sample of the population, it would be expected that these more commonly experienced colors would dominate on average. If the color recalled from dreams bore a direct relationship to the colors we experience in our waking environment, these colors should also emerge as dominant on average from a large population database of recalled dream colors. The "dominant pattern" that emerges from the dream color databases,

Table 1. Color content by percentage of reported color for the eight LTJ database subjects

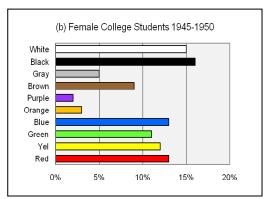| Variable	#1	#2	#3	#4	#5	#6	#7	#8	Composite Average
White	19.7%	17.2%	17.2%	14.9%	19.7%	17.1%	23.6%	23.6%	18.3%
Black	20.9%	14.2%	17.2%	29.9%	20.4%	19.7%	26.4%	26.4%	18.3%
Gray	0.0%	5.9%	3.1%	4.3%	7.5%	7.3%	0.0%	0.0%	4.8%
Brown	5.4%	7.7%	5.3%	3.6%	7.8%	8.6%	3.1%	3.1%	6.8%
Purple/Violet	2.5%	1.8%	4.0%	2.5%	2.5%	1.7%	0.8%	0.8%	2.0%
Blue	11.7%	8.7%	11.5%	16.4%	10.7%	12.2%	10.1%	10.1%	10.2%
Green	7.0%	9.5%	12.3%	5.3%	9.1%	11.9%	9.7%	9.7%	9.1%
Yellow/Blond	11.7%	15.1%	17.2%	10.0%	5.6%	5.4%	5.8%	5.8%	11.9%
Orange	2.3%	2.8%	2.6%	2.1%	4.7%	2.8%	0.0%	0.0%	2.6%
Red	18.9%	17.1%	9.7%	11.0%	11.9%	13.3%	20.5%	20.5%	16.2%

Figure 6. Dream color recall from two groups of female college students collected in the late 1940's; (a) collected 1947 -1948, n = 29.2% color recall; (b) collected 1945 – 19 50 for Hall-Van de Castle norms, 25.3% color recall

however, does not fit well with the expected pattern of colors from our natural environment. In fact it is hard to imagine that the majority of the population, or very many individuals, spend their waking hours in an environment dominated by those six colors in the following order of intensity: black and white, followed by red, then blue, green and yellow.

This may seem in contradiction to the continuity theory whereby dreams do incorporate some waking life content, but that is not necessarily the case. The natural waking experience certainly appears to influence the natural colors making up a dream scene (grass is typically seen as green, and sky is typically seen as blue for example). Many elements of the dream however, such as cars, clothes and such, have no pre-determined color assignment from our waking environment and can be almost any color, and sometimes it can be quite un-natural (a blue dog for example). Regardless of what colors make up the dream, the recall of those colors diminishes as we wake up, particularly in the case of spontaneous recall. Other mechanisms appear to more heavily influence our attention to, or recall of, a specific dream color.

An investigation by Roffwarg, Herman, Bowe-Anders and Tauber may explain why the effect of our external environment on dreams may not dominate what is recalled and reported upon waking (Roffwarg et.al., 1978). In the study, subjects wore colored goggles during the day (over a 15 to 25 day period) and color dream reports were taken by waking subjects during various onset, REM and NREM stages of sleep. I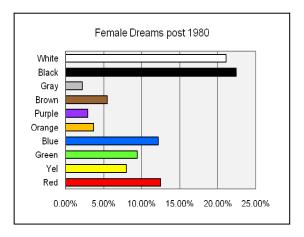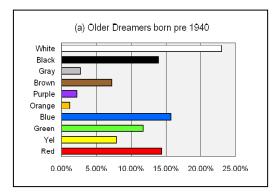n every case the color effect from the goggles were incorporated in the dreams. However, the effect dominated the early stages of dreaming and "all but disappeared after the third REM stage" where the color content of the dreams returned to a normal baseline. Bob Van de Castle (1994, p 253), commenting on these results, stated that "it appears that it is the deeply ingrained facets of waking personality that continue to shine through in dreams, brief exposures to experimental stimuli or environments have only fleeting effects on dreams unless those stimuli have a strong affective charge."

A study by Schredl (2008a) of 376 women and 68 men, principally psychology students, illustrates the influence of memory (and perhaps attention to certain colors) as an important factor in dream color recall. The study began by testing the subjects for color memory based on their ability to recall dominant colors from a film that they were shown. He then correlated the results with the colors they recalled from their subsequent dreams. As a group, the colors recalled from the film were black (0.46%) followed by red (0.30%) then white (0.13%) with blue, green and yellow at a much lower percentage (0.03%, 0.01% and 0.04%). The colors recalled from their dreams were a dominance of black and white (at a near equal percentage of 0.04%) with red, blue, yellow next (at 0.03%) and green (0.02%). The comparison between the film and the dream records resulted in some colors that played a prominent role in the film like black and red, and possibly white, being reported more often from the subsequent dreams. The memory for those colors seemed to be a factor. There was, however, little correlation with the other colors (blue, yellow and green) which had a low percentage recall from the film but a relatively moderate percentage recall from the dreams. When compared with the content analysis (figure 1) however, the colors recalled from the dreams agreed fairly well with the "dominant pattern" for the large population of dreamers (black and white followed by red, then a near equal grouping of blue, green and yellow). One explanation may be that that some of the incorporated film results, beyond black and red, diminished and gave way over the night to other internal determinants of dream color as was speculated in the goggle study. This study may have also highlighted another memory related factor that might have enhanced the recall of certain colors from both the film and the dreams. As will be discussed further under hypothesis #5, black and red are emotionally charged colors which tend to draw our attention, a factor which might explain why those colors were more easily recalled from both the movie and the dreams.

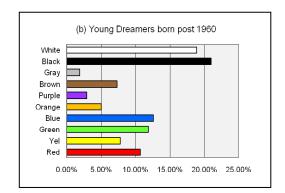Some studies (Murzyn, 2008; Schwitzgebel, 2002) had

Figure 7. Color recall from of Females recorded post 1980, n = 3900 dreams, 26.9% recall

Figure 8. Dream color recall for dreamers living pre and post 1950 time period, male and female dreamers: (a) born pre-1940, n = 2458 dreams, recall = 26%; (b) born post 1960, n = 1584 dreams, recall = 22.5%

found interesting relationships between dream color recall and historical shifts in attitude and or media exposure. Schwitzgebel proposed that our attitudes about dreams may have had an effect on the data stating: "In the 1950's, dream researchers commonly thought that dreams were predominantly a black and white phenomenon, although both earlier and later treatments of dreaming presume or assert that dreams have color. The first half of the twentieth century saw the rise of black and white film media, and it is likely that the emergence of the view that dreams are black and white was connected with this change in media technology." The Murzyn study tested for attitude towards dreams as well as the effects of black and white media on visual memory to determine whether these factors may have caused dream reports prior to the 1960's to lack color, or persons who had access to black and white media to recall black and white dreams more often. The paper cites a series of reports in the early 20th century where spontaneously recorded dreams resulted in low color counts of 20% in 1925, to 29% in 1942, to 15% and 9% in the 1950s. The paper states, "the tendency to report black and white dreams suddenly disappeared in the 1960s" attributing much of this to changes in methodology as well as attitude, citing increase in color recall to 82.7% and 69% respectively when there was "careful interrogation at the time of dreaming." Schredl also notes (in the summary provided in the introduction) that this change in research methodology has resulted in our understanding that dreams inherently contain more color than is recalled when spontaneously recalling and recording them. Methodology may therefore be more of a factor than attitude in reviewing results before and after the 1960s. Whereas the Murzyn study tested for attitude as well as exposure to media among a group of 60 subjects, and found some interesting correlations, the study concluded with a discussion of some variables regarding the influence of memory and selective recall, as well as attitude about colored dreams on a culture wide basis, remaining open. If there existed a general attitude towards dreams or color that affected spontaneous color reporting, then dreams reported before 1950 and those well after should show that difference. The effects of changing media from black and white to color over this period, should also be reflected in an additive fashion.

In order to test whether dreams from the pre-1950 time period resulted in less color recall or more black and white or gray, than reports post-1980, I used two data sets collected on female college students by Calvin Hall in the 1940's: one set of 681 dreams collected in 1947 and 1948

and another set of 500 dreams collected between 1945 and 1950 (later published as the Hall Van de Castle norms). The students had grown up during a period of black and white movies and by the time the dreams were recorded only 12% of movies were made in color (Wikipedia) and there was no color TV. The results are shown in figure 6 (a) and (b). I then compared this with a group of 3900 dreams from females recorded post 1980, a period that was well saturated with color media including movies, TV and digital displays. Those results are shown in figure 7. Overall color recall was tested against the full dominant color set. The results were that recall of all colors from the dreams of the 1940's college students was quite typical for spontaneous recall, 29.2% for the 1947-1948 group and 25.3% for the group representing the Hall Van de Castle norms. This was not significantly different than the 26.9% color recall rate for the post 1980 females. Comparing figure 6 (a) and (b) with figure 7, it can be seen that the specific colors recalled (or "dominant color pattern") for the 1940's dream subjects was similar to that of the post 1980 group, although there is curiously a larger percentage of black and white relative to color hues in the post 1980 reports than those from the 1940's subjects. This set of data therefore, does not show a significant difference in either dream color recall or the specific colors recalled, in dream reports from the 1940's and dream reports from the post 1980's.

Another hypothesis tested by the Myrzn study regarded older people being affected by attention and emotional engagement in their early years with the black and white media, and the possibility that it may have left an imprint on their mind which results in a lower recall of dream color (or greater memory for black and white dreams) even later in life. The dreams, attitudes and exposure to color media at an early age were studied on a population of 60 people, half of which were over 55 and half of which were under 25. The dream questionnaire was to be self-administered upon awakening and specifically asked about color. The results indicated that those who had access to color TV and film during their childhood reported little difference in recall of color (over 90% of dream reports contained color for both older and younger subjects) but those who had access to black and white media reported more "black and white" or gray scale dreams (about a quarter of the time).

The DreamBank.net database contained a number of data sets of adults who had grown up during the period of black and white movies and TV (dreamers who were adolescents during the 1930s and 1940s plus one set of 900 dreams from 1912 through 1965). Although there was no

way to control for specific attitude or media exposure for each subject, I was interested in whether the more general exposure to black and white media would show up in the dreams of the older subjects in comparison to younger subjects. I tested the data-sets of older persons (born before 1940) against younger persons born after 1960. The data set for older persons contained 2458 dreams from 2 males and 3 females born prior to 1940. The data set for the younger persons contained 1584 dreams of males and females (individuals and groups) from age 12 through late 20's. The results are shown in figure 8. The recall of dream color by the older persons born before 1940 was 26.0% and the recall of dream color by younger persons who were born after 1960 was 22.5%. The percentage of black and white, in relation to color hue, was curiously slightly less in those born before 1940. This particular set of data does not show any comparative increase in black and white dream color recall, in relationship to color hues, for those five persons who were exposed earlier in life to a general environment of black and white media.

Exposure to media has been shown to affect dream content in early stages of sleep or when it contains emotional scenes (Van de Castle, 1994, p. 257). Intense exposure, where there is a personal emotional affect such as threat simulation, has been shown to become incorporated in dream scenes and scenarios in video gaming studies (Gackenbach, 2008). The degree to which black and white movies and TV may have influenced color in dreams, however, was not apparent in the data that was analyzed herein.

In conclusion, although the colors within a dream scene may indeed reflect the natural waking color environment as the continuity theory predicts, the dominant colors spontaneously recalled from dreams appear to be influenced by other internal factors. The dominant pattern of black and white, followed by red, then blue, green and yellow is not consistent with the color patterns that dominate our waking environment. Studies using colored goggles to alter the waking experience provide valuable insight as to how environmental influences that influence dreams in early REM stages, may diminish over the night giving way to other internal determinants of dream color. Media exposure appears to influence dreams, particularly when it contains emotional content important to the dreamer. But the effects of childhood exposure to black and white media were not readily apparent in these database trials. Memory for, or attention to, certain colors appears to be a factor in recall, and each of these factors can be stimulated by emotion which may play an underlying role.

3.2. Hypothesis #2: recall of specific dream colors reflects personal color preference

If the recall of specific dream color was heavily influenced by personal color preferences, our "favorite color" for example, then there should be a correlation between the colors most recalled from our dreams and our preferred or "favorite" colors. If this hypothesis were true, then the profile of colors most favored by a sampling of the general population should be similar to the "dominant pattern" of dream colors most recalled. Three general population studies on "most favored color" were reviewed (Hurlbert; Hallock; Cheskin). All studies indicated blue to be the universal favorite. Hallock found blue chosen 42% of the time followed by green, purple, red and black. Market researchers Cheskin Research, MSI-ITM

and CMCD's Visual Symbols Library (Cheskin et. al. 2004) conducted a survey of 13,000 residents of 17 countries that also found people are most likely to choose blue as their favorite color, with blue, purple, green, red and black being at the top in most countries. This pattern of color preference (blue followed by green, purple, red and black) does not compare with the "dominant pattern" of colors recalled from dreams (black and white followed by red, blue, yellow and green). Hurlbert and Hallock both found males favoring blue and females the red tones such as purple. This result also does not compare with the content analysis data where females reported more blue in their dreams than males. Males indicated a preference for blue 57% then green, black and red (whereas the composite dream color profiles contained black, white and red most frequently then, green, blue and yellow). Females chose blue 35%, purple 23% then green, red and black (whereas the composite female dream color profile contained black, white and red most dominantly, then blue followed by green and yellow, with purple at only 2.4%). No color preference pattern compared well with the "dominant pattern" of color recall in the dream databases herein. The data does not support personal color preference as an influence over the dominant colors reported from dreams.

3.3. Hypothesis #3: recall of specific dream colors is influenced by the neurology of color perception

The color pattern that emerged hints that the neurology of color perception may have an influence on dream color. The opponent-process theory of color perception (Schiffman,1976) contends that the eye-brain system processes the tri-chromatic information from the eye at a more complex level based on hue cancellation between three opponent channels: red versus green, blue versus yellow, and black versus white. This has given rise to the "Natural Color System" (NCS) which describes the organization of the color sensations as perceived at the upper brain level, based on these six elementary color percepts of human vision as described by the opponent-process. The four colors, red, yellow, blue and green have been often termed the "psychological primaries" because they are perceived by the mind to be primary, likely due to this processing phenomenon.

It is notable that the content analysis revealed a dominant dream color pattern containing the same six colors that the opponent-process theory contends are responsible for human color perception. It is therefore not unreasonable to assume that the colors that dominate our dreams on average may be influenced at the most basic level by the neurological mechanisms responsible for color perception.

3.4. Hypothesis #4: recall of specific dream colors is influenced by archetypal manifestations

The "dominant pattern" evidenced in both large databases as well as individual dream journal data sets, appears curiously similar to color patterns that were described by Carl Jung as belonging to symbolic manifestations which he termed "archetypes" (Jung, 1964, p.58; Jung, 1971, pp. 44-45). Jung considered archetypes to be manifestations of instinctual forces arising from the collective unconscious and therefore innate and inherited, common in all humans. They appear in particular to accompany processes within the psyche that Jung termed "individuation" and "transcendence," processes of self-realization and progression to a new state of being (Jung, 1964, p.159–165; Jung, 1971,

p.273). They represent themselves as motifs, among them being geometric mandala-like patterns, in particular centering or circular motifs, patterns based on four elements such as the square (Jung, 1964, p.214, 266; Jung, 1973, pp. 3-4) and patterns representative of an integration of opposing forces.

According to Jung these motifs can vary a great deal without losing their basic pattern, and he observed color patterns to be one of the manifestations. More specifically to the study herein, Jung considered the four "psychological primaries" to be an important manifestation of the motif of four (Jung, 1972, p.51), and the appearance of black and white to be a manifestation of unconscious and conscious (Jung, 1964, pp. 370, 371; Jung, 1972, p.5). Jung went so far as to assign each color a symbolic significance, and considered it psychologically important when they appeared together as a group in a dream. He identified four colors as symbolic of the four orienting functions of consciousness: thinking, feeling, sensing and intuition (Jung, 1972, p.51). He regarded the appearance of this balanced pattern of four colors in a dream as evidence of a balance of forces and an evolving state of order within the psyche (Jung, 1971, p.397, 415). He also considered a missing color in the pattern (appearance of 3 out of 4) to be important, a sign of a disturbance or an incomplete state missing an element required for completion (Jung, 1971, p. 435, 447; Jung, 1972, p.76). Jung considered it a healthy sign of integration when black and white appeared as an equal pair, stating that transcendence to the new state is achieved through the union of conscious and unconscious contents of the mind (Jung, 1964, pp. xi, 146; Jung, 1971, p.273, 358, 399). Jung also attributed an important significance to the color brown in its relationship to the brown of our collective origins "Mother earth" and the wood of the great tree which he indicated symbolized the process of individuation (Jung, 1971, p. 448; Jung 1964, pp. 165-167).

Although the appearance of these color patterns might be a somewhat infrequent manifestation of the motif in any one dream, it is notable that they emerge as relatively distinct and dominant color groupings in the composite color recall patterns from both databases. The geometric motifs, which Jung referred to, do appear to be noticed and recorded in individual dreams. A search of the DreamBank.net database for evidence of the geometric motifs resulted in circular or centering motifs mentioned approximately 10% of the time, and the square motif approximately 6.6% of the time not counting many other dream objects or actions which may have taken on those geometric motifs. The pairing of black and white appeared in 5.9% of the color counts (355 cases) and the recall of a four color pattern (or the motif of 3 out of 4) in about 3.1% of the color counts (185 cases, 12 of which contained all four colors).

Unfortunately there are no scientific studies to support the validity of Jung's theories regarding these color groupings, only a number of empirical observations in Jung's writings and similar observations in collected dreams (Hoss, 2005). This is pure speculation, but when the pattern does exist within a dream there may be a simple neurological explanation for a symbolic relationship to exist between these color groupings and a perceived state of wholeness, balance or completion. Based on the opponent-process theory of color perception discussed previously, the balanced presence of the four "psychological primaries" would be neurologically or perceptually equivalent to the balance of all color

opponents, and thus a balanced totality of our visual color experience. Likewise white and black would take on a natural association with what we can see (consciousness) and what we cannot (unconscious), a pairing of white and black would be perceived as the balance of those opponents. The symbolic nature of the pattern may therefore be an artifact of the neurology of color perception to which the mind has placed meaning.

Although a content analysis alone cannot substantiate the validity of Jung's observations, the patterns which emerge on a collective basis bear a striking relationship to his theories, and thus the similarities are worthy of note for future observation and study.

3.5. Hypothesis #5: recall of specific dream colors is influenced by emotion and is a reflection of specific emotional states

Early studies on the human response to color provide significant evidence that exposure to color illumination in the waking state results in fairly predictable physiological and emotional responses (Birren, 1961; Birren, 1978; Brown, 1974; Ertel, 1973; Goldstein, 1942; Lüscher, 1971; Riley, 1995). Lüscher (1971) and Birren (1961) both cited studies where color was shown to evoke a physiological response in the autonomic nervous system, which occurs below our threshold of awareness. Brown (1974) determined that our brain responds directly to color in a similar manner, as does our nervous system. These influences may carry over into the dream state. A connection between physiological response and emotion in the dream state was made by Hobson and McCarley (1977) who hypothesized that the intensity of dreams is reflected in the dreamer's respiratory rate, heart rate and skin potential.

These color-to-emotion associations common in the waking state may carry over into the dream state due to similar brain centers being involved in both states – in particular the limbic system and the amygdale. Hobson (Hobson et. al., 2003: p. 17) states that the findings of Braun et al. (1997), Marquet et al.(1997) and Nofzinger et al. (1997), suggest that REM sleep plays a role in the processing of emotion via a cortical interplay with the limbic system. Marquet (in Hobson, 2007: p. 16) proposes that the amygdale functions to selectively process emotionally relevant memories in dreams. In the waking state the amygdale calls attention to important sensory information by placing an emotional "tag" on every stimulus (which would include color) that we come in contact with (Berne & Savary, 2004). The amygdale would therefore play a role in creating meaningful associations between color and emotion, which would possibly influence the colors assigned to a dream image, and likely the colors we most recall from our dreams. Attention to content was found to be a factor in color recall in the Schredl studies, so it is likely that attention to dream content, as influenced by intense emotions in the dream, may be a key factor in which content and which colors are recalled. Murzyn (2008) also found that color dreams were likely to be recalled more than colorless ones, emotional intensity being a possible factor there as well.

One indication from the content analysis, that emotion might influence dream color recall, is seen from the dominance of red over all other color hues in the large composite databases, figures 1 through 4. In some individual data sets (figure 5 and table 1) red is recalled as frequently as black.

Red is found to attract attention faster than other colors and has been demonstrated to increase anxiety (Elliott, 2007). Red is also the color, along with black, that is most associated with fear and terror (Hallock, 2007). Revonsuo contends that key function of dreams is that of threat rehearsal (Revonsuo, 2000). Hall and Van de Castle (1966) found the most common emotion in dreams to be anxiety, with negative emotion occurring in dreams about 2/3 more often than positive. Therefore, a dominance of red in dream color recall might be expected, due to the emotional charge and thus attention triggered by that color.

If the mind maintains the same emotional associations with color in our dreams as it does in the waking state, then it would be expected that the colors in our dreams should reflect the emotions being processed in the dream. Hartmann contends the more powerful the emotion the more intense the image representing that emotion will be (Hoss, 2005, p.45). It follows, therefore, that the intensity of an emotion might influence the intensity of an associated dream color. Because the emotional association process lies within the limbic system, a system which stimulates arousal and attention as well as processes emotional memory (Berne & Savary, 2004; Ratey, 2002, pp. 225-232), we may be better positioned to recall the more emotionally charged colors over those colors with lesser charge. The result would be recall of those colors which contained strong emotional content or associations, over other colors that may have populated the dream but were less emotionally important or contained neutral associations (such as green grass and blue sky). This may be a factor in why dream colors, stimulated by waking exposure to colored goggles, diminish over later REM stages. The later stages may emphasize colors stimulated by the emotional charge of the subsequent dream material.

Some preliminary studies (Hoss, 1999; Hoss, 2005, pp. 163-172) were performed to test the premise that dream color is representative of emotion. These earliest studies compared: a) the emotional responses from subjects as they enacted a Gestalt role-play of color dream image, with b) feelings the subject experienced in a recent waking situation, and c) common waking state emotional responses to color. The Gestalt role-play technique was derived from Gestalt Therapy (Perls,1974) and was simply scripted to provided a relatively quick means for surfacing the emotional memories contained within a dream image, without contaminating the information by projections from the researcher. The set of waking state associations with color were derived from color psychology studies, in particular a tool which tested for emotional state based on relative color preferences called the Lüscher Color Test (Lüscher, 1971). This tool was designed on the principle of the human neurological response to color so it was relatively free of popular or cultural color associations.

Subjects who reported a dream with a colored element in it were asked to tell the dream in full and select a colored element in the dream that they feel drawn to. They then were asked to imagine that they are that colored dream element and role-play the element by stating: what or who they are; what their purpose is; and how they feel as that dream element in its role in the dream. Their statement is read back to them and they are asked if it triggers the recall of any waking life situations. The feelings in the waking life situation are compared to those expressed in the role-play. Thirdly the common human emotional response to color, provided by the Lüscher test material, is compared with both the role-

play response as well as the waking life associations. While the comparisons were qualitative (comparing narratives), a strong relationship was observed between the three sets of data.

One case example from the study is given here to illustrate the process. The dream was of an unknown woman wearing a red hat, who was sinking into the ground. The dreamer imagined herself as the woman (before sinking) and expressed her feelings in the role-play as, "I am going out for the evening to have fun, I feel vibrant." The Lüscher studies listed an emotional response to red as feeling "intense, vital and animated, taking delight in action, desire to live life to the fullest." This dreamer stated that in waking life she had not felt that way in a long time and wanted to feel that way again. She was in a situation where she had suppressed her social life, having not gone out to enjoy herself in a very long time, in order to stay home with a troubled family member.

Although the studies contained a number of subjective variables, the information provided encouragement that the colors which emerged in dreams might be stimulated by emotional associations. Furthermore, the emotional associations appeared to remain fairly consistent between the waking state and the dream state as might be expected since the same brain centers are involved.

If dream color is associated with emotions that the dream is processing, then it would follow that dream color should reflect emotional conditions from the dreamer's waking life that the dream might be dealing with. This speculation lead to another preliminary but interesting test performed on some long term journaling data (Hoss & Hoffman, 2004 & 2005). The Lüscher Color Test was again used in these trials but was applied more as a testing tool to derive emotional profiles from color profiles. A working assumption was made that the color profile from a subject's dreams (attention to one color over another in a sequence of recalled colors) could be applied to the Lüscher test tool much like it was designed to work with a color profile from the subject in the waking state (preference for one color over another in a sequence of presented colors). The Lüscher 8 color test was used to perform a year by year analysis on the 11 year dream color data set from subject #2 in figure 4, in order to derive an emotional profile for each year. The Lüscher-generated emotional profile typically consisted of from 7 to 15 statements. These profiles were sent to the subject for self-scoring of each statement, as to how it fit the emotional situation they recall going through that year. The scoring of each statement was: + = yes it fits; 0 = the theme fits but not exactly as stated; - = does not fit as a statement or theme. A baseline profile was developed on the basis of the overall color count in the recorded dreams over the 11 year period. A profile was then created for each year based on the dream colors recorded for that year. The baseline profile that the subject was asked to score is shown below, along with the scores the subject provided:

Seeks success, stimulation and a life full of experience __+__. Wants to act and develop freely and uninhibited _+__ and shake off self-doubt __o__ . Restrained at times by his need to have things on a rational consistent and clearly defined basis __o___ . Likes contact with others and is enthusiastic by nature __+__. Receptive to anything new and modern or intriguing and has many interests and wants to expand his fields of activity __+__. Optimistic about the future __+__. Can be demanding and stubborn at times __+__ . Maintains an attitude of critical appraisal

and is not swayed unless sincerity and integrity can be estab-lished __+__ . Keeps a watchful control over emotional relation-ships until he knows where he stands ___+__ .

The subject had gone through two emotional crises dur-ing that period, but the timing and nature of each crisis were known only to the subject. Although the subject agreed to score the data, and appeared to address the unflattering as well as the flattering statements without obvious bias, the subject was quite skeptical about the concept and chal-lenged the researcher to identify a period of emotional crisis from the dream color data.

The analysis of the data was performed two ways. The researcher looked for significant changes from the baseline in the color patterns from year to year. Simply looking at the color patterns only provided some indication that per-haps something emotionally significant had occurred. The emotional profile for each year, once scored, provided infor-mation on the nature of the emotional changes that might have taken place. By looking at the dream color patterns over the 11 years, there appeared to be two periods of sig-nificant change from the baseline. The emotional profiles for those years provided further indication of emotional conflict taking place. An example one of the yearly profiles of the profile provided to the dreamer for scoring is shown below. It represented the second suspected crisis period which oc-curred in year 11.

Pursues his objectives and his self-interests with stubborn determination __+__ . Refuses to compromise or make con-cessions ___+___ . Relationships do not measure up to your expectations __+__ leading to disappointment ____+____ . Has mental reservations about the situation __+__ and remains emo-tionally isolated __+__ . Stress arises from instability in some set of relationships __+___ , Watchful control over your relationships because you need to know where you stand ___+___. Strives to align with others who can assist in your growth ___+__ .

The subject subsequently confirmed that there were in-deed two crises periods that had occurred in the 11 year period, and that they occurred in the two periods that were identified from the color profiles. The emotional profiles (de-rived from dream color alone) for those periods were scored as containing 81% and 100% accurate statements respec-tively. By all appearances, from this singular study of 11 samples from a single subject, the emotional experiences in the waking state were reflected in the colors recalled from the subjects dreams. Certainly a singular case study based on self-scoring is not statistically significant, but the nature of the result certainly supports further investigation of this nature into dream color as a reflection of emotion.

Although the content analysis of the databases can-not confirm emotion to be related to the color pattern that emerged, the dominance of emotionally charged colors (red and black) in the patterns, and the variation in the color pattern between individual journal data sets is consistent with what might be expected if emotional environment and personality influences dream color recall. Various theoreti-cal arguments about the neurology involved, attention and memory influences, as well as some preliminary trials, herein support emotion as a probable factor in the origin and recall of dream color. Therefore, further study along these lines, with proper tools, design and controls is encouraged.

4.   Discussion and Future Directions

The recall of color from dreams is an important area for con-tinued study, but what this paper is intended to introduce is the additional importance of researching the significance of specific colors recalled from dreams. The Schredl studies, as well as others referenced above, indicate that the basic recall of color from dreams may have much to do with mem-ory and attention mechanisms, as well as careful question-ing regarding color upon awakening from a dream. Beyond the basic recall of color, however, the studies referenced herein provide support to the hypothesis that the specific colors recalled from dreams, may have a neurological sig-nificance and may be heavily influenced by personality and emotional factors. Studies by Schredl (2008a), Murzyn (2008) and Schwitzgebel, (2002) also support emotional at-titude as having an influence on dream color recall (in the Schredl study for example, persons with more positive at-titudes towards creativity had greater recall of dream color). Further research is therefore called for which can better quantify the linkage between specific dream colors recalled and psychological factors, particularly emotion.

The first part of the research dilemma is to determine what is to be measured; color within the dream or color spontaneously recalled from the dream. Color origination in a dream and color recall may be subject to different influ-ences. For example, color origination may be stimulated by emotional or memory associations with that color, whereas recall of that color would be subject to attention and memo-ry mechanisms (perhaps also influenced by emotion) during the waking and recording process. Research designs which capture the dream and color content in laboratory settings, immediately upon awakening from the REM state, appear to capture more dream and color content (in the 80% to 100% range), and thus may provide results closer to that of what colors actually populated the dream. Designs that rely on spontaneous recall and journaling, tend to show color recall falling off to about 25% (typically within an 11% to 46% range). Therefore it would follow that attempting to capture the actual color originating within a dream may rely on REM awakenings. Immediate reporting upon awakening, with a strict questionnaire that focuses on describing the color of each element in the dream, also appears to capture a great deal of color present in the dream. However, spontaneous reports are quite useful as well in that they render a huge amount of data from collected dreams in large databases and may capture colors that have some particular emotional importance to the dreamer. Spontaneous reports are more subject to memory factors and attention to certain colors, but fading memory for color upon waking may actually have a beneficial effect in researching the hypothesis of psycho-logical factors, emotion, or emotionally stimulated attention to color, as a dominant influence on which colors are most often recalled from dreams.

Emotional response to color is a fairly well studied phe-nomenon in the waking state. Establishing a link between emotion and dream color, or demonstrating that the mind makes similar color-to-emotion associations in both the waking and dream state, would be an important contribution. It would be beneficial to study subjects using available tools for measuring emotional state and personality, recording the subject's dreams upon awakening, then subsequently per-forming a content analysis on the colors recalled to try to establish a statistical correlation. Incorporating comparative data on the common human response to color, from color psychology research and literature, would help to establish

a linkage between color associations in the sleep and waking state. Use of the Lüscher Color Test as one tool, but not the only one, in this sort of study is perhaps warranted to augment the data analysis, since it is fairly specific in linking emotional state to color. Repeating some of the preliminary trials outlined above, but with stricter controls, blind controls, independent judging of comparative narratives and statistical treatment, would provide useful to substantiate the author's preliminary findings.

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