Colour and Dynamic Symmetry

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Abstract

Investigations into the aesthetics of web page design have tended to focus on layout, ease of navigation and interface design. This paper explores the concept of dynamic symmetry as proposed by Jay Hambidge in the 1920's and applies it to two sets of web pages identified as "best' and "worst" designs. Although layout is explored the application of ratios in the use of colour is the main focus to show there are differing relationships between the two sets of web pages.

Keywords: Screen Aesthetics; Screen Design; Colour in Design; Dynamic Symmetry

1. Related Research

Much has been written concerning the application of Hambidge's (1920) concept of dynamic symmetry as an aesthetic construct. There are those writers (Erickson, 1986: Ngo and Ch'ng, 2001) who see some worth in constructing designs and visual imagery based on the application of ratios based on irrational numbers. There are others (Blake, 1921: Carpenter, 1921: Cook, 1922: Birkhoff, 1933) who see no proof in Hambidge's claims and dismiss his proof which was largely based on the proportional studies of Greek vases as "without rational foundation" (Blake, 1921). There are also those (Richter, 1922) who believe in the need for further research. Throughout the twentieth century artists and designers have shown interest in proportional systems such as dynamic symmetry. Hambidge's application of dynamic symmetry was used by designers at Tiffany's in the early 1920s as well as industrial designers such as Walter Dorwin Teague (McWinnie, 1989). Throughout the history of visual arts there have been a number of proportional systems which have been identified as having some aesthetic value. It has never been possible to provide definitive evidence that one is better than another. There have also been a number of empirical research projects to discover the public's preference to aesthetic ratios. A comprehensive survey can be found in Green's (1995) *All that Glitters: A Review of Psychological Research on the Aesthetics of the Golden Section*. The conclusion Green came to is that repeated experiments proved "illusionary" and this may be a result of the sensitivity of the instruments used (Green, 1995 p. 966). This may be so but artists and designers have learnt to make judgements concerning layout from example and experience, and many cases these fit various aesthetic ratio patterns. This sensitivity to aesthetic measures may be a result of what Reber, Schwartz and Winkielman (2004) term as "a function of the perceiver's processing dynamics" which equates to the proficiency of making judgements when processing a piece of work. The end result by the artist or designer may be an almost unconscious positioning of objects in a layout without any overall intent to use ratios.

It is not the author's intention to discuss aesthetic perceptions this has been comprehensively dealt with by authors such as Lavie and Tractinsky (2003) and Tractinski et al (2006) in regard to classical and expressive aesthetics. The author takes the starting point as being web page designs which have already been rated as being either attractive or unattractive. There exists a wide body of literature

concerning screen design and layout associated with usability. The majority of this work is based on the collection of performance metrics (Schmidt, Liu and Sridharan, 2009: Cyr, Kindra and Dash, 2008: Palmer, 2002: Graf and Hruegar, 1989). Aesthetics have been linked to the credibility of web pages (Robins and Holmes, 2008) with higher aesthetic values corresponding to a high significance in perceived credibility. There has been very little written on the connection between dynamic symmetry to well designed web pages. Ngo and Ch'ng (2000) conducted an empirical study on screen designs using popular multimedia designs and found that 40% loosely conformed to dynamic symmetry ratios. They also noted a user preference for designs using the principles of dynamic symmetry. These findings were however not supported by a similar study by Schaik and Ling (2003). Most of these studies required respondents to view and interact with web pages to make judgements on their aesthetic value. In this study the author takes an opposing position. It is taken as given that some web page designs are judged as having high aesthetic values while others are rated as low in aesthetic content by design experts. Web sites were chosen as they topped high hit values in a Google search for "best" and "worst " web page designs. The "best" site exhibiting examples was "designtutorials4u", http://designtutorials4u.com/top-15-non-flash-websites-for-october/ and the Webby Awards http://www.webbyawards.com which has a long history of evaluating the best of web design work. It was judged as important not to use flash sites as we needed to evaluate a non time based image as moving objects would make an evaluation difficult. The "worst" site for examples was "Web Pages That Suck" http://www.webpagesthatsuck.com/worst-business-web-sites-of-2009-but-you-can-learn-something-from-them.html. Both these sites are run by experienced professional designers with extensive career histories, and are rated by the general public who visit the sites and can upload examples. The evaluation of the degree of what constitutes "best" or "worst" was not considered important only that as a group of examples these pages had some commonality that designers regarded as inherent characteristics. There are a number of ways one could judge "best" or "worst" from difficulties in navigation, legibility or layout. The examples chosen were identified primarily for their layout composition. Ten examples of "best" or "worst" were randomly chosen for evaluation. In choosing the pages to evaluate as far as possible different design solutions were chosen to maximise difference in the layouts so the examples could not be seen as coming from one class of layout solution.

2. Approach and Methodology

The author was interested in finding if there was any evidence of Hambidge's dynamic symmetry in any of the web page design layouts and if there was any difference between the "best" and "worst". Secondly we wanted to take this further to see if there was a ratio relationship in the use of colour within the designs and if the ratios corresponded to dynamic symmetry root ratios. The theory being that if aesthetic measures could be made on space proportionality it might also be able to be made on colour proportionality.

To examine each web page the original web site of each example was accessed and viewed on a Dell M6400 laptop which has a 16:10 ratio currently the standard ratio for laptops. Interestingly this is very close to the 1.618 ratio for the golden mean. All pages were viewed using the Chrome browser

at maximum screen size. A screen grab was then made. The resulting image proportion minus the menu navigation equates very closely to the ratio of a root 3 rectangle (Figure 1).

Figure 1. Viewing screen proportion with a ratio of close to 1.732 root 3.

The basis of dynamic symmetry starts with a square also known as unity. A successive system of rectangles is built on the side of the original square by the diagonal of the previous rectangle acting as the radius of an arc. In Figure 1 diagonal BC is the radius for the arc CE, and radius BF for arc FG and so on. A series of rectangles is formed with the ratio of the sides. Hambidge differentiates two types of rectangles these being static and dynamic. The static rectangles have their side ratios expressed in integers while dynamic rectangles are expressed as irrational numbers. Hambidge was particularly interested in the root five rectangle as it has a direct relationship with the golden section.

All root rectangles could be subdivided using the diagonal into multiple of the same root value rectangle. In Figure 2 the root 3 rectangle the diagonal DG is crossed by the line BC which is at 90 degrees to line DG. This sets up the placement of a logarithmic angle spiral commencing at C which has a relationship to phyllotaxis in plants. The rectangle formed by this has the same root ratio as the large rectangle. Subdivisions of the large rectangle using the smaller rectangles form a grid which in Figure 2 shows that the design conforms vertically to this grid.

This subdivision methodology (Figure 2) was applied to all the web page designs and the results can be seen in Figure 3. an evaluation of how these designs fit the grid created by the root 3 subdivisions shows that “good” 9 of the ten page designs had an alignment for elements of the design to the grid. Conversely only 2 of the 10 “worst” pages showed this evidence. This indicates even in this small example that there is a significant difference in the application of ratios to the position of graphical elements, whether this is due to a conscious or unconscious decision. This application translates then

into an evaluation of a higher aesthetic value. The question is, can this also be evidenced in ratios of colour used in the page designs.

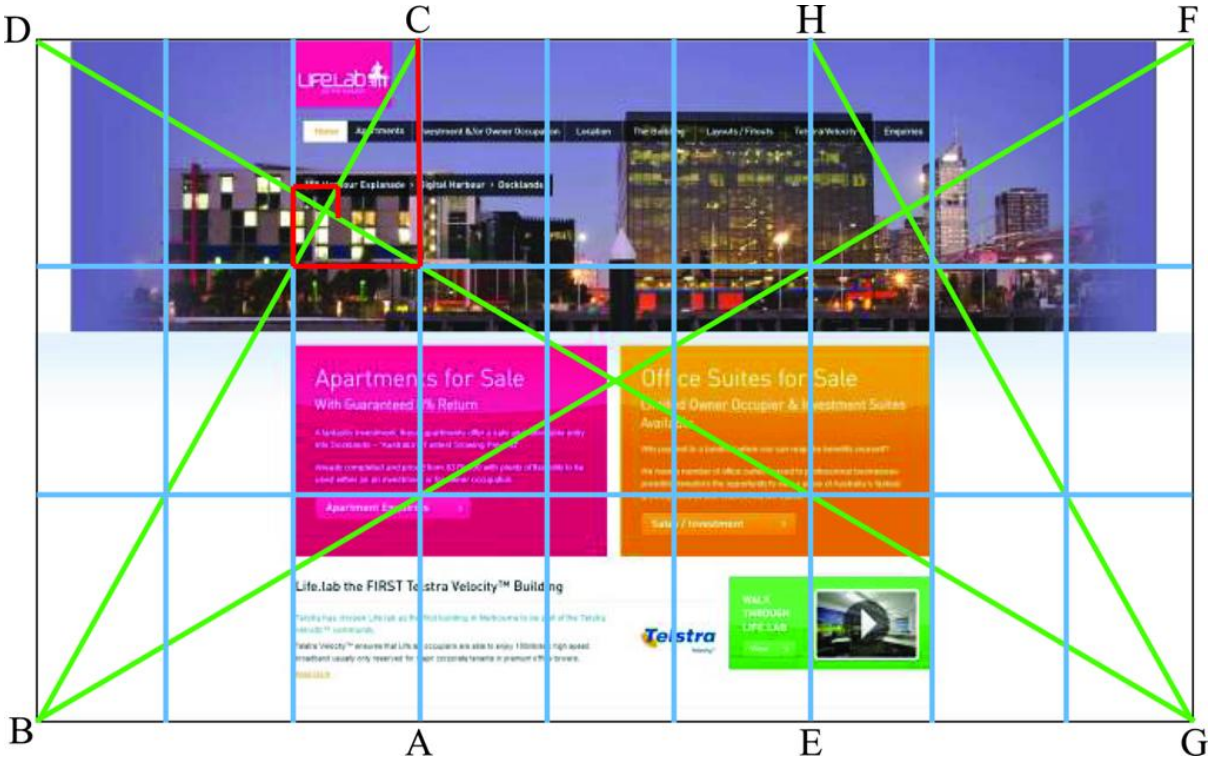

Figure 2. Root 3 subdivisions showing the logarithmic angle spiral.

Screen grabs of the pages were reduced to 16 colours and saved as a gif format. Although the web page is made up if 24 bit colour the subtle variations in tone can all be concatenated into a basic colour pallet therefore aggregating like hue values and making the job of counting colours a lot simpler. The colour data file was then able to be read as pixels and totals were calculated for each pixel colour value. These were then converted into percentage values (Figure 4). These percentage values were then interrogated to reveal if there was any relationship between the dominant and overall colours used in the designs.

Figure 3. The two columns on the left are pages identified as “worst”, and the two right columns are identified as “best”.

Visually there is a noticeable difference between the two sets of web pages. The “best” page ratios all tend to align close to the root ratios, whereas the “worst” pages show a much wider spread. It should be noted that difference in the numeric value for these root ratios is quite small so any standard statistical evaluation would show no difference between them.

3. Differences in colour ratios

It can’t be suggested that the designers of these pages deliberately organised the distribution of the colour ratios or proportions. Six of the “best” page designs recorded exact root ratios while 4 were only 0.1 off the root value. By comparison “worst pages recorded only one exact root ratio. We can conclude that there is some evidence that colour ratios contribute to overall aesthetic value. A good example is Figure 2 which recorded a ratio of 2.44 between the dominant colour and all others and shows the design conforms to the root ratio 3 grid.

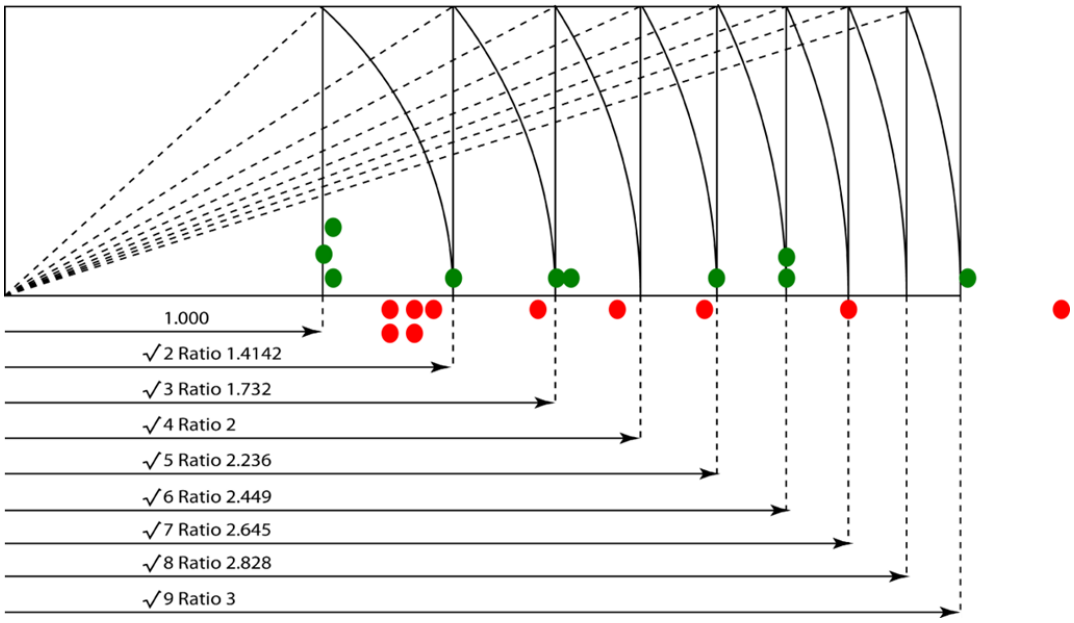

Figure 4. Ratio between most dominant colour to all colours. Green dots represent ratios for "best" web pages and red dots represent "worst" ones. The red dot at the far right recorded 5.

The difference in the use of colour can also be evidenced in the hue spread within the different web page designs. Hue refers to the wavelength of the colour which for example groups red with pink, orange and brown depending on the saturation level. Figure 5 illustrates the colour spread of the palettes used represented using the CIELAB colour space. Lab colour is a mathematical formula to describe colour and is commonly

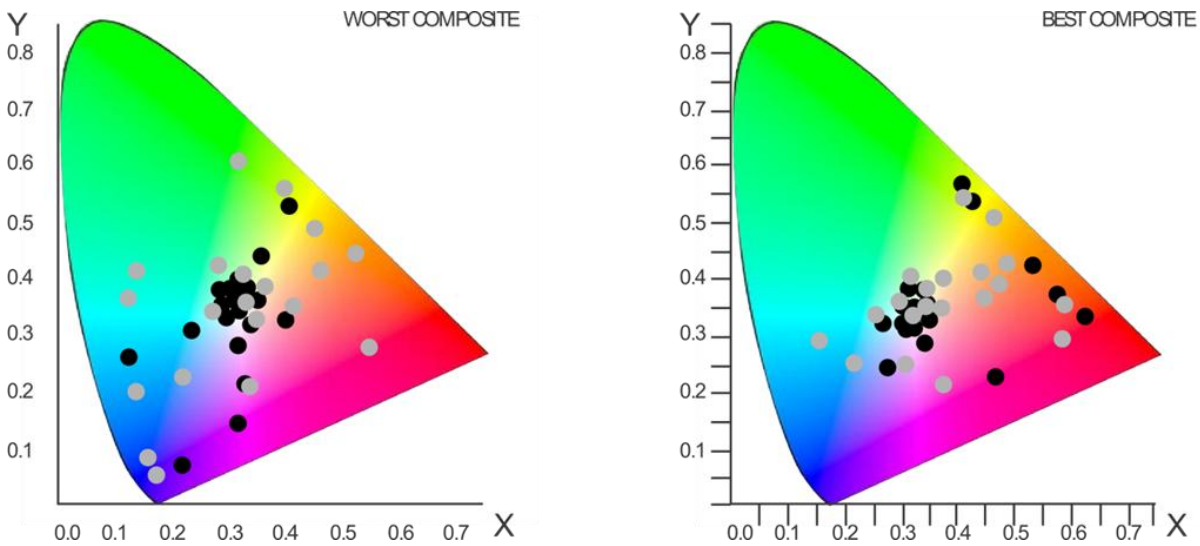

Figure 5. CIELAB colour space identifying the four largest colours in each web page design. Black dots represent the first two colours and grey dots represent the third and fourth colours.

used to determine visible and printable colours between computer devices such as computer screens and printers. Figure 5 illustrates a comparison between the two sets of web pages as described in the CIELAB colour space. The four largest colour percentages in each web page were plotted using the BabelColor translator and analyser software. The black dots represent the first two colours used, and

the grey dots represent the third and fourth largest colours. The “worst” pages show two features. There is a clumping to the centre of the colour space which indicates the use of low saturated colours. Typically black and white are represented at this position. The “worst” composite also shows a greater spread of colours which is evidenced in the web page designs where there is little consideration regarding restriction of the colour pallet used. This is particularly evident in the third and fourth colour choices where there is a wide spread of saturated colours used. By contrast the “best” colour space shows a more restrained use of the pallet with a tendency to preference the warm hues.

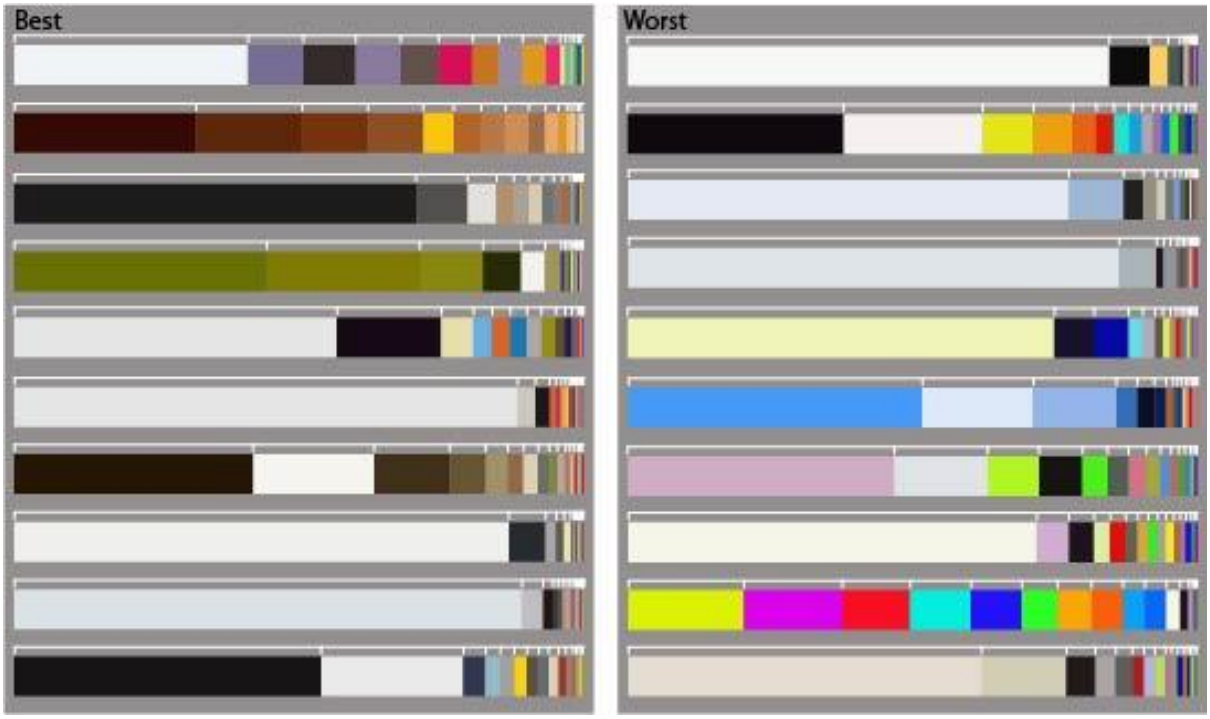

Figure 6. Web page colour use shown as a percentage of overall colour use.

The use of the more subdued pallet is also evident in Figure 6 where the hue value of the colours used in the “best” web page designs are similar. Figure 7 illustrates the differences in the colour distribution. The original spectrum distribution of all 10 “best” and “worst” web sites have been combined to illustrate the colour distribution of the groups as a whole. These have been converted to saturated values so the hue value can easily be seen and read. The brightness value is then calculated from the original spectrum distribution. Colours which have no hue value such as white, black and grey tones are removed. A comparison of brightness values clearly indicates that “best” web pages have a greater variation between dark and light tonal values while “worst” pages tend toward the lighter tonal values. The distribution of hue values is markedly different with over 50% of the “best” hue values being in the yellow to red group. The “worst” group shows a wider variation in hue value with blue and yellow being of almost equal percentage value.

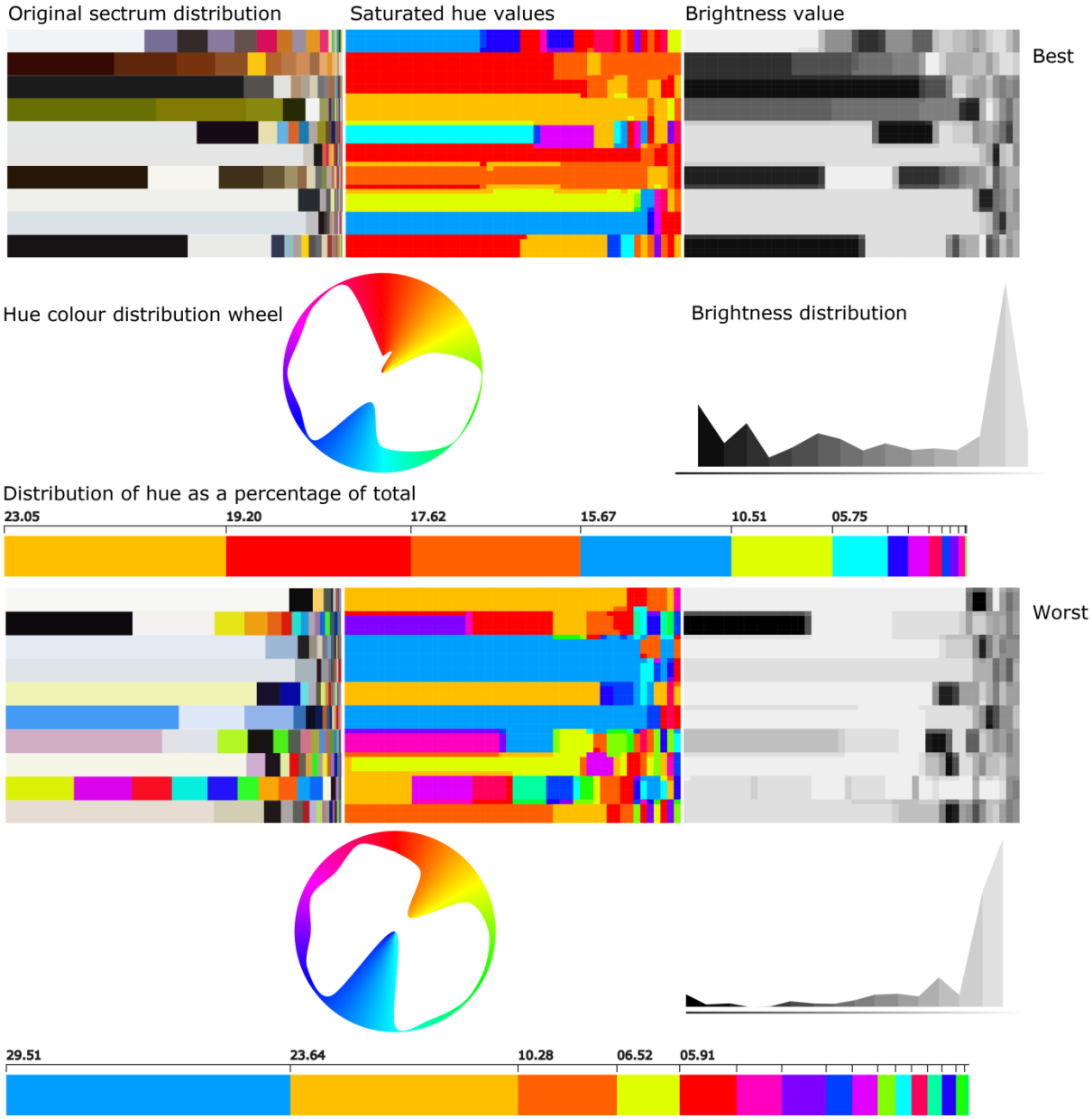

Figure 7. Comparison between hue distribution of “best” and “worst” pages.

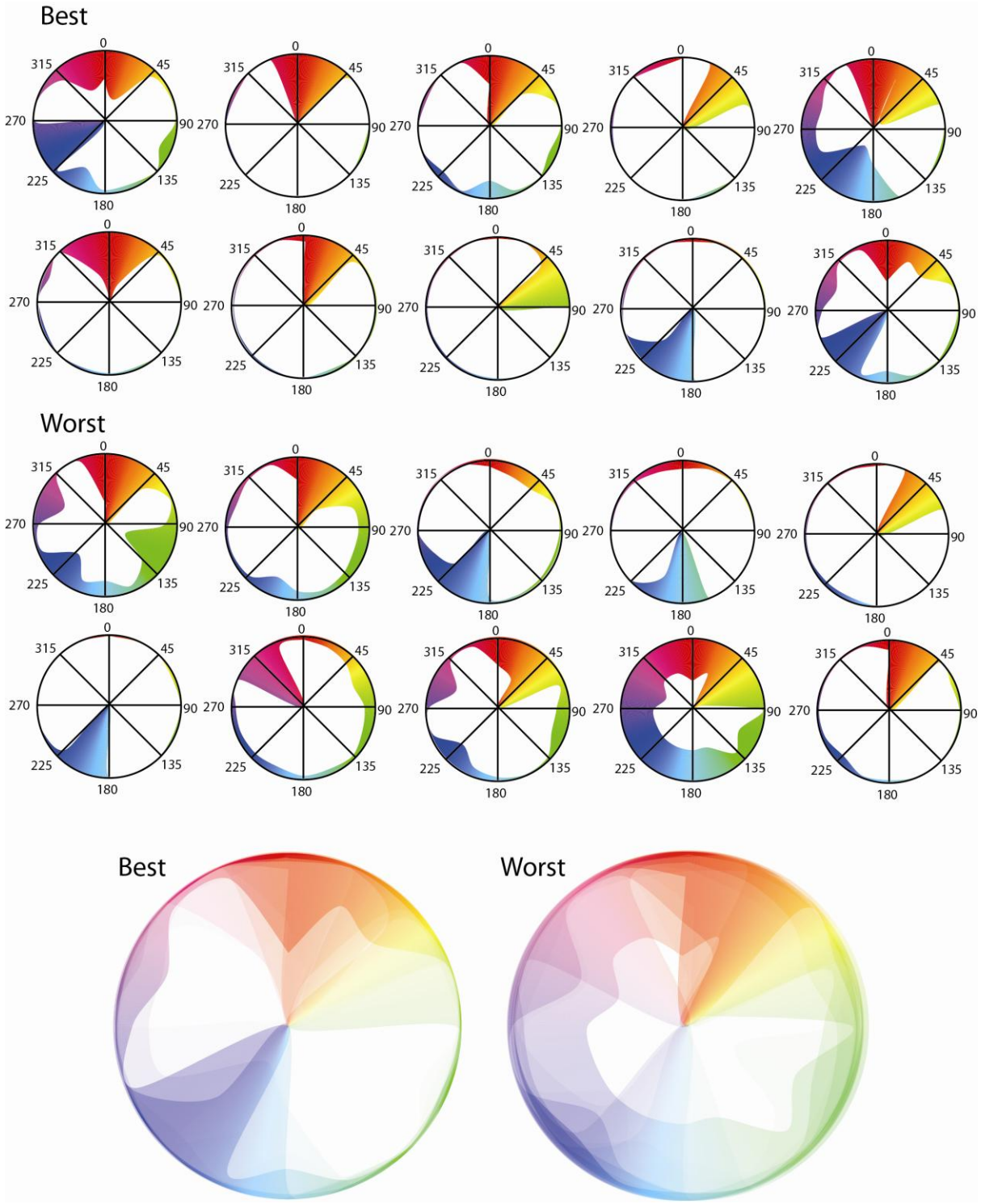

Figure 8. Comparison of hue distribution between all pages.

If we compare the hue spread between all web pages as in Figure 8 we can see marked differences in the hue spreads. The colour wheels represent the saturated hue values of the colours present in each of the web pages in the “best” and “worst” collections. Hue values range from 0 to 360. 0 is represented by red and hue values rotate through the colour spectrum to 360 which is another value of red. It is interesting to note that in both groups there is a tendency for a spike to occur in one particular hue value. The composite images at the bottom of Figure 8 illustrate the hue spectrum covered by each group. It is most noticeable that “best” hue values are confined to the red/yellow

band and the blue band which are complementary colours. The “worst” hue values are more dispersed.

Intentionally or unintentionally the designers of these pages have used different decisions in working with colour as part of their design process. The “best’ collection of web pages shows the preference for the use of two or three predominant colours. These correspond to a collection of other colours which are based on similar hue values. The “worst” pages have a preference for a wider arrangement of colours with preference for saturated or pastel colours. It is a well known practice for designers to build a colour scheme around two or three hues often taken from the colour information from photographs used in the page design.

Clearly this is quite a small study, but it does indicate that there is some evidence of difference in empirically measured colour properties between the two groups of web pages. It invites the need for a larger study which incorporates multiple site pages. This study indicates that colour ratios associated with colour usage in the designs have a close correspondence to root proportions. The examinations of the use of colour as outlined in this paper point to the past neglect in this area of aesthetics.

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