The Color of eCommerce

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ABSTRACT

The color schemes of 25 physical retail stores and 25 online stores across five genres selling merchandise for $50 or less (books, cards, clothing, software, and toys) were analyzed. This exploratory study combined qualitative visual analysis with quantitative data on hue, saturation, and brightness of the background, fill, highlight, and sign colors. Online and physical store colors were significantly different in their use of earth tones, warm and cool colors, saturation and brightness. There was little variation in the color scheme in physical book, card, and clothing stores. Toys and computer stores were more distinctive. Toy stores used multicolored signs. Computer stores were least likely to use wood and more likely to use colorful plastic shelving. Online clothing stores used the fewest colors. Their web sites were almost entirely white. After white and very muted dull green fills, blue is the color of online eCommerce, followed by yellow. There is almost no use of reds, oranges, or browns online. Unlike their physical counterparts, online card stores use the most colors, often an endless list of pastels. In the three instances where the sample included both a physical and an online store from the same company, the only similarity in color scheme at all was in the number of colors (but not the quality of those colors) used in the sign for the toy store. Online store designs do not appear imitate physical storefronts at all.

INTRODUCTION

Store buildings and eCommerce web sites are both purposefully designed visual experiences. Although analysis tends to focus on display and transaction of merchandise, the setting itself helps express the character of the vendor (branding) and contributes to the mood of the customer. The color scheme, whether generated by interior design of a store or web design of an online store, is a core component of the visual experience.

Physical stores are, of course, three dimensional real world settings. Web sites are 2-D representations on the screen. Some visions of experiential eCommerce include three dimensional virtual stores. What kind of color schemes do eCommerce sites use? Should 3D experiential eCommerce replicate natural world color schemes or web color schemes? Are bricks and mortar store color schemes different than eCommerce web color schemes? This study will compare color schemes of bricks and mortar (B&M) stores with color schemes of eCommerce web sites using quantitative and qualitative methods to look for meaningful approaches to analyzing color schemes and useful advice to designers.

METHODS

This study was both a methodological exploration of how to approach the challenge of analyzing color schemes in physical locations and web sites as well as a first attempt to compare them. We were not certain whether any useful conclusions could be drawn. Therefore we did not go to great effort to generate a statistically representative sample of the population of stores in our five genres. Instead, we sought a fairly large, broad sample to begin exploration.

Convenience Samples

This project was inspired by the M.A. Thesis Project, "Digital First Impressions: An Analysis of eRetailing Home pages" by Jiatyan Chen (2000). Chen examined five business genres – books, electronic greeting cards, toys, clothing and accessories, and computing merchandise-- eCommerce sites that carry products or services with prices ranging from free to under $50. We decided to shoot photographs of physical retail stores paralleling the collection of eRetailing home pages, five from each category, with a 50 store total convenience sample consisting of 5 virtual and 5 physical storefronts for five business genres.

To create her eRetail home page collection, Chen first took screenshots of myriad sites she visited within a few months, and selected the 5 genres to explore further. Using Yahoo, Netscape Center and several other web portals to locate a list of potential sites, she visited and took new screenshots of these sites, writing down her observations as: (a) a designer regarding their layout, and (b) a user interacting with the site. She picked out at least 5 sites for each genre, ranging from representative designs for that genre to sites with different and interesting elements. Other than looking at the homepage of each site, she explored the site for its structure and navigation patterns, attempting to get a feel of the shopping experience it provides. She revisited these sites during November through January, taking note of their Christmas presentations. We ended up with a sample of 5 online stores in each of five genres.

Capturing a screen shot of a web site is easy. There are no lighting issues, no decisions about what angle to shoot from. The web site colors look different to the eye depending on whether it is viewed on Mac or PC, what the gamma and brightness settings of the monitor are and the lighting conditions in the room the moment it is viewed. But, measuring the color on either platform will at least yield a common numerical representation.

We discovered retail stores in all five business genres object to in-store photographs. After being kicked out of the five of the first six stores we tried to shoot in, we realized our photos would have to be taken from outside of the store looking in. We shot without permission in every location except one. Unfortunately, that one granted permission and then asked us not to mention them by name or to include recognizable photos in our project. We concluded it would be better not to ask in the future. Because we shot from outside without permission, there was no possibility of adding light – we had to work with what was available in terms of both angle and lighting. We shot photos from the outside looking in at locations in San Francisco and Lansing. Most but not all are national chains. Clothing stores were abundant, with far more than five options easily available. We shot 10 clothing stores, but to reduce to the target of five, ended up going with the first five naturally encountered in the search for clothing stores. For the other categories, we ended up including every store we were locally familiar with to reach the total of five stores per category.

We did not attempt to select physical stores and web stores with matching parent companies. Some of our web stores are no longer in business. Some of our web stores never had physical counterparts. In three coincidental cases, (one card, one bookstore, and one toy store) we have one physical and one virtual store in our sample.

Collecting the photos and screen shots was the easy part. Next we were faced with how to turn these images into meaningful color data. The contrast between identifying colors in a web site and identifying photos in a clandestine store photograph is extreme. Many of the photos had less than optimal exposures, due to how quickly and covertly they were shot. We used Photoshop software to adjust Levels and Curves, separately for the exterior sign and interior, to most closely approximate what we recalled the store looking like. This process is admittedly imprecise. However, it is a normal process we have engaged in thousands of times as artists adjusting photographs for projects. The physical store photographs can be described as “artist-corrected colors.” The store and web site examples below were both shrunk to fit in this document – for the analysis B&M store photos were shot with digital cameras at 2048x1536 pixels and the web sites were captured at 100% actual size.

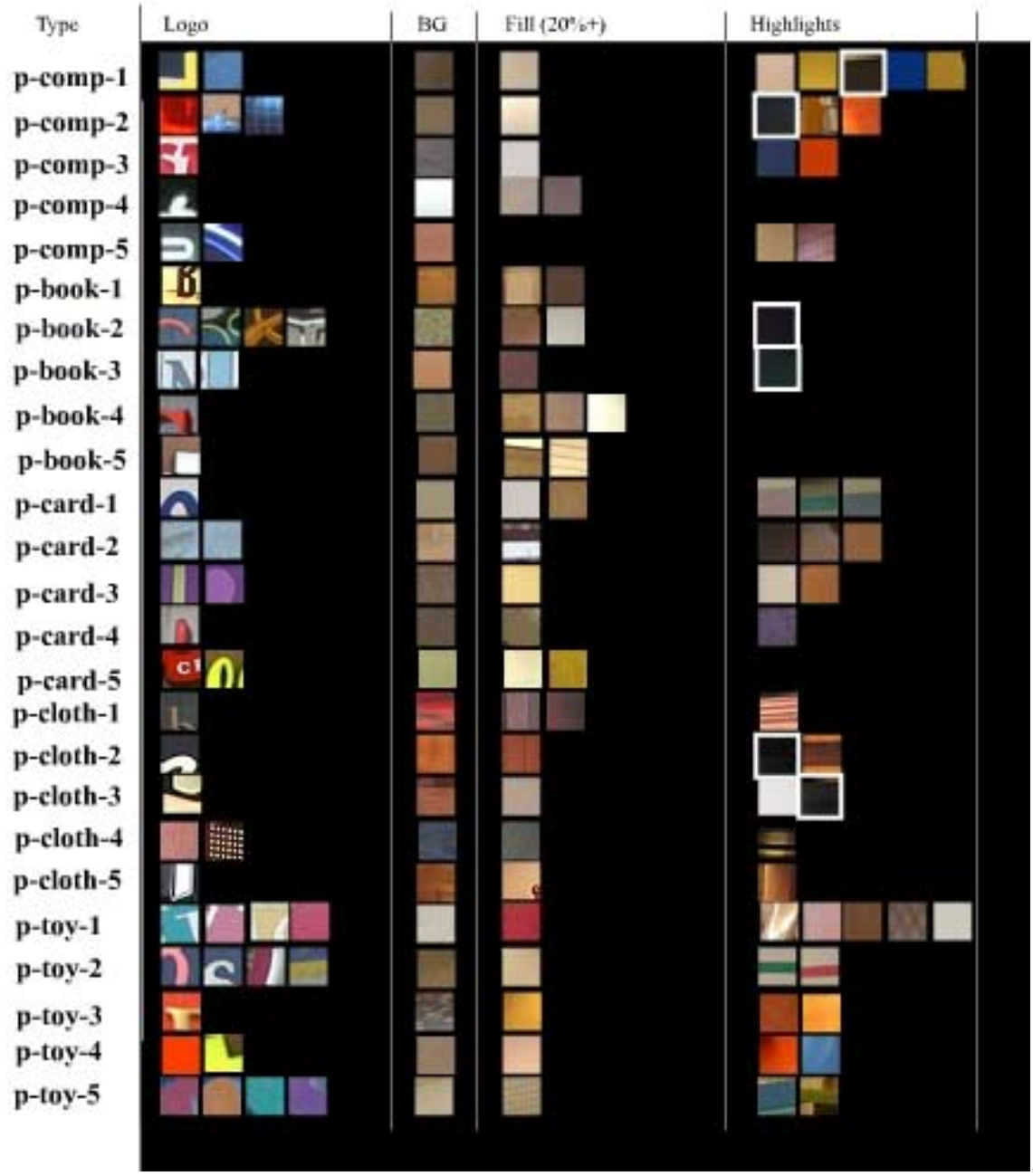
Data Reduction: Isolating Color Schemes

Devising a common method of isolating a color scheme for physical and online stores was a definite challenge. We made the decision to exclude colors of actual products and concentrate on the more permanent background structure. In physical stores we excluded the merchandise itself and also posters because they were deemed temporary and different in nature from built-in background décor. On web sites we excluded merchandise and the color of text and instead focused on blocks of color.

At first we attempted to isolate pure colors from the photographs, like the example below. The round patches of color represented the palette for the store interior. However, there was an enormous tension and likely poor agreement between coders or even by the same coders trying to balance what the color looked like to the eye versus what the color an electronic "eyedropper" grabbed. The eyedropper seemed to grab mud even when you clicked on what looked bright yellow. Yet the pure colors we chose also seemed unnatural, and were in strong disagreement with the actual grabbed colors.

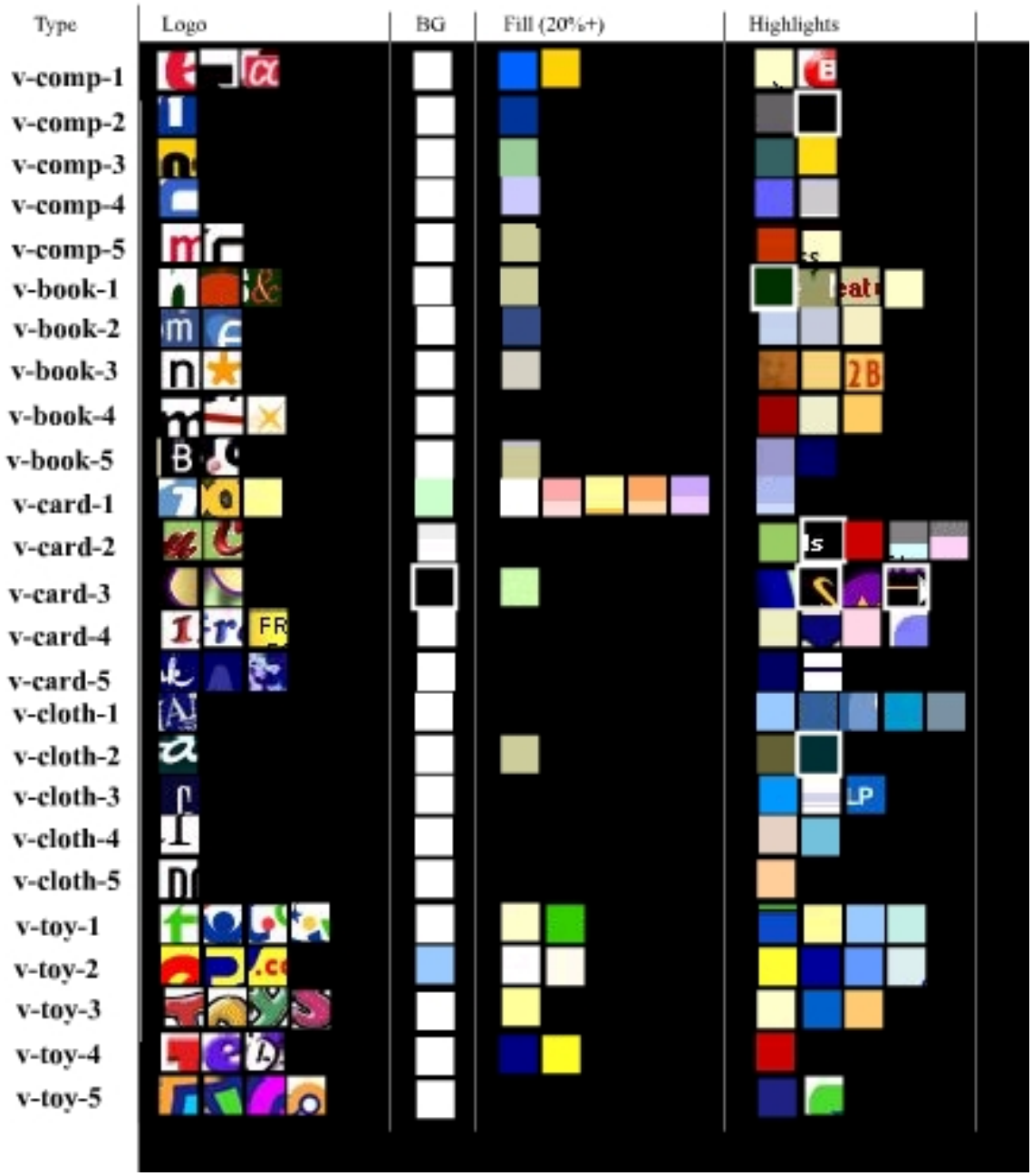
We switched to an alternate methodology. We configured a screen capture package to grab a 16 by 16 square pixel region. With that tool activated, we moved the region onto the photograph and positioned it to grab 16x16 squares of representations of the color scheme. Using this capture technique, we attempted to describe the colors in the retail store exterior SIGN and the web site LOGO. We attempted to identify the dominant BACKGROUND color, other FILL colors comprising approximately 20% or more of available color space (excluding the area covered by merchandise), and HIGHLIGHT colors used to provide accents but comprising less (usually far less) than 20% of available color space.

Here is our visual data set for the 25 physical store location color schemes.



Color is perceived subjectively. On a web site, the color value of individual colors can be measured objectively, but even this does not describe the subjective perception of that same color on the web site. The perceived color depends upon lighting and on what colors are nearby. These color swatches were as close as we could thing of to come to objective reporting of color data. The swatches are affected by lighting and nearby colors in the room, but to a lesser extent than the eye would perceive. All swatches are the same size, even though some represent large areas of color and others represent parts of shelves peaking through merchandise. These are actual area grabs from the artist corrected photographs and from the web sites. In our analysis, we present the color data sets over black, and later, over gray. (Notice how different these identical colors look over the different backgrounds!) When the color swatches are shown over black, we have added a white outline surrounding near-black swatches, for clarification.

Here is the visual data set for the 25 online stores:

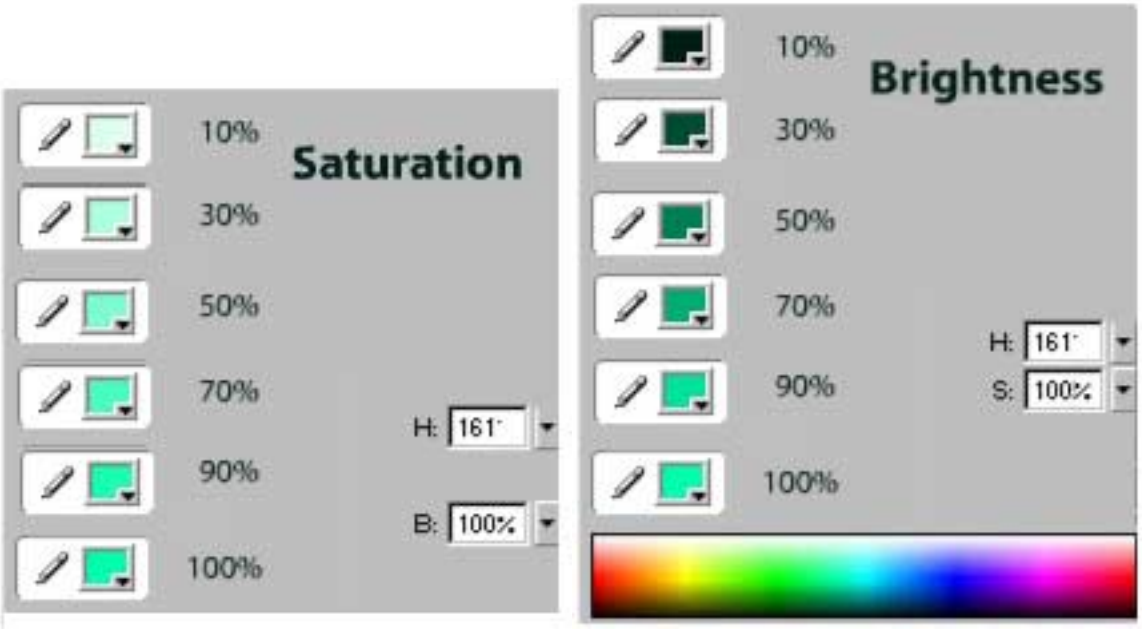


Numerical Data Methods

Once the color scheme data had been reduced to this collection of swatches, we used the eyedropper tool in Macromedia Flash software to derive Hue, Saturation, and Brightness data for each color. The eyedropper averages across a 3 pixel area. If the grabbed color did not look like the swatch, we tried grabbing again. It was only about 1 in 20 grabs in the physical swatches where the grab seemed unrepresentative and was redone. A single coder (one of the authors) grabbed all swatches and grabbed all color data. No attempt was made to assess coder reliability. We still did not know whether the process would yield anything worthwhile.

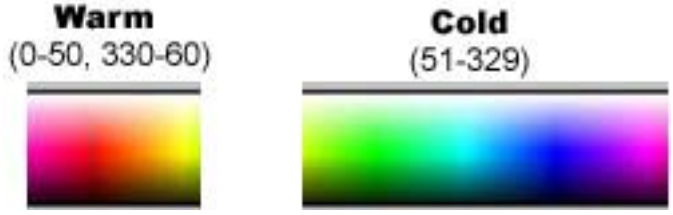
Hue, Saturation, and Brightness values interrelate. Hue is also called Chroma in some color value discussions – Hue ranges from 0 to 360, describing a color's position in around a color wheel. The tables below show the practical meaning of saturation and brightness. The Saturation table shows a green hue of value 161, with brightness held constant at 100%. Ten percent saturation is almost white still. Thirty percent saturation is a very light green. Notice that differences between 70% and 100% saturation are hard to perceive in this case. Numeric differences do not match perceived differences.

Turning to the brightness example with the same green holding saturation constant at 100%, 10% brightness is almost indistinguishable from black. Thirty percent to 50% are natural looking greens. Higher levels of brightness show colors rarely seen in the natural world.

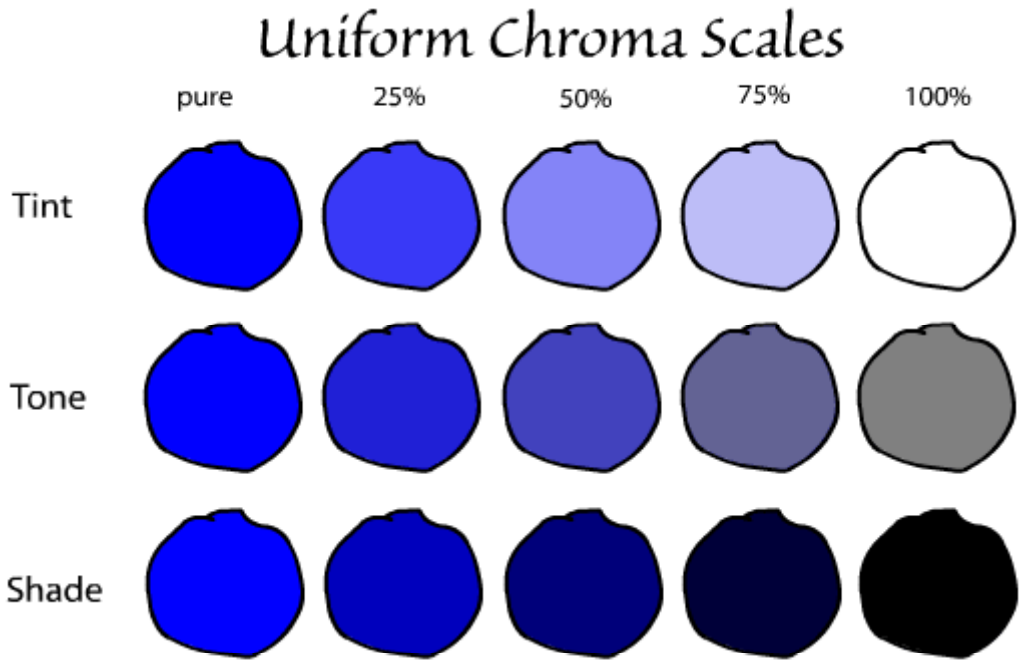


Up to 5 sign colors were coded, 1 background color, up to 4 fill colors, and up to 5 highlight colors. Only two stores exceeded the planned number of colors. These "extra" colors were ignored. Using a spreadsheet, we counted number of SIGN, FILL, and HIGHLIGHT colors used in each physical and online store.

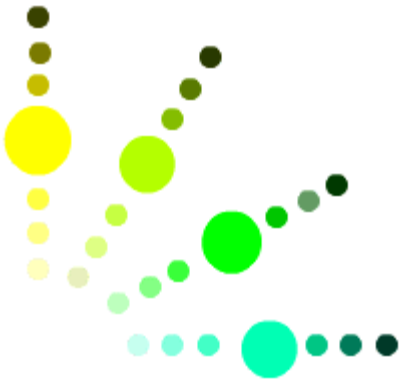
We coded the background and fill colors as being either warm or cold, based on hue. Hue values between 0 and 50 as well as 330 to 360 define the red, red-orange, and yellow portion of the spectrum. These colors are considered vibrant, high energy, warm. Colors between about 51 and 329 are the greens, blues, and purples. These are cool colors, relaxing, distant, less intense. We computed the "percent of warm" main colors in the color scheme. (White and black were considered "not warm".)



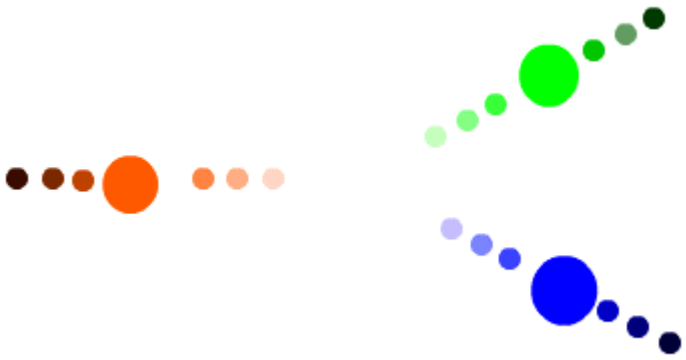
We also analyzed the kind of color scheme used by the store. One common color scheme is the uniform chroma scale (varying the amount of black, gray or white added to the same hue, as in the example below) (Faber, 1987). This is an easy way for artists to ensure the colors they use will be harmonious, with a sense of sophistication and restraint.



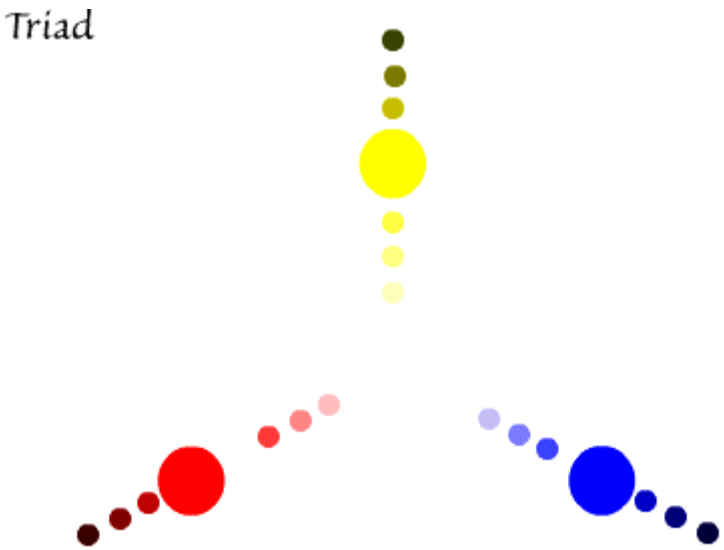
A second common color scheme combines analogous colors found next to each other on the color wheel.



Split Complimentary color schemes are a more complex combination, avoiding directly complimentary (opposite) colors but setting up a strong contrast by hue.



Triads are another color scheme technique. (Any of these examples can be rotated around the color wheel, as long as the distance between the colors are maintained.)



RESULTS

Numerical Overall Comparisons

Table 1 shows mean differences between bricks and mortar stores and web stores along the summary data. The number of colors in the outdoor sign or logo was not different, both averaging approximately 3 different colors. There were differences in the number of fill and number of highlight colors: physical stores had more fill colors and web stores had more highlight colors. Overall, combining fill, highlight, and background colors, there were not significant differences between web and physical stores. It may be that the differences in number of fill and highlight colors are a function of the medium or of the coding system.

Table 1

	Bricks & Mortar	**Web**	**Significance**
# Sign Colors	2.96	3.00	.897
# Fill Colors	1.40	0.92	.036
# Highlight Colors	2.92	1.76	.004
Total Colors (F+H+B)	4.16	4.84	.139
Avg SQRT Brightness (F+H+B)	20.5	38.7	.000
Avg Saturation (B+F)	24.2	7.5	.000
Percent Warm (B+F)	85%	20%	.000

The colors used in physical and online stores are extremely different. Combining background and fill colors, an average of 85% of physical store dominant colors were warm colors. Online stores used an average of only 20% warm colors.

The high extreme of brightness is almost white, and the low extreme of brightness is almost black. We wanted to look at moderation in saturation, rather than those extremes. Brightness ranges from 0 to100, with a midpoint of 50. We took the brightness, subtracted 50, and converted to absolute balue of the distance from mid level brightness. Lower numbers are closer to the middle. Thus, the physical stores had much more mid tone colors, moderate brightness (an average of 20.5), while the online stores were much more extreme in their dark and light tones (averaging nearly 39 compared to the theoretical high of 49).

Average saturation of the background and fill colors was also significantly different. Physical stores are dominated visually by higher average saturated colors than online stores. So, the character of the colors in physical stores are significantly warmer, more richly saturated, and more mid tone in brightness.

That is the overall B&M to online numerical analysis. Let's go back and look at the color swatches themselves.

The Backgrounds

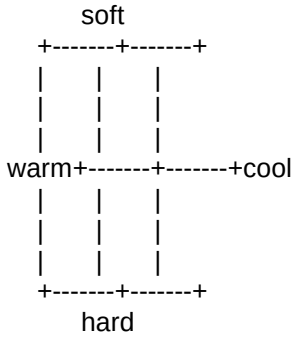
The background color most dominant in physical stores turned out in most cases to be the floor. Walls were mostly obscured by shelves and other forms of merchandise display. Although someone describing the color of most physical store walls would say they were a shade somewhat near white, the color swatches do not reveal white. Other than very rare pockets of bright light illuminating the wall, the darkness and reflection of nearby colors makes the walls show various shades of earth tones. Floor (usually a rug, sometimes wood, rarely cement), wooden shelves, and whitish warm walls dominate the physical stores.

Only one of the 25 physical stores used pure white in their color scheme (Apple Computer!). Only three online stores DID NOT use pure white as their primary background color (two card stores and one toy store). The online toy store which used light blue instead of pure white for their background used white and the online off-white

color in all of the online store colors as their dominant fills, so they did not venture very far from the pure white trend. One of the card online stores used white as their second most dominant color. So, only one online store, a card store, strongly departed from the dominant pure white theme and used a pure black background.

Most of brick-and-mortar (B&M) shops utilize a variety of shades and gradients in the background to support and highlight forth their merchandise. The web sites, on the other hand, use flatter and plainer colors. Arguably, the gradients are natural side effects of lighting and viewing angle in the real world. The selection of shades also depends on the availability of furniture, especially for smaller stores, where they might be re-purposing the fixtures from the previous occupant. Nevertheless, B&M stores do have broader access to wider varieties of furniture and fixtures and can manipulate them under different lightings and area (3D space), compared to a 2D limited and flat screen encountered by online stores.

Shigenobu Kobayashi (1990) classified colors on 3 axes: warm vs. cool, soft vs. hard and clear versus grayish. Two of these, warm vs. cool and soft vs. hard, form the opposing sides of a square, the Color Image Scale.



A very rough description of the color scale starts with the baby colors on the soft end to the dark colors on the hard side; and red on the warm side to blue on the cool. He then associated keywords with the colors. According to Kobayashi, warm-soft sectors tend to generate an intimate feeling, compared to the dynamic character of warm-hard. Cool-soft conveys a clear feeling, whereas cool-hard brings forth reliability and formality.

Using the Color Image Scale, most online stores fall into the "clear" colors soft-cool sector (white, pale blue, pale green) with the hard dark text for optimum contrast. A couple of the sites (all card sites) used either soft (pink) or the neutral (purple) colors.

It is curious to note that brown/tan/gray predominate the B&M stores, most probably due to the natural wood or concrete colors in the furniture and off-white walls. B&M stores use these colors rather than replacing them with less natural, brighter hues. Brown is a fairly calm color, falling just a little off the center into the hard sectors. It is a color associated with Kobayaski's "elegant" and "classic" sectors. Many stores seek this kind of image.

Clothing stores tend to provide more variance in the gradients. The clothing stores often used wood all over, in different shades. Wood floors, wood walls, several different shades of wooden shelves. Generally, their colors more away from the "natural" brown tones of

books and cards towards the "gorgeous" or "dynamic" warm-hard sector, providing a little more emphasis and strength.

The Highlights

The highlight colors fall towards the hard end of the Color Image Scale. This makes sense since they are the colors that call for greater effect on the shopper than the rest of the image. The contrast between online and B&M stores is not that big. If we look at the categories, however, interesting patterns showed up with toys and clothing. The online toy stores emphases primary colors, often times all of them (but usually not red). The B&M toy stores usually picks one of the primary color and make that the center piece, building the rest of the color around it.

B&M clothing stores chose brown and black, in the hard-neutral to hard-cool section. These colors elicit the feelings of classiness and sophistication. On the other hand, online clothing stores prefer lighter blues and neutral tones, putting them in the neutral-soft and soft-cool sections, signifying elegance and neatness.

Comparing Business Genres

Tables 2 through 6 (at the end of this document) show B&M with Online Store comparisons within each genre. They are accompanied by visual presentation of those color swatches. Here are some observations.

The differences between online and B&M stores are consistent in every business genre. Online stores use colder, less saturated colors and fewer midtones. The number of colors online and in B&M is highly similar, although they seem to differ in how much color is used (online stores have fewer fill colors but more highlights, resulting in the same overall number of colors).

*Toy stores have colorful signs, both online and B&M.

*Clothing stores have two color, color-conservative signs. In fact, online clothing stores seem to go to extremes to use as little color as possible in their sites, almost trying to out-white the competition. Online clothing stores are almost painfully white, using as few colors as possible.

*B&M card stores, clothing stores, and book stores use almost the same color schemes.

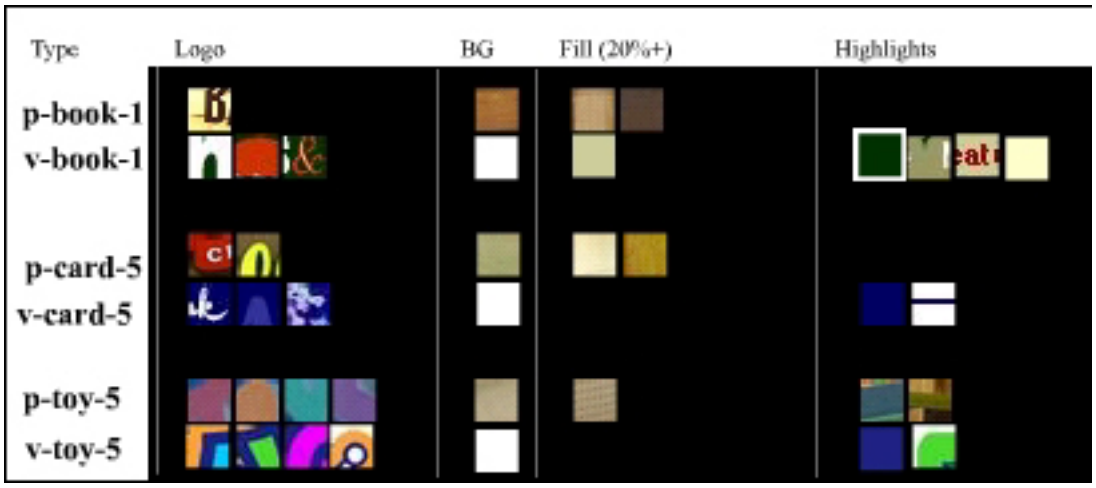
*Online card stores break the mold of physical card stores – they have colorful signs and use lots of fills, often pastels.

* B&M toy stores and online toy stores have multicolored signs. B&M toy stores use particularly strong warm colors, with frequent reds and oranges. Online toy stores are extremely blue and yellow, with only a single store out of the five using a red highlight, and one other store a light orange highlight to break the blue-yellow norm.

*B&M computer stores are different than the other business genres. They use brighter highlights and include more blues in their highlights than other B&M stores. The online

computer stores revert to the usual online blues and yellows over harsh pure white. Two online computer stores use a smattering of red for highlight, but the dominant feel is cold.

Comparing Online to B&M Stores

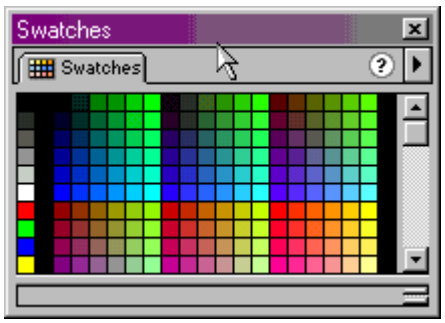


We mentioned that three of our sample stores happened to exist in both online and B&M form. Out of curiosity we created this table comparing them. There appears to be almost no correlation between the colors in the B&M store and the colors online, with the exception of the Toys R Us sign, which has similar colors though very different in tone. The signs for the card and book stores are completely different from each other, as are the interiors. The online site is failing to take advantage of its physical counterpart to invoke familiarity and to inherit branding benefits.

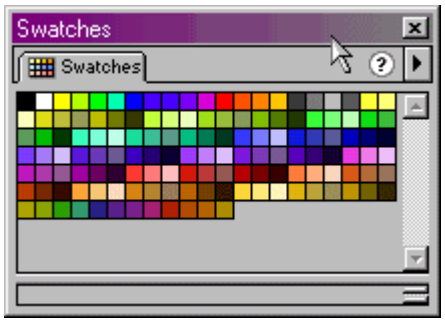
DISCUSSION

In looking closely at the color schemes for B&M and online stores, both were disappointing. B&M stores were disappointing in their rigid adherence to the same model of soft wood and earth tones. It's effective and elegant, but it's the same no matter whether a store sells cards or clothes.

The online color schemes were far more disappointing. Online stores have two large constraints. The first is the "web safe" color palette is very limited, if online store designers actually know about web safe colors and limit their designs to that select set of 219 colors.



Even so, few online sites use the reds, oranges and browns available within those web safe colors. Furthermore, they probably are not obligated to stick with that palette and may not have even considered it when developing their color scheme. Here is an alternate palette Heeter designed for more natural online color schemes:



The colors are, black-white. Then, the high intensity colors in order around the wheel starting with yellow and ending with orange-yellow. Next there are four shades of gray. Then, repeating is a set of three swatches corresponding to each high intensity color the following pattern: 25% tint, 50% tint, 75% tint. 25% tone, 50% tone, 75% tone. 25% shade, 50% shade, 75% shade. Finally, the last group of 12 colors are an earth tone instead of a high intensity palette, where she mixed them all with yellow ochre for a more toned down and natural color selection.

A second online constraint is that small text is hard to read over most textures, including rich wood textures. Web stores seem to need to show lots of text along with every product. B&M stores pile merchandise on top of other merchandise, and require consumers to pour through looking for items of interest. Web sites give large space to individual items and show the text and price tag whether the customer asked to know more or not. Even if lots of small text is needed, there are ways of working warmer more natural colors and more adventuresome color schemes into web designs. At a minimum designers should experiment with shades of white that are not pure cold white but include hints of other colors, like natural wall paint. The color schemes used were mostly uniform chromatic scales, or analogous color schemes of nearby colors. Color palettes were high brightness, low saturation colors. The differences between online and B&M stores were consistent across business genres.

As online stores move into 3D realms, they would be advised to incorporate rich, warm, natural colors. It seems online sites give too much space to individual pieces of merchandise in isolation, and provide too much text before the user asks to know more. We would advise creating a richer visual experience, more filled with product. Avoid pure white walls. Fill the stores so that only a small amount of wall shows.

REFERENCES

Birren, Faber (1987). Creative Color: A dynamic approach for artists and designers. Shiffer Publishing L.T.D, Atglen, PA.

Kobayashi, Shigenobu (1990). "Color Image Scale", Kodansha.

Appendices

Bookstores

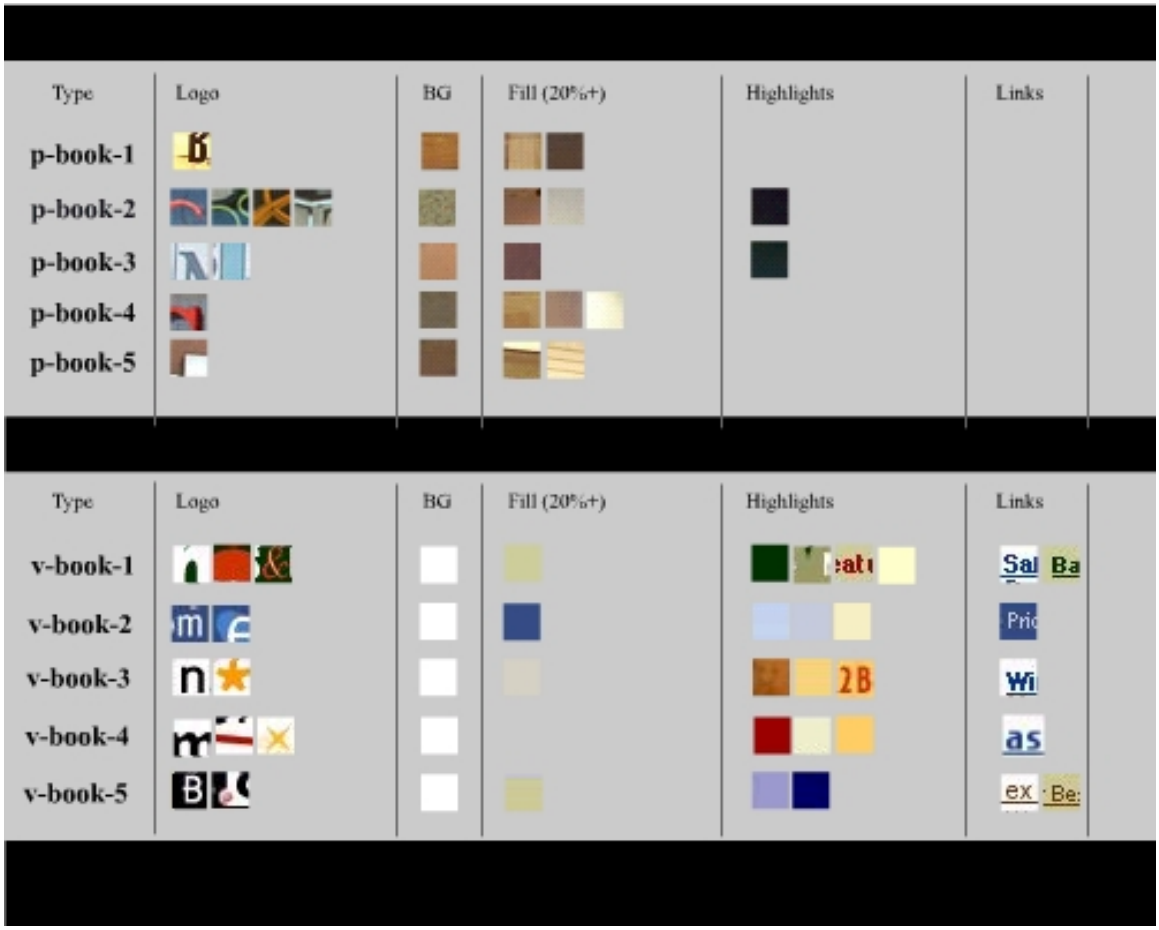


Table 2: B&M and Online Book Stores

	pBook	vBook	
Sign Colors	2.96	3.00	0.897
Fill Colors	1.40	0.92	0.036
Hilights	1.76	2.92	0.004
Total Colors	7.12	7.84	0.236
% warm	85.00	20.00	0.000
SQRT Brightness	20.00	38.00	0.000
Avg Saturation	24.00	8.00	0.000

Card Stores

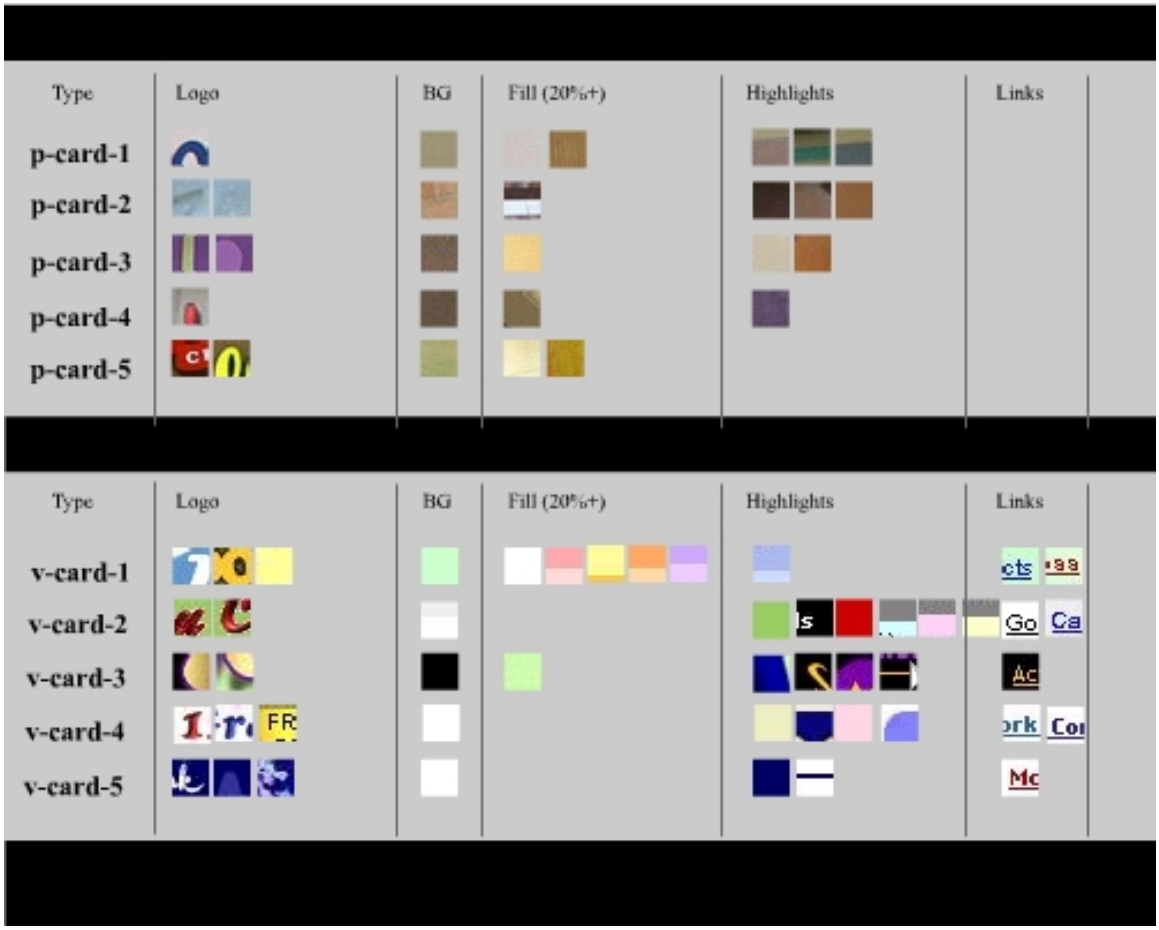


Table 3: B&M and Online Card Stores

	pCard	vCard	
Sign Colors	3	3.05	0.888
Fill Colors	1.25	0.9	0.185
Hilights	2.1	2.85	0.094
Total Colors	7.35	7.8	0.532
% warm	83	14	0.000
SQRT Brightness	21	39	0.000
Avg Saturation	22	8	0.001

Women's Clothing Stores

Table 4: B&M and Online Women's Clothing Stores

	pClothing	vClothing	
Sign Colors	3.13	2.87	0.543
Fill Colors	1.13	0.87	0.263
Hilights	2.13	2.53	0.417
Total Colors	7.4	7.27	0.869
% warm	80	17	0.000
SQRT Brightness	21	40	0.000
Avg Saturation	21	9	0.013

Computer Software Stores

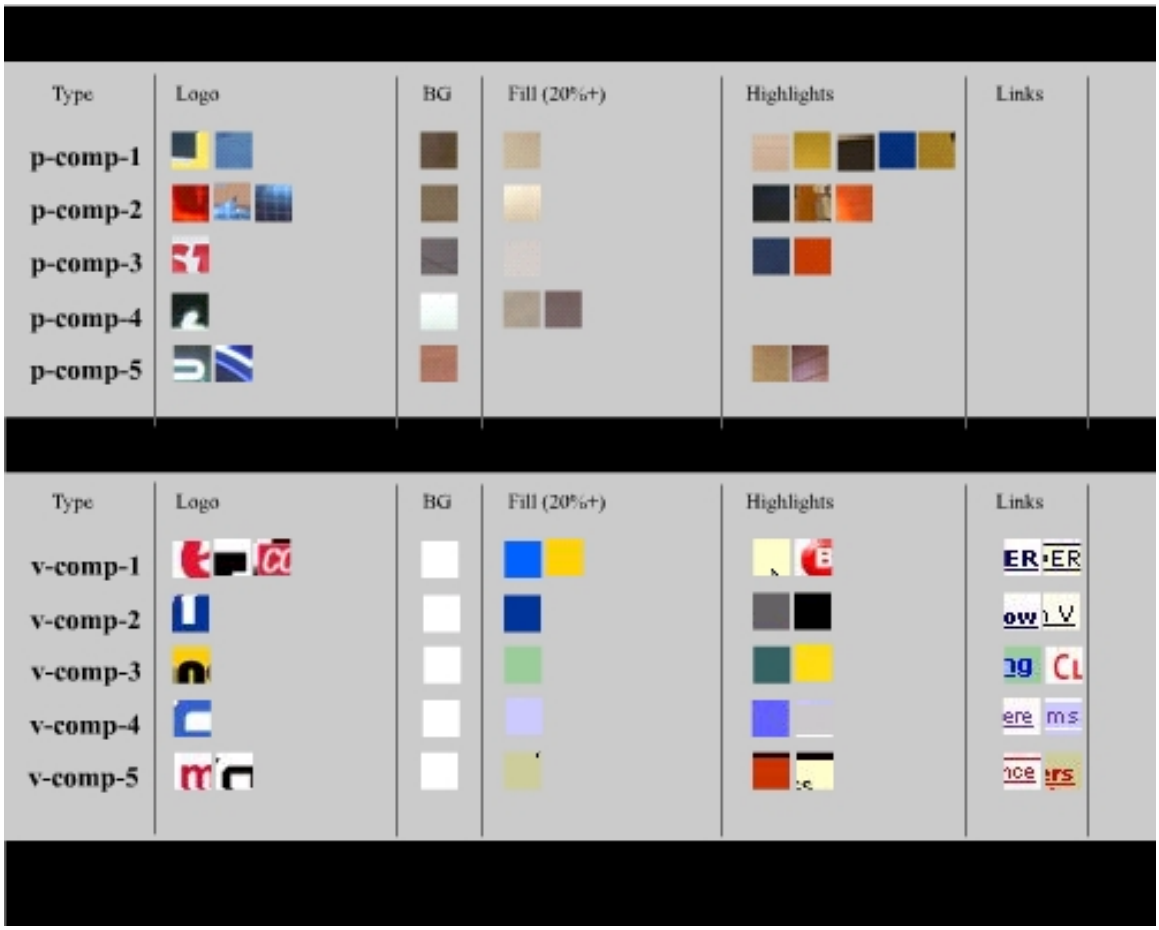


Table 5: B&M and Online Computer Software Stores

	pCompute	vCompute	
Sign Colors	3.6	3	0.300
Fill Colors	1.1	0.7	0.222
Hilights	2.5	2.7	0.764
Total Colors	8.2	7.4	0.458
% warm	35	24	0.000
SQRT Brightness	21	40	0.000
Avg Saturation	16	6	0.034

Toy Stores

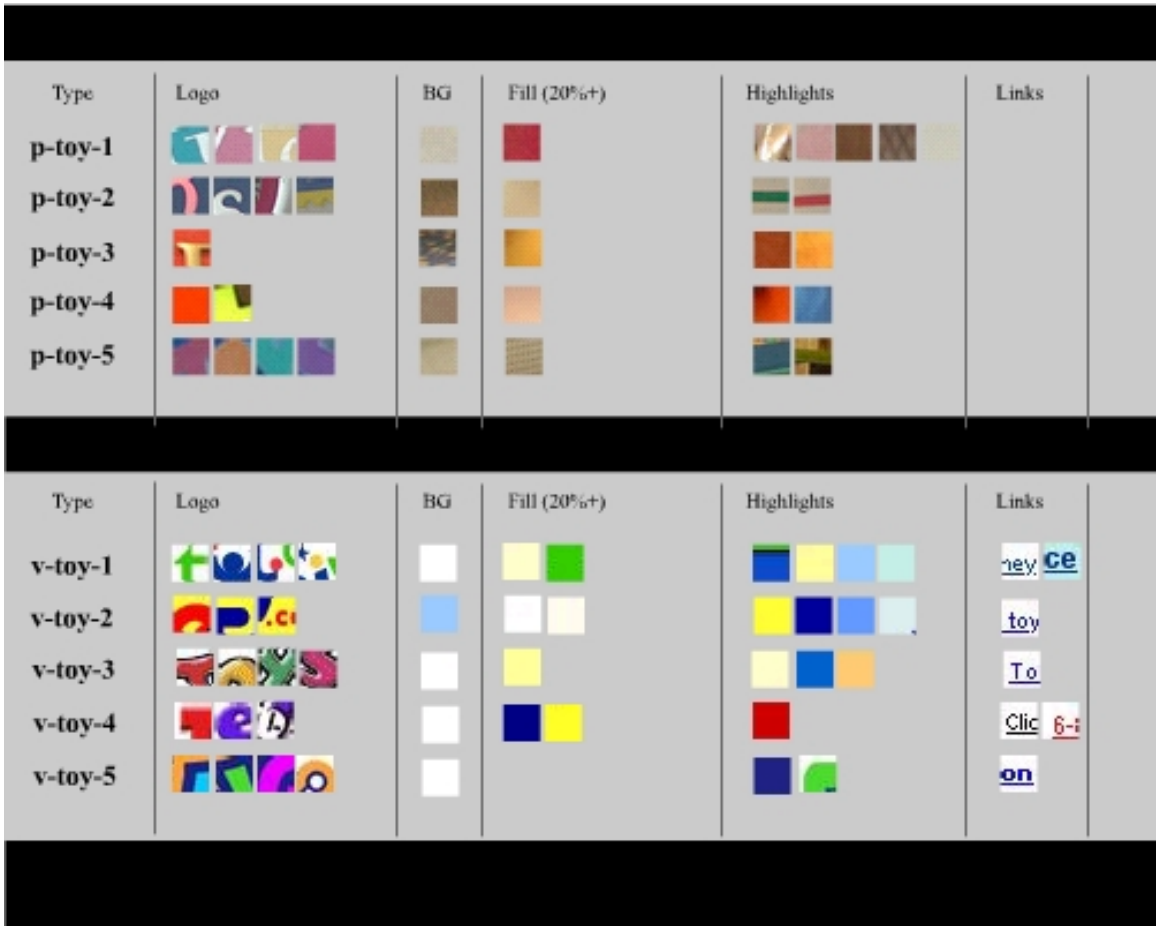


Table 6: B&M and Online Toy Stores

	pToys	vToys	
Sign Colors	4	4	1.000
Fill Colors	1.2	1	0.694
Hilights	2.6	3	0.608
Total Colors	8.8	9	0.892
% warm	80	23	0.007
SQRT Brightness	21	39	0.003
Avg Saturation	18	6	0.020

Table 7: Genre Comparisons within B&M and within Online Stores

	B&M books	cards	clothing	computers	toys
Sign Colors	2.96	3	3.13	3.6	4
Fill Colors	1.40	1.25	1.13	1.1	1.2
Hilights	1.76	2.1	2.13	2.5	2.6
Total Colors	7.12	7.35	7.4	8.2	8.8
% warm	85.00	83	80	35	80
SQRT Brightness	20.00	21	21	21	21
Avg Saturation	24.00	22	21	16	18

	online books	cards	clothing	computers	toys
Sign Colors	3.00	3.05	2.87	3	4
Fill Colors	0.92	0.9	0.87	0.7	1
Hilights	2.92	2.85	2.53	2.7	3
Total Colors	7.84	7.8	7.27	7.4	9
% warm	20.00	14	17	24	23
SQRT Brightness	38.00	39	40	40	39
Avg Saturation	8.00	8	9	6	6