Color–Emotion Associations in the Pharmaceutical Industry: Understanding Universal and Local Themes

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Abstract: The strong shift toward operating in global markets has posed enormous adaptation challenges for product marketing especially with regard to universality and consistency of brand design decisions. The color-in-product design decision is also susceptible to this global–local tension. A pharmaceutical film coating formulator supplier to leading local and global pharmaceutical companies was interested in developing a solid validated global color preference database to enable informed brand decision making for its customers. The following study reports results from a global survey that examined the color–brand attribute associations within the global pharmaceutical industry. Data were collected from a multigeography gender and age balanced sample of 2021 subjects, revealing a strikingly powerful color language comprised of universally consistent associations and local contextual patterns that are each critical to global brand decision makers within this industry.

BACKGROUND

General

In the past two decades, there has been a strong shift toward operating in global markets. This shift has posed new challenges for product marketing such as verifying or adjusting the universal quality of design decisions through new brand images, verbal expressions, and design levers.1 Over the years, many have learned the hard way that some concepts, ideas, and expressions do not translate well from one culture to another. As a result, it is now common to conduct substantial multicultural testing before the launch of globally positioned products. Within this context, Colorcon, a pharmaceutical film coating formulator supplier to leading local and global pharmaceutical companies, was interested in developing a solid global color preference database to enable informed brand decision making for its customers. (Note that this company has pharmaceutical companies as direct customers but needs to consider it’s customers’ customers including the pharmacists, physicians, and end users.)

Using emerging technologies in color film coating, this company transforms plain white tablets into unique branded ones to allow for innovative ways of distinguishing new drugs. The colored tablet is used to differentiate the brand and generate emotional engagement supportive of the drug personality. This in turn contributes to establishing brand identity and affinity. Given the company’s presence in North America, Europe, the Middle East, Africa, Latin America, and Asia, the company asked “what colors do people in our geographical jurisdictions prefer.” It was assumed that understanding the influences that color preferences might be subjected to would critically aid their ability to address their global customers’ needs and requirements.

On Coloring Tablets and Competitive Challenges of the Pharmaceutical Industry

Pharmaceutical companies are constantly searching for new and better ways to differentiate their products. Despite the industry’s strong growth in recent years, competition in the industry has long been very intense. International Medi-
cal Statistics (IMS) health reports\(^2\) that in 2009 this global industry reached the $750 billion mark in revenues and that between 2002 and 2006 it has added more than $200 billion of absolute growth.\(^3\) Although growth rates have slowed in past years (specifically, the IMS projects global compound annual growth rate for the pharmaceutical market at 3–6% through 2013, compared with 6.6–7.9% during years 2004–2007), this continues to be a vibrant marketplace. This anticipated growth trend will be driven by many factors, among which is the emergence of new markets, including China, Eastern Europe, and Latin America, the global aging population, the innovative new medicines, the demand for a higher quality of life, and the new drug development methodologies that fast-track drug introduction.

Although these trends are projected to continue to grow and intensify, the industry faces a host of challenges that make competition increasingly difficult. Growth of the branded firms is moderating, as generics become a stronger market force enjoying patent expirations and governments’ cost-control efforts. Specialty and biotech products are emerging in new therapy areas, and although regulatory agencies partner with pharmaceuticals to develop and approve newly introduced drug development methodologies,\(^4\) they also intensify constraints to ensure the safety and tolerability of new medicines. Although drug development becomes lengthier, more complicated, and costly, the race for the next blockbuster drug grows more fierce and challenging.\(^5\) Concomitantly, as competitive conditions grow, so do efforts to differentiate drug offerings.

Consequently, the marketing end of the pharmaceutical value chain is becoming more powerful and knowledgeable in its differentiating practices.\(^6\) Developing a proven efficacious drug is no longer sufficient. Instead, firms spend as much on marketing as they do on research and development (R&D),\(^8\) reappropriating an unusually large percentage of their revenues to promote their products. Although in the 1970s, promotion-to-sales ratios for drugs typically ranged from 10 to 20% of sales,\(^9\) throughout the 1990s, the top 10 drug companies in the world consistently spent about 35% of sales on marketing and administration and only 11–14% on R&D.\(^10\) Examining the top 10 US companies in 2002, expenditures for marketing and administration were 31% of sales, compared with only 14% for R&D or an astounding $67 billion of their $217 billion in sales that year.\(^11\) Along the same line, in 2008, Gagnon and Lexchin found that the pharmaceutical industry in the United States spent 24.4% of the sales dollar on promotion, versus 13.4% for R&D, as a percentage of US domestic sales of US $235.4 billion.\(^12\) These hefty marketing budgets are structured around relationship management with both consumers and the medical community. (Note that while branding in general can happen at the level of the company, the therapeutic area, and the drug itself, our discussion centers on the latter, i.e., branding of the drug.) In fact, some 70–80% of the industry’s marketing expenditures are channeled toward relationship building and maintaining.\(^13\)

Within this context, branding campaigns are developed to communicate drug personality profiles to support product differentiation. Such campaigns identify valuable attributes and devise a strategy to promote the drug’s personality in a memorable manner. Brand builders often attempt to engage consumers’ senses to generate a full impact.\(^14\) Of the five senses, sight is engaged when creating a desired “brand look” to best communicate the drug’s personality profile while generating maximum sensual effect. Color is often selected as the design element of the drug that engages the sense.

Although a color strategy can target the company brand (e.g., the color strategy of Coca Cola’s Red, JetBlue’s Blue, and ING’s Orange are to name some of the several examples), some pharmaceuticals have devised a color strategy for particular drugs, which is concerned with coloring the tablet itself (such as the notable example of Pfizer’s Viagra). Coloring the tablet is assumed to have differentiation advantages for the target customer by providing the tablet with a memorable look, a color that enhances and support drug features, and an aid in fighting counterfeiting in this industry.\(^15\) Still, this leaves open the key questions: what power does color have as a design lever, and how does it actually engage the consumer and consequently build brand affinity?

**Why do Colored Tablets Make a Difference?**

Color design decisions present an intriguing challenge as color selection is often guided by intuition and experience rather than science. Research in the field of psychology provides indirect support to the use of color as a design lever, focusing on its ability to promote object memorizing. Foster and Jelicic\(^16\) assessed memory for natural objects using implicit and explicit measures. Implicit evaluation involves the unintentional retrieval of memories, whereas explicit assessment involves the conscious recollection of a previous experience. Wichmann et al.\(^17\) argue for the existence of two different memory systems: (a) an edge-based structural description system that identifies the object’s shape and/or contour but ignores other features and (b) a more surface-based sporadic memory system, which absorbs spatial, contextual, and semantic information that distinguishes objects from one another. Summarizing research in this area, Lloyd-Jones argues:\(^20\)

Color provides a perceptual input to implicit memory systems and may be represented at a perceptual level (in a structural description system) or at a semantic level, in which stored knowledge of a prototypical object color provides an associative link between a representation of an object shape and/or the object name. Thus, for some objects, stored object-color knowledge may be used in a top-down fashion to constrain identification.\(^4\)  

Although the role of color in memory of objects enjoys only limited attention,\(^21\) Vernon and Lloyd-Jones\(^23\)
assessed the effects of colored objects in which color is a cue to identity. They argued that during the initial encounter with an object, color information is encoded and activates stored color representations. If tablets can be colored to trigger specific, desired representations, then color can aid in drug differentiation, capitalizing on activation and reactivation of one’s spatial surface-based spooradic memory and stored semantic information.

Color, as a salient differentiator (an agent of meaning), is recruited to create user experience that augment and reinforce the brand attributes of the drug. For example, a cardiovascular drug in tablet form should not only be efficacious but it should also look competent. Color is used to signal meaning to support this drug’s potency and generate a desired patient experience: the drug is powerful because it is proven safe and efficacious and because it looks this way. The visual experience of the tablet effectively competes for the attention and memory space of end users, while the medical community busies itself with the package insert.

The argument we have constructed so far is simple and centers on the following assumptions:

a. The pharmaceutical industry is experiencing powerful growth and tremendous competition.
b. To effectively participate in this industry’s rivalry, pharmaceuticals put tremendous effort into R&D, while also devoting at least as much attention to marketing and branding to differentiate drugs.
c. Branding typically engages the senses; in the case of a drug tablet the sight sense is likely to be a natural target. The way the tablet looks should support the personality profile of the brand.
d. Color seems an effective design lever able of engaging the consumer’s memorized associations represented by the color.

Still, this straightforward and well-substantiated argument is insensitive to the nature and scope of color influence. More specifically, it ignores the question of universality of color associations. Are color associations similar across different contexts? Are people from different cultures responding similarly to various colors, conjuring up similar images and triggering the same associations? Because many drugs are positioned as global, they require brand consistency but colors’ meanings and associations might not be consistently interpreted around the world. The exploratory study described here assessed what colors are preferred in various jurisdictions around the world to empirically validate color preference commonalities and dissimilarities as contingent on culture.

EXPERIMENT: EXAMINING GLOBAL HUE BRIGHTNESS AND BRAND ATTRIBUTE ASSOCIATIONS

Research Description

Colorcon was interested in developing a solid global color preference database to enable informed brand decision making for its customers. Specifically, the company was interested in understanding the patterns associated with brightness and hue preferences and brand attribute associations for medications across the different jurisdictions in which it is active. A color research and consulting agency was contracted to undertake a multicountry study designed to investigate this question.

The tablet medicine market is structured in two tiers. The first tier consists of tablets that are still produced in white noncoated application. A second growing tier of tablets currently covers about 20% of tablet medicines worldwide and appears in colors selected to support brand personality attributes. For example, drugs claiming to be innovative or cutting edge are likely to be produced in different colors than ones positioned as reliable or calming. Despite this, the science behind color selection decisions is still limited. In fact, color decision makers often select colors they like and that intuitively appear connected with brand attributes. Such color decisions capitalize on intuitive understanding of the geographies in which the drug is intended to be launched as well as competitive and regulatory analysis to best understand what constraints are placed on color selection when competitive offering in these geographies are regarded and regulatory color-usage restrictions are considered.

A review of color preference literature (see, e.g., the works of Guilford, Jastrow, Birren, Harbin and Williams, Gotz and Gotz, including works that date back to the 19th century, shows a field of inquiry that is among the older and better developed areas of color studies. Nonetheless, this field of knowledge is highly fragmented with respect to methodologies used (rank-order, paired-comparison, etc.), number of colors studied (including value and saturation), sample size and nature (single digit to hundreds of children, adults, and mixed age groups), and heterogeneity of cultures studied (usually 2–3 and not >7 cultures). For the most part, these studies cannot advise how to form a global color strategy sensitive to local association and meaning differences.

Design and Procedure

Addressing the research question, the following methodology choices were made to define the variables “colors,” “attributes,” and “geography.”

a. Color: Previous research on color preference reviewed a small number of primary colors: red, blue, green, and yellow (see Fernberger, Garth and Porter, Jacobs and Suess, Jastrow, and Kwallek et al.), and some have also offered conclusions regarding the importance of color value (i.e., lightness or darkness of the hue). Still, focusing only on primary colors would have substantially limited the generalizability of our findings, as drug personalities vary and require a greater variety of colors to select from. Therefore, primary, secondary, and tertiary colors were included in the palette with values ranging from light to medium to dark.

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b. Attributes: Through a literature review and an expert panel, 27 relevant drug personalities and emotional attributes were identified.

c. Cultures: Twelve key markets were selected to participate in this study. Company expert panels determined market selection including Brazil, Canada, China, France, Germany, India, Italy, Japan, South Korea, Spain, the United Kingdom, and the United States.

Participants were surveyed using a web-based survey. Participants were self-recruited from preexisting panels of adult consumers who had worked with the survey firm in previous studies, none of which were related to color or medications. Samples in each country were filled from the panels until the desired sample sizes were reached. Sample sizes ranged from 160 in France to 244 in the United States.

Respondents were presented with 27 different attributes of a medication. These included attributes that would be expected to be directly associated with the effectiveness of a medication (e.g., Fast Acting), attributes more generally associated with product preferences (e.g., First in Class), and attributes more associated with emotional responses (e.g., Happy). For each attribute, the respondent was first asked to choose the brightness level (Light, Medium, or Dark) they viewed as most associated with that attribute. Then, given the brightness level chosen, the respondent was asked to rank nine hues (red; orange; yellow/orange; yellow; green; blue/green; blue; purple; and white/gray/black) in terms of their association with the attribute. This design has the advantage of allowing for a palette of 27 colors (brightness/hue combinations), which represents a significant increase from previous studies.

Results and Discussion I: Brightness Level Choice

Figure 1 gives a dotplot trellis display of the proportions of respondents who chose the Light, Medium, and Dark brightness levels, respectively, for each of the attributes. The attributes are ordered in the display based on the brightness choice category with the highest proportion over all countries for that attribute, starting with the attributes most associated with the Light level, to those most associated with the Medium level, to those most associated with the Dark level (this is clear from the plot, as the attributes start with mostly circles to the right, move to mostly triangles to the right, and end with mostly pluses to the right). Country indicators are given as A, B, C, etc., to preserve the confidentiality of the proprietary nature of the data.
It is apparent that there are strong patterns in the association between attributes and brightness choice that are consistent across countries. A light brightness level is preferred for attributes associated with calmness, such as Relieving, across all countries. Positive and more intense emotions, such as Love and Exciting, are associated with a medium brightness level. Finally, negative attributes, such as Unhealthy and Failure, are strongly associated with the dark choice. In addition to being strongly associated with these negative attributes, the Dark level also almost always has a low probability for the other attributes, indicating a relatively highly focused association pattern.

The trellis display also highlights the existence of strong country-to-country differences in brightness association patterns. If there was no difference from country to country in brightness choice for a given attribute, the symbols for each level would line up in roughly straight vertical lines. This is never completely the case but is roughly true for the attributes noted above. However, for others there are clear differences from country to country. Such differences include the following:

a. New: Although the choice of brightness level is split almost equally in countries A and C among the three levels, in other countries there is a clear preference for a particular level. That level is not consistent, however, being Light in countries G, K, and L and Medium in countries D, E, F, and H.

b. Dependable, Trust, Quality, Happy, and Confidence: The Dark level is almost never the preferred choice, but the split between the Light and Medium levels varies greatly from country to country. Country H is completely different, with the Light level rarely chosen and the Dark level the most popular choice.

c. Expensive: A Light level is never preferred, but a Dark choice is typical in countries A, B, C, D, and H, whereas a Medium choice is typical in countries E, F, and J.

d. Powerful: The Light level is almost never the preferred choice; although the Dark level is strongly preferred in some countries (such as A, B, C, D, J, K, and L), it is evenly split with the Medium level in countries E, F, G, and H. The situation in country I is completely different: for Dependable, as the Dark level is rarely chosen, and the Light and Medium levels split evenly.

The listed order of the countries in Fig. 1 is also worth commenting. A trellis display is most effective if groups and variables are ordered based on context, rather than in an arbitrary fashion (such as alphabetical order). As noted earlier, this was done for attributes (based on the most popular brightness choice for the attribute), and, similarly, a natural grouping or ordering of countries is desirable. To construct such an ordering, a dataset was constructed consisting of the 81 proportion values (three brightness level proportions for each of 27 attributes) for each of the 11 countries. This $81 \times 11$ matrix was then run through a hierarchical variable clustering algorithm\(^\text{37}\) to form a tree that groups the variables (in this case, the countries) based on the matrix of their pairwise squared correlations. As a result, countries are more likely to be grouped together, if their brightness choice proportions for the different attributes are more strongly correlated with each other.

The resultant tree is given in Fig. 2, and it provides compelling support for a cultural component of brightness choice. It can be seen that the four British and British colonial countries (India, Canada, the United States, and the United Kingdom) form a cluster, as do the four Latin countries (Brazil, France, Italy, and Spain). Korea and Japan also form a group. It is noteworthy that China does not group with the other two Asian countries, but instead its brightness proportion values are highly correlated with those of Germany (this last association is unexpected and warrants further study). The ordering of countries in Fig. 1 reflects this structure in the clustering tree, but to preserve confidentiality of the proprietary information here the cluster orderings and within-cluster country orderings have been masked.

The country-to-country differences apparent in the dot-plots also can be tested and extended statistically. For each respondent, the response of interest is the ordered categorical variable that takes on one of the values \{Light, Medium, and Dark\}; in this context, the goal is to model for each respondent \{$p_L$, $p_M$, and $p_D$\}, the vector of probabilities that the person would choose Light, Medium, or Dark, respectively, for that attribute. This is done using a proportional odds model\(^\text{38}\) incorporating Country and Gender as categorical predictors and Age as a numerical one, with the significance of the different predictors assessed using likelihood ratio statistics.

Table I summarizes the results of proportional odds fitting for each attribute. For each attribute, the following entries are given: the $P$-value for the Country effect, the gender that is associated with choosing darker colors over lighter colors for that attribute (if the test for significance of the Gender effect is statistically significant at a 0.05 level), the age (younger or older) that is associated with choosing darker colors over lighter colors for that attribute (if the test for significance of the Age effect is statistically significant.

![FIG. 2. Variable clustering tree of countries based on brightness level choice proportions.](image-url)
at a 0.05 level), AUC, the area under the receiver operating characteristic curve for the fitted model, a standard measure of the strength of the ability of the model to distinguish the three groups from each other (see, for example, Swets et al.\textsuperscript{39} and Nagelkerke\textsuperscript{40} pseudo-$R^2$ measure).

Several patterns emerge from this table. First, although at least one of the predictors is highly statistically significant for each attribute, none of the relationships are very strong based on AUC and pseudo-$R^2$. This reinforces that while the observed effects are apparently real, there is still a great deal of person-to-person variability in brightness choice. The Country effect is statistically significant for each attribute and is highly statistically significant for almost all of them, which argues in favor of cultural effects across countries. There is relatively little evidence of age being related to brightness choice, with the effect being statistically significant for only five of 27 attributes, and no apparent pattern in those effects. However, for many attributes (17 of 27), gender is related to brightness choice. For attributes that are generally more associated with lighter colors, men are more likely to prefer darker colors, whereas for attributes more associated with medium and darker colors, men are more likely to prefer light colors. That is, women are more likely to choose brightness levels consistent with the general overall pattern, whereas men are comparatively more likely to choose the opposite brightness level.

Results and Discussion II: Associations of Hues Given Brightness Level Choice

The second aspect of the experiment was to examine the associations of hues with attributes, given the brightness level chosen. Figure 3 is an example of a display that illustrates such associations. This trellis interaction plot, which refers to the attribute Exciting, gives for each country the average rank of each hue over all respondents who chose a given brightness level for that attribute (recall that respondents were asked to rank the hues from most to least associated with the attribute once they chose what they viewed as the most associated brightness level). These average ranks are then connected across brightness choice levels using lines of the corresponding hue. If hue rankings were the same for each brightness level (i.e., if there was no interaction between brightness choice and hue preference), then the lines would be parallel, but it is very apparent that this is not the case for any country.

TABLE I. Summary of results of proportional odds models fit to brightness choices.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Country, $P$-value</th>
<th>Gender (Darker)</th>
<th>Age (Darker)</th>
<th>AUC</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>0.0001</td>
<td>Male</td>
<td></td>
<td>0.626</td>
<td>0.053</td>
</tr>
<tr>
<td>Calming</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.723</td>
<td>0.176</td>
</tr>
<tr>
<td>Relieving</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.592</td>
<td>0.034</td>
</tr>
<tr>
<td>Safe</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.617</td>
<td>0.056</td>
</tr>
<tr>
<td>Plain</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td>Younger</td>
<td>0.621</td>
<td>0.068</td>
</tr>
<tr>
<td>Common</td>
<td>0.003</td>
<td>Male</td>
<td>Younger</td>
<td>0.570</td>
<td>0.023</td>
</tr>
<tr>
<td>New</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.602</td>
<td>0.052</td>
</tr>
<tr>
<td>Dependable</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.637</td>
<td>0.109</td>
</tr>
<tr>
<td>Cautious</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.640</td>
<td>0.109</td>
</tr>
<tr>
<td>Trust</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.594</td>
<td>0.039</td>
</tr>
<tr>
<td>First in Class</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.627</td>
<td>0.094</td>
</tr>
<tr>
<td>Quality</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.592</td>
<td>0.037</td>
</tr>
<tr>
<td>Innovative</td>
<td>&lt;0.00001</td>
<td>Female</td>
<td></td>
<td>0.595</td>
<td>0.040</td>
</tr>
<tr>
<td>Interest</td>
<td>&lt;0.00001</td>
<td>Female</td>
<td></td>
<td>0.609</td>
<td>0.057</td>
</tr>
<tr>
<td>Love</td>
<td>&lt;0.00001</td>
<td>Female</td>
<td>Older</td>
<td>0.597</td>
<td>0.040</td>
</tr>
<tr>
<td>Exciting</td>
<td>&lt;0.00001</td>
<td>Female</td>
<td>Older</td>
<td>0.619</td>
<td>0.056</td>
</tr>
<tr>
<td>Energizing</td>
<td>&lt;0.00001</td>
<td>Female</td>
<td>Younger</td>
<td>0.669</td>
<td>0.114</td>
</tr>
<tr>
<td>Fast Acting</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td>Younger</td>
<td>0.615</td>
<td>0.063</td>
</tr>
<tr>
<td>Happy</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.640</td>
<td>0.082</td>
</tr>
<tr>
<td>Confidence</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.650</td>
<td>0.107</td>
</tr>
<tr>
<td>Expensive</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.609</td>
<td>0.060</td>
</tr>
<tr>
<td>Powerful</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.616</td>
<td>0.118</td>
</tr>
<tr>
<td>Unhealthy</td>
<td>&lt;0.00001</td>
<td>Male</td>
<td></td>
<td>0.677</td>
<td>0.163</td>
</tr>
<tr>
<td>Failure</td>
<td>&lt;0.00001</td>
<td>Female</td>
<td></td>
<td>0.584</td>
<td>0.029</td>
</tr>
<tr>
<td>Discomfort</td>
<td>0.024</td>
<td>Female</td>
<td></td>
<td>0.583</td>
<td>0.021</td>
</tr>
<tr>
<td>Disgust</td>
<td>&lt;0.00001</td>
<td>Female</td>
<td>Older</td>
<td>0.613</td>
<td>0.038</td>
</tr>
<tr>
<td>Fear</td>
<td>0.003</td>
<td>Female</td>
<td>Older</td>
<td>0.615</td>
<td>0.033</td>
</tr>
</tbody>
</table>

Presenting 27 such interaction displays (one for each attribute) is not feasible but fortunately this is not necessary. Figure 4 gives a variable clustering tree of the 324 × 27 matrix consisting of the 324 values plotted in an interaction display (the mean rank for each brightness/hue combination for each country) for each of the attributes. The tree thus groups together attributes that are similar in terms of the pairwise squared correlations of their mean rankings. The figure shows that the attributes split into four well-defined groups, as follows:

1. Uncomfortable or threatening attributes: Unhealthy, Failure, Fear, Discomfort, and Disgust join together tightly and then Cautious joins as well.
2. Reliable or unthreatening attributes: Safe, Dependable, and Trust join together in an intuitive subgroup, which then joins with Natural, Plain, and Common and then Calming and Relieving. It is revealing in this context that despite the positive characterization of safety attributes, these are joined with what would be viewed as unexciting attributes.

3. Uplifting or energizing attributes: The active attributes Love, Exciting, Interest, and Energizing form a tight group, with Happy joining; the other subgroup joins the positive attributes Fast Acting, Quality, and Confidence with Powerful. The joining of Powerful to this group reinforces that the respondents' color associations are that powerful medication might be fast acting and high quality but not necessarily safe or dependable.

4. Inventive or leadership attributes: New, Innovative, and First in Class are natural members of this group, and it is interesting to see that Expensive then joins in,
suggesting that customers expect to pay more for better medication.

The strong groupings apparent in the clustering tree allow for a more efficient summary of the interaction results, since a “typical” attribute from each group can be used to describe general trends (although the patterns are not identical across all attributes in a given group, of course). Figure 3 for Exciting is typical of the uplifting or energizing attributes group. Recall that for these attributes the Medium level is typically the dominant choice for all countries, and the Dark level is rarely chosen. It can be seen that in all countries red is strongly positively associated with Exciting at all brightness levels (mean ranks are being plotted, so low values mean that the hue was ranked highly), whereas white, gray, and black are strongly negatively associated. The other hues are moderately associated with the exception that brown is not viewed as associated with Exciting for the relatively few people who choose the Dark level, except in countries J, K, and L, and blue/green is a strong choice in country G among those who choose the Dark level. The interaction displays for the other attributes in this group are similar to that given in Fig. 3, with the notable exception of patterns related to the color white. Among those who choose the light level white is strongly associated with Confidence, Quality, and Fast Acting in every country except one and is associated with Powerful in three countries.

Figure 5 gives the interaction display for Failure, a typical member of the uncomfortable or threatening attributes group. Recall that for these attributes a dark brightness level is preferred in all countries. The strong association with the color black (the white/gray/black hue among those who chose the Dark level) in all countries is unsurprising, as is the strong association with dark brown in most countries. There is less consistency in the hues that are least associated with negative attributes, being blue in countries A, B, and C, green in countries E, F, G, H, K, and L, and orange in countries I and J. Although the patterns related to black and dark brown persist in the other negative attribute displays, the colors least associated with the attributes differ depending on the attribute. For example, blue is negatively associated with the attribute Unhealthy in countries E and H but not B, whereas red is least associated in countries K and L.

Figure 6, the interaction display for Innovative, represents the inventive or leadership attributes. The brightness level choice is much less consistent over the attributes in this group, making comparison of the interaction displays more difficult, but for all of these attributes, the Medium
level is commonly chosen in at least some countries. The white/gray/black hue is strongly negatively associated with the attributes in this group, with the only exception being white for First in Class in countries D and I and for Expensive in country L (among those who choose the Light level). Brown is also negatively associated with these attributes among those who choose the Dark level. Blues, purples, and greens dominate the strong positive associations for these attributes, with blues and purples most preferred in countries A, B, and C and greens in countries D, E, F, G, and K.

The interaction display for Dependable, a typical member of the reliable or uninteresting group, is given in Fig. 7. Recall that the light brightness level is the most common choice for the attributes in this group. Given that, the most important pattern is that white is most strongly associated with the attributes in all countries. The typical second choice is the obviously similar light yellow, whereas purple is almost always the least associated hue.

Figure 8 combines the results of the two facets of the experiment into one display. The figure gives a trellis dotplot display, as in Fig. 1, but the dotplots are grouped according to the clustering of Fig. 4. Despite the fact that the clustering ignores the distribution of brightness level choice (being based only on the brightness/hue rankings), there is remarkable consistency in many of the dotplots within a cluster group. For example, all of the uncomfortable or threatening attribute dotplot displays (in the lower right) are very similar, with the exception of (the less overtly threatening) Cautious. This is strong evidence of a consistent view of negative attributes across the broad categories of countries, brightness choices, and hue associations. This can be contrasted with the inventive or leadership group in the upper left, where there is much less consistency either across countries or across attributes. This suggests that these patterns are more local and cultural in nature. The other two groups form a middle ground not only with many commonalities across countries and brightness choices but also with noticeable differences.

In summary, our inquiry reveals several important findings:

a. There are strong patterns in the association between attributes and brightness choice that are consistent across countries. For example, negative attributes such as Unhealthy and Failure are strongly associated with the dark choice in a universal manner.

b. Still, while cross-country consistent attribute–brightness associations presume universality, we also note significant country-to-country differences in brightness association patterns pertaining to several attributes. For such attributes, the Country effect is statistically signif-
icant, which argues in favor of cultural differences across countries.

c. There is relatively little evidence of age being related to brightness choice, with the effect being statistically significant for only five of 27 attributes and no apparent pattern in those effects. However, for many attributes (17 of 27), gender is related to brightness choice.

d. When attributes are clustered based on their hue-attribute interaction only, four discrete groups of attributes emerge, each of which holding coherent meaning within cluster and distinctiveness across clusters. This remarkable consistency within each cluster group suggests that respondents could employ color “language” in an associative coherent manner to what seemed as categories of attributes of similar meanings.

e. Interestingly, such coherence was particularly present for uncomfortable or threatening attributes. There is strong evidence of a consistent view of threatening attributes across the broad categories of countries, brightness choices, and hue associations.

**GENERAL DISCUSSION AND CONCLUSIONS**

As our findings reveal, attribute–hue associations suggest the possible existence of color language\(^\text{41,42}\) that not only has universal properties but also is partially contextual within the cultures studied. It is of interest and importance to reflect on the possible nature of such “language” as this unconventional communication platform is likely to exert powerful influence over consumer decision making and behavior.

Given that language is the most fundamental mechanism by which people share and exchange information and meaning, its universal properties are likely to fall into the category of a biologically evolved function as opposed to a culturally sensitive set of constructs.\(^\text{43}\) What points to the innateness of language is the accuracy and speed at which humans process language and the accelerating rate at which children acquire language. Chomsky’s\(^\text{44}\) insight into universal grammar, whereby all existing languages are based on very few and similar grammatical principles that are likely to be innate to humans in a Darwinian sense,\(^\text{45,46}\) can serve us to better understand the possible properties of color language uncovered by this experiment.

Although language is often thought of as related to the verbal expression of thoughts, there is no evidence that language is essential to cognitive operation and/or a manifestation of such capacity. Instead, language can structure the exchange of other forms of meaning. Here linguists are concerned with the structure of language itself and the rules used to form this structure. These rules constitute a “mental grammar” that is thought to be well defined, although not identical, in every language, as in the case

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**FIG. 7.** Trellis interaction display of mean ranks of associations of hues with attribute “Dependable” given brightness level choice.
of Music language, Sign language, and the English language. All three enjoy similar structural properties that guide the formation of meaning such as accepted signals, harmonious and disharmonious relationship between elements, etc. What is important to recognize is that the basic "grammatical rules" are kept as the foundation, whereas the meanings and variations formed are context sensitive (within the context of a specific opera played, the tale of a story told or an event signaled). In a Chomskyian manner, the ability to master the language structure is innate, while much of the language meanings are likely to be learned.

Examining how attributes were clustered in this experiment solely on the basis of their color association, provides an intriguing departure point into the color language discussion. Although Colorcon has been intuitively grouping attributes, such as "common" and "plain" together or "new," "cutting edge," and "innovative" as another set, while working with their clients following the semantic of the attributes themselves, it was intriguing to discover that a similarly consistent and coherent grouping occurred when attributes were clustered based solely on the colors with which they are associated. This finding unearth the possibility that underpinning the semantic structure of attributes (language as an expression of thoughts as we referred to above) is a color language (language as a nonverbal structure of meanings) that supports the semantic language and parallels it in a subliminal, and, maybe, intuitive way.

Equally interesting is the divide that emerges between universally and contextually held attribution–color associations. Although attribute–hue brightness associations seem to split into these two categories (i.e., universal and contextual), the attribute lists in each category are different from one another in that universal attributes are also primarily visceral in nature, whereas culturally contextualized attributes are split between visceral and intellectual-type attributes as shown in Table II.

Is it possible that through the process of human evolution attributes or constructs related to basic emotions, like love and fear as well as experiences like discomfort or relief, grew deep root into mankind consciousness and became hardwired? Alternatively, is it the case that attributes or constructs like Quality, Confidence, First in Class, and Innovative that emerged in a much later evolutionary stage (given their contemporariness and conceptual nature derive meaning from the context in which they are observed or discussed) became culturally sensitive? Our study of color–attributes associations was neither intending to address the evolution of language necessarily nor can it state any definite conclusion in this area. However, the clustering of attributes based on associations with
As with any language, understanding the semantic properties and grammatical structure is essential to effective exchange of meanings. Although our study scratches the surface of what might be a deeply embedded language, it seems reasonable to expect that color decisions should not be made arbitrarily, absent of understanding the associations and meanings that might be attached to the color language of the target audience. Our findings reveal an intricate web of color associations that if used effectively can leverage existing associations to engage customers’ senses and support brand positioning. Conversely, misuse of color language either within or across local markets may result in conflicting and ineffective product messaging. Clearly, the universal facet of color language, especially aspects pertaining to brightness preference, the strong association of dark colors with uncomfortable or threatening attributes, and the significant role of reds and white in conjuring certain attribute associations, all suggest specific codes of communication relevant to global product design and marketing. In addition, we also note that “country dialect” may at times be a more critical factor when making product branding color decisions.

Although the universal cultural dimension of color language presents a challenge to product design and marketing decision makers, an additional layer of complexity awaits those who seek to position multiatribute brands in multiple jurisdictions. As the data reveal, attributes appear to be clustered and associated with certain brightness levels and hues in ways that are consistent within the cluster and within the geographies studied, whereas, at the same time, vary across attribute and geography clusters. Pragmatically speaking, it takes a sophisticated balancing act to manage a cross-geography/cross-attribute drug as the color associations that such combination requires are complex. Clearly, effective design will require customizing color appearance to best match cultural references in the respective regions and prioritizing attributes to best reconcile dominant color choices.

TABLE II. Attribute typology derived from attribute–hue associations.

<table>
<thead>
<tr>
<th>Attribute range/attribute nature</th>
<th>Universal</th>
<th>Contextual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visceral</td>
<td>Natural</td>
<td>Trust</td>
</tr>
<tr>
<td></td>
<td>Calming</td>
<td>Confidence</td>
</tr>
<tr>
<td></td>
<td>Relieving</td>
<td>Powerful</td>
</tr>
<tr>
<td></td>
<td>Safe</td>
<td>Cautious</td>
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<tr>
<td></td>
<td>Love</td>
<td>Happy</td>
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<tr>
<td></td>
<td>Exciting</td>
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<tr>
<td></td>
<td>Energizing</td>
<td></td>
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<tr>
<td></td>
<td>Failure</td>
<td></td>
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<tr>
<td></td>
<td>Discomfort</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disgust</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fear</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interest</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Unhealthy</td>
<td>First in class</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Innovative</td>
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<tr>
<td></td>
<td></td>
<td>Expensive</td>
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<td></td>
<td></td>
<td>Quality</td>
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<td></td>
<td></td>
<td>Dependable</td>
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<td></td>
<td></td>
<td>Plain</td>
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<tr>
<td></td>
<td></td>
<td>Fast acting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Common</td>
</tr>
</tbody>
</table>

Recognizing the complexity of color branding design decisions (especially those pertaining to cross-geography/cross-attribute drug positioning), one need not ignore gender considerations. As noted, men are different than women in brightness level preference and in general are more accepting of dark colors than women. Apparently, gender-specific drugs such as Pfizer’s Viagra present fewer design complexities than Eli Lilly’s gender-neutral antidepressant Prozac.

These results have clear implications for color associations in drug design and have influenced Colorcon’s interactions with its customers. The results are also intriguing in their relevance to the study of consumer behavior in general but generalizing color associations beyond the context of drug design may not be possible, as it is difficult to estimate the contextual effect of the pill form on respondents’ brightness, hue, and attribute associations. It may or may not be the case that a cutting-edge drug and a cutting-edge television set in Japan will both be associated with the exact same hue and/or brightness selection, although it is reasonable to assume that hue and brightness will matter in both cases. The contribution this study makes goes more toward claiming and substantiating the existence of color language and association network, and arguing for its importance for product design and marketing decisions in general, than toward the generalizability of specific color attribute associations identified beyond this drug design context. Furthermore, the methodology employed by this study allowed us to identify correlations but directional causality. Thus, it remains unclear as to whether an attribute like “safe” that prompts a light-value association for a subset of the sampled group in this study will also be prompted, if a light-colored pill was shown to the same audience.

Future research needs to address theoretical and methodological concerns as well as application challenges. Conceptually, it is necessary to further explore and expose the linguistic characteristics of the color language and its structure, addressing questions like: What is the scope of its universal grammar and structure? What other universally held constructs constitute its vocabulary, and are they mostly visceral or intellectual by nature? What plausible explanations account for regional clustering (as well as regional differences) in color–attribute associations? Methodologically, it would be advantageous to develop deeper understanding of causality directions (from color to attributes rather than just from attributes to color consumer decision flow). Similarly, it is important to study attributes in combination rather than in single form,
given that most branding efforts attempt to associate more that one attribute with any given drug and as our results showed, multiple attributes may lead to “color conflicts” rather than a meaningful cohesion.

Commercial application related research should address the possible connection between color-attribute associations and actual consumer consumption choices. In addition, such research can also address possible implications of color language for effective design of products in general and drugs in specific as well as brand positions. Within the context of the pharmaceutical industry developing and testing, a performance measurement system that evaluates the impact of color language decisions on patient compliance with prescribed drugs, sales performance of drugs, and doctors’ prescription preferences seems particularly warranted.