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Pharmaceutical Packaging Color and Drug Expectancy

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Pharmaceutical Packaging Color and Drug Expectancy

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ABSTRACT

Pharmaceutical markets are expanding considerably due to the aging population, higher development costs and also direct-to-consumer advertising which entails more demands from consumers and prescriptions from physicians. Pharmaceutical packaging as a visual communication tool is promised to a mounting importance, because of growing blister packaging, safety standards upgrading, expansion of OTC drugs and developing television advertising. This study examines the impact of packaging color on consumers' expectancies towards the drug and seeks determining if prototypical color codes exist for drug categories. Results show a significant influence of color and darkness on perceived drug potency. Gender differences are discussed.

"You take the blue pill and the story ends. You wake in your bed and believe whatever you want to believe. You take the red pill and you stay in Wonderland and I show you how deep the rabbit-hole goes[2]."

These words, pronounced by the character *Morpheus* in the "Matrix" movie, illustrate the evocative power or potency of a pill color. During the last three decades, a dozen studies have dealt with the evaluation of a drug's expectancy or potency according to its intrinsic color. But quite a few have addressed the subject of prescription drug package color effects on consumers' judgments and attitudes. The subject is not superfluous because direct-to-consumer (DTC) advertising now represents an important means of promotion for pharmaceutical companies, knowing that the color and form of a packaging or a medicine are the only visual aspects or hints presented in print or on television (see for instance Nexium®, "the purple pill" from AstraZeneca). Moreover, mail order (direct sales) distribution which now represents the second retail distribution channel behind drugstores (independent and chain outlets combined) relies heavily on the visuals of drugs promoted on-line. We propose, in this paper, first to give some key facts about the pharmaceutical industry and state why drug packaging is assuming a growing role in product promotion. Then we shall review the few previous studies pertaining to the effects of drug color. Due to space limitations, color psychology and its applications to other fields of consumer research (print advertising, retail atmospherics) will not be reviewed in this paper. Finally, we shall present a laboratory experiment studying attitudes towards prescription drugs, according to the dominant color of a drug package. The results of this experiment will be discussed and expanded.

THE PHARMACEUTICAL US MARKET

In 2003, about 466.3 billion dollars were spent worldwide on medications (IMS Health, 2004). This figure includes ethical (prescription-only medicine; POM), semi-ethical and OTC drug sales. Nearly half of this sum (49%) was spent in the USA, 25% in Europe and 11% in Japan. During the same year, the 291 million US residents spent 203 billion dollars on prescription drugs alone (+ 11.2% vs. 2002), representing 3.22 billion scripts (+ 2.4%; NACDS, 2004). These figures have more than tripled within ten years (IMS Health; NACDS Economics Department). This 2003 global spending corresponds to an average of 698 dollars per capita in the USA. Demographic (aging of population), social (Medicare reform), economic (increasing R&D costs, high levels of domestic prices) and marketing factors (growing share of mail-order channel and increasing direct promotion investments) explain this rapid evolution to some extent. Another cause of this escalation is imputed to direct-to-consumer advertising (Findlay, 2000; Kaiser Family Foundation [KFF], 2003), which is forbidden in Europe (Cozens, 2002). In this general context, several reasons explain why packages (for both prescription and OTC drugs) and especially printed color on them are becoming a major issue in pharmaceutical marketing and justify the present study:

Growing direct-to-consumer advertising (DTCA): in 2003, $3.23 billion were spent on DTC advertising (Lawrence and Zaugg, 2004). Since the FDA authorized less stringent regulations about communication in 1997 (Sumpradit, Ascione, and Bagozzi, 2004), television has become the major medium for drug communication (66% of DTCA in 2003 vs. 13% in 1994). Most observers recognize that DTCA works: "*every additional $1 the industry spent on DTC advertising in 2000 yielded an additional $4.20 in sales*" (KFF, 2003) and that it influences physicians' prescriptions (Mintzes, 2003). The drug appearance or package on TV (i.e. packshot) then becomes the main visual and the principal means of differentiation between suppliers.

Drug samples to consumers: sampling is already considered as an efficient promotion tool (Joseph and Mantrala, 2003) but DTC sampling is about to develop; the packaging could have a greater impact than standard compulsory information notices.

Packaging standards: although 80% of solid medicines in US are conditioned in bottles (less than 15% in Europe), experts forecast a fast growth for blister packaging (Pilchik, 2000). While the issue is not prevalent today in the US for prescription drugs, it could soon become, as total world demand for blister packs should exceed that of bottles in 2007 (Packaging Digest, 2004). A blister is composed of a thermoformed plastic with a sealing foil. This latter packaging implies a secondary cardboard package, displaying a larger printable surface.

Changes of drug status: a substantial number of drugs, previously prescribed by physicians, became free-access OTC medicines. Now some studies report that nearly 3 OTC purchasing decisions out of 4 are made in-store. Packaging has naturally a role to play.

New FDA regulations on OTC drugs: in March 1999 new regulations (effective April 2002) urged manufacturers "*to standardize their presentation of such information as active ingredients, directions, uses, warnings, and other data. […] The information must be boxed and cannot include logos, graphics, or bar codes*." (Canale, 2001). Measures against tampering are also being upgraded. All these dispositions entail a need for larger packaging.

Weapon of massive differentiation: knowing that the color or the form of a medicine *per se* cannot be automatically patented or constitute a trademark (for instance, see INTA, 1996; Steele, 2002), a specific packaging may convey and reinforce brand equity (especially for OTC drugs on drugstores' shelves).

Economic worries: more and more counterfeiting and smuggling cases (low-priced export drugs which are reintroduced into the US) are reported. Losses for the pharmaceutical industry appear significant. For instance, GlaxoSmithKline felt compelled to change

[1]Both authors equally contributed to this work.
[2]"Matrix", written by Andy & Larry Wachowski.

the color of its Combivir® tablets (from white to red; Murray-West, 2003) aimed at developing countries. Special printing techniques (bright stocking, nude labeling) are encouraged for limiting illegal practices.

Health issues: experts recognize that the colorful presentation of a medicine (compound or package) may improve compliance (adherence to treatment) and reduce the risks of confusion (Carter, Taylor, and Levenson, 2003; Elwyn, Edwards and Britten, 2003) and medication errors (Hethcock, 1978) which are counted yearly by the thousands.

Order mail growth: Web-based drug selling activities display the highest growth rates (+21.7% between 2001 and 2002) in the sector. Drug and package visuals are paramount in this medium.

THEORETICAL FRAMEWORK AND HYPOTHESES

Since the very first days of medicine, the power of a drug appearance and its attached expectancy has played a significant role on therapeutic success. The placebo effect ("*I will please*" in Latin) has been recognized since Socrates (Moerman and Jonas, 2002). The very belief in the physician and/or the treatment contributes to the cure. Among the manifest signs constructing this belief, the drug appearance (color and form) and its packaging, may have some influence in efficacy of treatment (Buckalew and Coffield, 1982a). In the same way, the very brand name of a drug will have differential therapeutic effects according to its consonance (Klink, 2002) or its notoriety (Branthwaite and Cooper, 1981).

Previous studies pertaining to prescription drugs and color

Surprisingly, to our knowledge, no specific study addressed the *packaging color* for pharmaceutical products as a predictor of drug expectancies. On the other hand, a few studies have been conducted on the influence of *pill color* on attitudes towards medication or treatment. We reviewed eight studies, conducted between 1970 and 1991, to which we added two extra studies found and reviewed by de Craen *et alii* (1996). Most reviewed studies employed either patients or students with limited sample sizes. Results are sometimes divergent or weakly significant. It nevertheless appears that color does influence perception of medicine potency or expectancies towards it.

A first group of studies addressed the relationships between color and form of medicine and their perceived potency and efficacy. Schapira et al. (1970) showed that anxiety was reduced with green pills and depression with yellow tablets. Cattaneo, Lucchelli and Filippucci (1970), along with Lucchelli, Cattaneo and Zattoni (1978) demonstrated that blue pills induced quicker and longer sleep than orange pills. Similar reports were given by Blackwell, Bloomfield and Buncher (1972), indicating sedative effects of blue capsules. Huskisson (1974) showed that a red placebo is as efficient as a real analgesic drug. Sallis and Buckalew (1984) demonstrated that the perceived potency of a drug decreased in function of the following pill color order: red, black, orange, yellow, green, blue and white.

A second group of studies dealt with the relationships between drug colors and perceived therapeutic classes. Jacobs and Nordan (1972) showed that red and yellow placebo pills were classified as stimulants, while a blue placebo was classified as a depressant or a tranquilizer. In two successive studies, Buckalew and Coffield (1982a; 1982b) demonstrated that some ethnic and cultural factors could alter general color classifications of medicines. Significant differences between African American and European American samples were also noted for pill size-strength relationships. Finally, Buckalew and Ross (1991) revealed that only a few colors presented some obvious link with therapeutic classes: beige and orange for skin treatment and red for heart condition.

A comprehensive review of literature on the placebo effect of color was also conducted by de Craen et alii (1996) that covered about three decades. The main conclusions of these authors were that "*the colour of drug seems to influence its effectiveness, but consistent trends are not apparent*". They concluded by writing that further research "*contributing to a better understanding of the effect of the colour of drugs*" was warranted. Some authors explain the color placebo effect by the physiological effects of color (e.g. Jacobs and Hustmyer, 1974) while others merely associate it with idiosyncratic color preferences (Schindel, 1962) or learned cultural symbolism (Adams and Osgood, 1973).

Hypotheses

Given the absence of previous works on packaging color and perceived drug expectancy and potency, we shall set forth our hypotheses by relying on previous studies exploring relations between these perceptions and the drug color. We therefore hypothesize:

H1: a "warm-colored" (red or yellow) packaging will be perceived as containing a more potent drug than "cool-colored" (blue or green) ones. This would impact various expectancies related to a given medicine. Indeed, some authors like Berlyne (1960) or Jacob and Hustmyer (1974) have stressed the arousing nature of long visible wavelengths.

H2: a dark packaging will be assessed as containing a more potent drug than a light one. This would impact various expectancies related to a given medicine. As early as the 1950's, authors underlined the potency effect of dark or saturated colors (Osgood, Suci and Tannenbaum, 1957).

H3a: "warm color" packaging will be more often associated with stimulant therapeutic classes. Recurrent studies indeed showed associations between red and stimulant qualities or drugs (Jacobs and Nordan, 1972).

H3b: conversely, "cool color" packaging will be more often associated with sedative/soothing therapeutic classes (Lucchelli, Cattaneo and Zattoni, 1978).

METHOD

The main objective was to assess the impact of a drug packaging color on related perceptions and expectancies. A pilot study revealed that general beliefs about prescription drugs as a whole were likely to moderate perceptions and attitudes toward a specific packaging. A specific measurement instrument for these beliefs was consequently warranted. Horne, Weinman and Hankins (1999) have constructed a specific scale, the 'Beliefs about Medicines Questionnaire' (BMQ) that was primarily intended for patients with heavy chronic pathologies (psychoses, renal dialyses and heart conditions), while Perrien et al. (1998) used a general involvement scale for an analgesic. Therefore, a more general index targeting consumers (ICOMED) was created in another study and used in the present one. This experiment consisted in exposing 150 European participants to a prescription drug packaging bearing a specific color and asking them to make several judgments about the drug's perceived qualities.

Independent variables

Independent variables comprise packaging color (hue and brightness), the pre-test mood, gender and general beliefs towards medicines.

FIGURE 1
Packaging used in experiment (brown condition)

Stimuli selection

Packaging form and appearance. In Europe, most solid medicines (pills, tablets, etc.) are packaged in blisters and boxes rather than in bottles (about 85% against 20% in the US; Pilchik, 2000). This blister, composed of PVC and foil, is usually kept by the consumer in its box. This form of packaging is now increasing significantly in the US (+16% annually vs. 6% for bottles). Also, for reasons of ecological validity and for the sake of practicality, an actual drug cardboard packaging was tested, i.e. a rectangular box (Cf. Figure 1), with a fictitious brand name.

The packaging of an actual generic analgesic drug was used for this experiment. Once scanned, the box image was altered in several ways: the original brand name was erased and replaced by a fictitious but credible name (cf. infra); the "paracetamol" mention was erased because of its popular notoriety; the background colors–except for the white or gray parts–were modified and switched to a condition color.

Choice of color conditions. In this experiment, 7 conditions were applied: 6 hues and an achromatic color (medium gray). The colors displayed on a LCD computer screen are showed in Table 1, along with their RGB and HSL (hue, saturation and lightness/brightness) references. Absolute lightness levels are also indicated. The RGB reference displays the phosphors' intensity values (between 0 and 255) for the three primary colors red, green and blue. The second HSL norm specifies hues in degrees (0° to 360°) on the chromatic wheel while saturation and lightness are expressed in percentages.

A given color can be defined by its three dimensions hue, brightness and saturation (Mounts and Melara, 1995). The authors opted here for "natural" colors, i.e. hues that are often seen on actual pharmaceutical packages. Thus, a strict control for color saturation levels was not implemented and only hue and lightness levels were taken into account for results.

Choice of the drug brand name. So as to assess strictly the chromatic effect of a pharmaceutical packaging, an unknown drug brand name was warranted to avoid any familiarity effect (Kent and Allen, 1994). For additional reasons of intellectual property and trademark protection, we decided to use a fictitious but credible brand name (see Perrien *et alii*, 1998). A preliminary approach, resorting to an expert group (physicians, pharmacists and nurses), a documentary research[3] and a quantitative survey among students have allowed determining that drug brand names were often perceived or imagined with rare consonants in the native language and with diphthongs which evoke a foreign country or intrinsic qualities. For example, at least 66 drug brand names start with the letter Z. This latter seems to communicate and connote a concept of efficacy (Erlich, 1995; Klink, 2003). These statements led the authors to invent the brand name "Zolgan" which recapitulated the various characteristics evoked *supra*. Verification on official Web sites helped to ensure the inexistence of such a brand name. We shall observe however that this fictitious brand appears realistic to the extent that a consultation at the Drugs@FDA[4] site allowed detecting 211 brand names (plus 264 generic appellations) which contained the syllable "Zol" and 42 brand names (plus 5 generic names) which contained the syllable "Gan". Eventually, the modified packaging comprised the fictitious brand name (see Figure 1), an upper-right pictogram symbolizing a capsule, a central hexagon, the active molecule "dextropropoxyphene", the mention "20 capsules" and the corporate name of the manufacturer (Irex, a subsidiary of Synthelabo). The height of package was diagonally halved, the left part remaining untouched (white) and the right part showing the experimental hue.

Mood before test. Mood of participants was assessed before exposure to stimuli by the *Self-Assessment Manikin* (SAM) scale, comprising pleasure, arousal and dominance 9-point sub-scales (Morris, 1995).

Attitudes and beliefs towards prescription drugs. A specific scale–developed and validated in a European context (submitted paper)–was used in this study. The *ICOMED* index (for Index of COnfidence toward MEDicines) is composed of two opposed 7-item sub-scales: the first one measures the individual's defiance (distrust) level towards prescription drugs and the second subscale measures the individual's reliance (trust) level towards prescription drugs. Each item consists in a 7-point scale.

Dependant variables

Two main variables, likely to be influenced by color, mood and general drug attitude, were measured in this experiment: the expectancies towards the displayed drug packaging and its possible attribution to a specific therapeutic class (resultant mood is also a dependent variable).

Drug expectancies. Ten items were successively proposed, displayed as 7-point semantic differential scales (Osgood, Suci and Tannenbaum, 1957). Half of the scales were score-inverted. These items comprised: medicine power (gravity of condition), drug activity duration, required precautions of use, rapidity of action, perceived dearness (price), therapeutic efficacy, potential side effects, prescription drug (as opposed to OTC), type of treatment (symptomatic or curative) and brand identity ("genericness").

Attribution to therapeutic classes. Referring to previous studies about drug expectancies according to the color of pill or capsule (see *supra*), we tried to confirm some relationships between specific hues and ailments or therapeutic classes. Eight major categories were proposed to participants: heart/blood pressure (cardiac),

[3]MedScape Drug Info: http://www.medscape.com/druginfo/; DMOZ: http://dmoz.org/Health/Pharmacy/Drugs_and_Medications/

[4]http://www.accessdata.fda.gov/scripts/cder/drugsatfda/index.cfm

TABLE 1
Color references for experimental conditions

Condition color	L*	HSL References			RGB References		
		H (¡)	S (%)	L (%)	R	G	B
Red	107	4	84	94	240	53	38
Yellow	212	54	100	100	255	229	0
Green	168	116	76	93	70	238	57
Blue	87	228	81	91	44	81	232
Orange	148	28	100	100	255	121	0
Brown	84	25	67	47	120	74	40
Gray (neutral)	150	-	0	59	150	150	150

**Lightness is measured by the screen luminous intensity, varying from 0 (black) to 255 (white).*

TABLE 2
ICOMED scores for sample

Gender	Defiance Score (1)	Reliance Score (2)	ICOMED Index (2-1)
Males	3.68	4.63	.95
Females	4.21	4.58	.38
Mean	3.95	4.61	.65
F	10.667	.077	4.118
p	.001	.078	.044

digestion/liver (heartburn etc.), inflammation/fever (antipyretics), pain/migraine (analgesics), respiratory system, depression/anxiety (psychotropic/stimulant), insomnia (hypnotics/sleep pill) and skin. Participants could make only one choice.

Measures and procedures

Experimental sessions took place with small groups composed of 2 to 4 individuals (totaling 150 participants; 53.7% female; X=19.96 years), to whom a flat 17" LCD screen was displayed at a distance of about 1.2 meters. To avoid any discrepancy in color display, the same screen was used for all groups. A 6-page booklet was given to each participant. In a first stage, subjects self-evaluated their current mood with the *Self-Assessment Manikin* (SAM) iconic scale, composed of three 9-point scales. The experimenter then explained: "*a pharmaceutical company wants to market a new drug within a few months. Several packaging layouts have already been selected. You are going to assess one. Look at the screen displaying the packaging while answering the following items regarding this medicine*". The packaging image was then displayed on-screen (only one color per condition). While looking at the packaging, participants evaluated it and rated the associated drug expectancies. Participants would afterwards assign the package to one possible therapeutic class among eight. A second mood evaluation was accomplished with the SAM iconic scale before subjects expressed their beliefs towards drugs in general (ICOMED index). As a conclusion, Ishihara chromatic plates were displayed to control for individuals' color vision. Demographics were finally recorded.

RESULTS

Manipulation check

Mood. Participants' mood significantly changed after exposure to stimulus and questionnaire items. Further covariance analyses did not show any specific effect of mood and its dimensions on drug attitudes and judgments. Pleasure: before 6.18, after 5.81 (p<.000); Activation: before 5.35, after 4.85 (p<.000) and dominance: before 5.72, after 5.83 (p<.000).

ICOMED index. The participants' general attitude towards medicines was assessed by the ICOMED index. Reliability for the defiance scale showed an alpha of .68; alpha for the reliance scale reached .73. The overall mean score for participants was .65, knowing that the index may vary from -6 (high defiance towards drugs) to +6 (high trust towards drugs). A significant gender difference for the defiance scale [F (1, 149)=10.67; p<.001] and the global index [F (1, 149)=4.12; p<.044) is noted (see Table 2). Female participants trusted drugs less than male participants did.

Relations between expectancy items. Partial correlations have been calculated (i.e. controlling for color) so as to assess the strength and direction of putative links between the 10 expectancy items. Thus, we notice that a drug construed as designed for a benign illness will also be associated with brief action (r=.47; p=.000; two-tailed), low risk (r=.60; p=.000), low price (r=.52; p=.000), limited efficacy (r=.39; p=.000), limited side effects (r=.58; p=.000), OTC status (r=.40; p=.000) and symptomatic treatment (r=.50; p=.000). Correlations with rapidity (vs. delayed) of action (r=.10) and "genericness" (r=.11) are not significant

TABLE 3
Mean potency score by color condition

Package color	Perceived potency
Brown	38,33
Red	36,80
Gray (neutral)	35,63
Blue	33,78
Orange	32,50
Yellow	31,18
Green	31,18
Mean potency score	34,17

(p>.16). A further factor analysis showed that 8 items out of 10 loaded on the same factor. The rapidity of action and brand identity ("genericness") were considered as different constructs. The remaining 8 items indicated an eigenvalue of 3.975, explaining 49.7% of variance, with all loadings above .5. The aggregation of these 8 items constituted a "drug potency" index, which showed a good reliability with a Cronbach alpha of .8507.

Color effects on dependent variables

Six hues were used in the experiment, along with a neutral condition (medium grey). Another independent variable was constituted *post hoc* in a dual way: the stimulus brightness. Two categories were constituted after agreement between experts: light (yellow, green, orange and grey) and dark (red, blue and brown). This choice was validated by a metric measure of color brightness which was taken with the help of PhotoShop® 7.0 imaging software. The respective effects of hue and brightness were analyzed for the three main dependent variables: drug expectancies (10 items), the drug potency (8 aggregated items) and the attribution to a specific therapeutic class.

Drug expectancies. An analysis of variance showed a main effect of color hues on some drug expectancies. Main effects of hues were significant on three expectancies: "medicine power" [gravity of illness; F (6, 149)=2,635; p=.019], "required caution" [F (6, 149)=2,558; p=.022] and "drug dearness" [drug price; F (6, 149)=3,210; p=.005]. Red, brown and grey packages are perceived as designed for serious illnesses vs. yellow or green packaging. Brown, red and orange packages require some precaution of use, compared to blue, green and yellow. Brown- and red-packaged drugs are perceived as more costly than orange or yellow boxes.

As far as package brightness is concerned (light vs. dark hues), significant effects were detected for the following expectancies: "drug delayed action" [F (1, 149)=4.05; p=.046], "drug dearness" [F (1, 149)=9.49; p=.002], "side effects severity" [F (1, 149)=3.8; p=.05] and "drug curative value" [F (1, 149)=5.65; p=.019]. Dark-hued packages (red, blue and brown conditions) are considered as acting more rapidly, more expensive, more susceptible of side effects and more curative than light-hued packages (yellow, green, orange and grey conditions). H2 is validated.

When effects of color screen brightness (metric values) on drug expectancies were assessed by linear regressions, it appeared that absolute screen color lightness (varying from a minimum of 0–black–to a maximum of 255–white; see Table 1) impacted significantly drug power (beta=-.171; p=.037), drug action duration (beta=-.175; p=.033), activity delay (beta=+ .172; p=.036), drug dearness (beta=-.23; p=.005) and curative value (beta=-.163; p=.047).

Perceived drug potency (8-item summated score). The packaging color hue had an impact on the global perception of the drug we called potency [F (6, 149)=2.35; p=.034]. Brown and red packages entail greater potency scores compared to green or yellow hues (see Table 3). H1 is validated.

When experimental hues were rearranged in two brightness categories, a significant positive effect of brightness on perceived potency was also apparent [F (1, 149)=7.27; p=.008]. Brightness absolute levels were also employed as a metric variable. A linear regression shows a significant relationship between brightness and perceived drug potency (R2=.052; beta=-.228; p=.005).

Therapeutic class attribution. Participants had been given no particular indication regarding the precise nature of the proposed drug. Eight therapeutic classes were proposed, knowing that only one could be chosen. Overall, the most often chosen classes were analgesics, drugs for heart condition, antidepressants and hepatic drugs. Chi-square tests did not reveal any specific relationship between hues and therapeutic applications. Red is mostly attributed to the heart condition drug (32%) and analgesics (20%). Yellow is attributed mostly to heart (23%) or dermatologic (23%) drugs. Green is related to analgesic (25%) and hepatic (21%) medicines. The blue package is affected to an analgesic drug (26%), while the brown one is related to a heart condition drug (33%). The neutral package (gray) is partly attributed to an analgesic drug (25%). Regarding the attribution of light or dark packages, one association appears significant: dark vs. light packages are related to heart condition drugs (z=2.794; p=.005). Another relation approaches significance: light packages are more related to antipyretics (z=-1.83; p=.06). Although non-significant, results show trends compatible with H3a and H3b.

DISCUSSION

Given the scarcity of empirical research on pharmaceutical packaging and its growing importance in global drug companies' communication, and given the known visual impact of color, an exploratory approach on drug packaging color seemed warranted and justified.

Indeed, previous works about design were mainly conceptual papers pertaining to *product* design as a whole (Bloch, 1995), dealing with product form rather than packaging color *per se* (e.g. Underwood, Klein and Burke, 2001). Other authors addressed the subject of which design attributes (e.g. prototypicality, unity) influence consumers' cognitive and affective responses (Veryzer

and Hutchinson, 1998). Specific studies on packaging color are rare (Gordon, Finlay and Watts, 1994; Garber and Hyatt, 2003) and thus warranted, even limited to an occidental context.

The main objective of this study was to assess the presumed effect of the color of a drug packaging on subjective evaluations pertaining to that drug. The present results indicate that packaging color does have an effect–in a European context–on some expectancy items related to a given drug (strength, safety measures and price) and especially on the "potency" construct (which is composed of the 8 specific items abovementioned) which presents a good reliability (alpha=.85). Color warmth also seems to imply drug potency, as being comparable to a color arousing quality (Berlyne, 1960; Jacobs and Hustmyer, 1974).

The brown and red hues appear to signify and connote gravity in a supposed treatment, with a high potency score (respectively 38.3 and 36.8) as opposed to green and yellow hues which are more associated to trivial or limited effects (both 31.2 for potency score). Similarly, dark tones generally induce more potent considerations: the darker the package, the more potent the drug; this seems compatible with previous findings on color perceptions and meanings (Osgood, Suci and Tannenbaum, 1957; p 299-302) and color effects on emotions (Valdez and Mehrabian, 1994). This lightness effect is corroborated by results of regressions on metric lightness values of employed package colors. Although not always reaching significance levels, some trends regarding therapeutic class attribution by color are similar–even partly–to those obtained previously (Buckalew and Coffield, 1982a; Schapira et al., 1970). Thus, reddish hues (brown and red) are found to be associated with heart condition drugs, while yellow is related to skin medicines (Buckalew and Ross, 1991). Nevertheless, we did not find any confirmation of white (i.e. achromatic) association with analgesics and green/blue with sedative drugs (Buckalew and Coffield, 1982a; 1982b; Blackwell, Bloomfield and Buncher, 1972). A gender effect also appears in our results. Women appear to distrust medicines more than men do. Color preferences among gender were not controlled for in this study. Yet, specific preferences might play a role, similar to those exposed by Cattaneo, Lucchelli and Filippucci (1970; study 2), where men preferred orange (warm) capsules and women preferred blue (cool) ones. The ICOMED index does not seem to influence the participants' ways to evaluate color packages. However, the relative youth (and health condition) of participants (mean age=20) may explain an absence of mediation. We may add that ICOMED was also tested elsewhere on adults (30-50 years old) and seniors (65 to 80) and that it presented higher reliability levels and better fitness indices in confirmatory factor analyses. Links between medicine beliefs and health involvement should be explored (e.g. Perrien et al., 1998). But again, it should be noted that significant differences in ICOMED appear according to gender: female participants scored higher on the defiance scale ($p<.001$) and lower on the global index ($p<.05$) than their male counterparts did.

Implications for future research. Some additional packaging features have not been addressed in this experiment and some experimental extensions seem warranted. For instance, package graphics or picture (Underwood, Klein and Burke, 2001), letter fonts and styles, cardboard texture, along with brand name sounds (Klink, 2003; Yorkston and Menon, 2004) would deserve a further exploration. A similar experiment is to be submitted to healthy adults and senior patients. Recurrent treatments for chronic illnesses or ailments are likely to impact attitudes towards specific medicines and their packaging. Also, individual characteristics such as aesthetic sensitiveness (Bloch, Brunel and Arnold, 2003) or style of processing (Childers, Houston and Heckler, 1985) should be included as moderating variables in future studies. Another question is whether cultural color meanings impact drug expectancies in line with packaging hues (Madden, Hewett and Roth, 2000).

Implications for business research. Pharmaceutical businesses should heed the form and color of their new packages before marketing, be they prescribed or OTC. The impact of color on drugstores' shelves is obvious (see for example Celebrex® or Prilosec®), but the likely development of blister-packaged prescribed drugs, along with FDA compulsory notices, will also stress the growing importance of boxes' general outlay, either in physical outlets or on-line (189 million scripts by mail order in 2003). The expanding R&D costs and shorter ROI periods imply a maximization of market shares and profits during the market life of a drug; an attractive and meaningful package can then make the difference against a more ordinary and conventional container.

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