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► To cite this version:

Jean-Éric Pelet, Panagiota Papadopoulou. The effect of colors of e-commerce websites on consumer mood, memorization and buying intention. *European Journal of Information Systems*, 2012, 21 (4), pp.438-467. 10.1057/ejis.2012.17 . hal-04027333

HAL Id: hal-04027333

<https://hal.science/hal-04027333v1>

Submitted on 13 Mar 2023

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THE EFFECT OF COLORS OF E-COMMERCE WEBSITES ON CONSUMER MOOD, MEMORIZATION AND BUYING INTENTION

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Abstract

This paper aims at studying the effect of the colors of e-commerce websites on consumer mood, memorization and buying intention. Based on a literature review a conceptual model is proposed, showing the effects of the color of e-commerce websites and specifically of its components, hue and brightness on the behavioral responses of the consumer, memorization and buying intention. These responses are conveyed by mood. Data collection was carried out during a laboratory experiment in order to control for the measurement of the colored appearance of e-commerce websites. Participants visited one of the 8 versions of a website designed for the research, selling music CDs. Data analysis using ANOVA, regressions and general linear models (GLM), show a significant effect of color on memorization, conveyed by mood. The interaction of hue and brightness, using chromatic colors for the background and foreground supports memorization and buying intention, when contrast is based on low brightness. A negative mood infers better memorization but a decreasing buying intention. Implications for theory and practice are discussed.

Keywords: color, consumer behavior, e-commerce, web design, mood, memorization.

INTRODUCTION

E-commerce website interfaces seek to entice consumers in a buying intention and manifest a buying behavior, by activating their senses, specifically their sight or hearing. The perception of a website atmosphere lies almost exclusively in its visual aspect since 80% of the information processed by Internet user's brain comes from sight (Mattelart, 1996). Color constitutes an important sight stimulus for online consumers, since it is a key website characteristic, associated with the information displayed as well as with the overall website aesthetics. As such, color is deemed as a significant website factor, positively influencing the frequency of a consumer visiting a website (Lemoine, 2008) and affecting online shopper responses (Eroglu *et al.*, 2001, 2003).

Although color is a widely researched topic in various fields (Divard and Urien, 2001), to this day there is a lack of studies focusing on color in the online context. Color in websites has been studied within information systems, especially in human-computer interaction, usability and e-commerce, recognized as a fundamental aspect in web interface design (Lee and Koubek, 2010; Wu *et al.*, 2008; Coursaris *et al.*, 2008; Kang and Corbitt, 2001). Research has found color to be an important factor in e-commerce, influencing website aesthetics (Agarwal and Hedge, 2008; Coursaris *et al.*, 2008; Schmidt and Liu, 2005) e-retailer perceptions (Agarwal and Hedge, 2008), user preference for e-commerce websites (Lee and Koubek, 2010). Studies are largely associated with the impact of colors on website readability, offering recommendations about how to choose the most harmonious colors (Hill and Scharff, 1997; Hall and Hanna, 2003; Nielsen (2000). Yet, color is omnipresent on e-commerce websites. Aware of the significant and widely known impact of the atmosphere inside stores on consumer activities and behavior in a traditional buying situation (Kotler, 1973; Donovan and Rossiter, 1982; Filser, 1994, 2003a, 2003b; Lemoine, 2003), there is a need to investigate the effects of colors as a component of e-commerce interfaces, on online consumer behavior.

Color has always been used by human beings as an aid to recognize important information among other. In addition, it can aid an individual's memory in retaining and recalling information in many activities, including education or purchases. Similarly, in the online context, the color of an e-commerce website can possibly improve consumer memorization of information presented in the website.

With the large amount of information presented on e-commerce websites, memorization becomes an important factor for buying online since consumers are often facilitated in their purchases when they can retain information from one page to another. This implies that memorization of information in an e-commerce website may have an impact on consumer buying intention and can potentially be facilitated by the website colors. However, the relationship between memorization and purchase intention online has not been investigated. In addition, there is a lack of research regarding color and its effect on memorization and buying intention in e-commerce websites.

To address this gap, the aim of this paper is to examine how the colors of an e-commerce website can help consumers memorize information so as to end up buying on the website. The paper presents an empirical study of the effects of e-commerce website color on the memorization of product information and buying intention. Our research method includes both a qualitative and a quantitative part. Unlike most empirical studies dealing with color by comparing warm and cold colors, we examine color by focusing on its hue, brightness and saturation, following the recommendations of Gorn *et al.* (2004), so as to demonstrate that its influence varies according to the intensity of each of these three components. Our findings show that the colors used on an Internet website have a positive effect on memorization of product information and buying intention, which is also mediated by mood. They also show that mood acts as a mediating variable for the effect of colors on memorization.

The structure of the paper is as follows. In the next section a literature review on color and web interface aspects is provided. The following section presents the research model and hypotheses. The empirical testing of the model, including the exploratory qualitative study followed by a quantitative study is described next. The section that follows presents our results which are subsequently discussed in the next section. The paper ends with the conclusions, implications for theory and practice, limitations and future research.

COLOR AFFECTS MOOD AND ONLINE PURCHASE DECISIONS

Color contains three principal components (Trouvé, 1999):

- The hue (or chromatic tonality), which is the attribute of the visual sense defined according to the colors denominations such as blue, green, red;
- The saturation, which provides the proportion of chromatically pure color contained into the total sense;
- The brightness, which corresponds to the component according to which a surface illuminated by a source seems to emit more or less light.

To this day, the effects of the three color components on the Internet have been but seldom documented. In the offline environment, Bellizzi and Hite (1992), Dunn (1992), Drugeon-Lichtlé (1996) and Pantin-Sohier (2004) chose hue as the main variable in their experiments and showed that brightness and saturation should be taken into consideration when conducting experiments about color. As Valdez and Mehrabian (1994), Drugeon-Lichtlé (2009), Camgöz *et al.* (2002) and Gorn *et al.* (2004) show about the brightness component of color, an experiment involving color should compare hue and brightness rather than warm and cold colors in order to understand what consumers recall and what influences their buying intention.

On a website, the interface represents a graphic chart, which refers to a collection of website elements. A graphic chart includes two colors, the foreground color and the background color, both of which constitute the color scheme. These colors reveal the contrast, which corresponds to a strong opposition between the foreground and the background colors, as defined by W3C (W3C, 2008). Its main function relies on facilitating the readability of the displayed information, and *a fortiori* the memorization process.

A summary of the main studies on color in a computerized context is presented in Table 1.

Table 1 : Studies on computer interface color and its effect on other variables

Reference	Dependent variable	Independent variable	Scales	Experiment	Results	Critique
Lee and Koubek (2010)	User preference	Color (Aesthetic aspects)	Objective performance measures (task completion time), evaluation of the design factors, and decisions of preference on the websites	Experiments on nine online bookstore websites with ten participants	(1) pre-use usability and task completion time were correlated; (2) the relationship between pre-use usability and preference was greater than that of task completion time and preference; (3) design attribute assessments after actual use were highly intercorrelated; and (4) organizational structure and layout had a greater effect on user preference than aesthetic aspects, such as color and typography	Color as part of aesthetic aspect, not specific variable
Coursaris <i>et al.</i> , (2008)	Perceptions of Website aesthetics	Color temperature and gender	7-point Likert scales (anchored “ Strongly Disagree/Agree”) measured responses to the question “ My perception of this Website is that it is ... ” for each of the following items: clean, clear, symmetric, aesthetic, pleasant for classical aesthetics, original, creative, fascinating, sophisticated, and uses special effects for expressive aesthetics	A 2 x 2 between-subject research design manipulates the temperature of a Website’ s primary and secondary colors.	More favorable perceptions regarding a website design’ s aesthetics when cool color combinations (blue-light blue), as opposed to warm color combinations (red-orange), are used.	Cold vs. warm colors were used rather than the components of colors
Brady and Phillips, (2003)	Perceived usability	Color and balance	A usability checklist was developed by selecting 36 guidelines for web design and usability (Koyani <i>et al.</i> , 2006)	Viewing screenshots of four homepages	This study focused on the role aesthetics play in website usability. Perceived usability was measured as the design principles of color and balance were manipulated. No statistical differences in user satisfaction between the four sites.	The sites were identical in content varying only in color, balance, or a combination of the two.
Moss <i>et al.</i> , (2006)	Aesthetics	Internet sites Color, Gender	Interviews	Analysis of 23 factors intended to compare the results according to the gender	13 among 23 factors showed differences based on subjects related to navigation, language used and visual content	Experiment based on aesthetics, not on memorization or buying intention process.

Reference	Dependent variable	Independent variable	Scales	Experiment	Results	Critique
Ojampää and Näsänen, (2003)	Speed of visual search and reading	Luminance contrast	Content analysis	Eye movements during the visual search experiment were recorded simultaneously with threshold search time measurement by using an SMI (Sensomotoric Instruments Inc.)	Moderate or even high color contrast does not guarantee quick visual perception. With black and white information, the speed of visual perception decreases with decreasing contrast. Visual search times, number of eye fixations, and mean fixation durations increased strongly with decreasing luminance contrast despite the presence of color contrast.	The experimentation does not take the memorization process into account
Humar <i>et al.</i> , (2008)	Speed of reading- Number of correctly identified characters as a measure of legibility performance	Color combination of a text color and background color	ANOVA, t-test to study the differences in legibility among pairs of color combinations	Testing 56 color combinations and identifying 21 uppercase alphabetic characters, selected and presented in conformance with the Snellen chart	The speed of reading text in different color combinations cannot be described as one-dimensional problem.	Color combinations rather than color components were used
Fernandez-Maloigne, (2004)	Appearance of compressed images compared (organized, forced choice) and absolute measure tests were used	Colors and colored appearances of compared images following various compression levels	None	Observations ; quantification of treatments of the digital image color (e.g. contrast, brightness) ; - 55 observers making comparative tests and tests of absolute measure around various configurations of 8 colors	Mathematical metrics were mostly in contradiction with the judgment of the observers	Interesting experience to prepare the laboratory conditions. No variable related to the psychological aspects of the respondent was measured.
Gorn <i>et al.</i> , (2004)	Perceived download speed	Foreground and background color	3 items of speed	Time perception : Students placed in front of a program and to whom questions were asked concerning the program and the execution of certain tasks	Red background infers a perceived duration longer than a blue one	Work on time, nothing on memorization of information and on buying intention

Reference	Dependent variable	Independent variable	Scales	Experiment	Results	Critique
Wu <i>et al.</i> , (2008)	Emotional responses and subsequent shopping behavior	Website music and color	12-item semantic differential scale (Mehrabian and Russell's, 1974) modified for online shoppers to measure participants' emotional response to the surroundings in terms with a 7-point Likert scale, Arousal dimension: happy-unhappy, pleased-unpleased, satisfied-unsatisfied, contented-melancholic, hopeful-despairing, and relaxed-bored.	Laboratory experiment with a 2 (music: fast/slow) x 2 (color: warm/cool) between-subjects factorial design	Music and color factors had a significant effect on participants' emotional response. Participants felt more aroused and experienced greater pleasure when they were exposed to a warm color website.	Cold vs. warm colors were used rather than the components of colors
Roulet, (2004)	- Sense- motivation - Mouse manipulation - Cognitive : - Explanatory : sex, initial mood, optimal level of stimulation	Website colors	- SSS version V of Zuckerman (1994) (optimal level of stimulation) - Locus of control (LOC) (Rotter, 1966) - Androgynous of Bem (BSRI) (Bem, 1974) - Confidence level (9-point Likert scale)	- Self-estimation of the duration of their own test; - Study of various personality traits in interaction with complex mental processes such as attention capture, reading, semantic memorization	Absence of significant effect of peripheral color and its constituents	Nothing about the buying intention variable
Papachristos, <i>et al.</i> , (2005)	Affective state (12 most emotional descriptors: Pleasant, Formal, Fresh, Modern, Friendly, Aggressive, Professional, Attractive, Calming, Dynamic, Reliable and Sophisticated)	Color characteristics	Bayesian Belief Network (BBN)	A machine learning algorithm generates a network that relates the color model of a website with the emotional values that are attributed to it by its users	It seems to be preferable to use more than four colors or monochromatic and analogical It seems to be preferable to use low contrast levels between colors Cold colors are perceived as more suitable than warm ones For monochromatic color scheme, it is preferable to have high contrast in brightness	Cold vs. warm colors were used rather than the components of colors
Kiritani and Shirai, (2003)	Time spent on a website Time spent for searching information Understanding of found information	Website colors	Time error, Response time, Devotion, Interest, Irritation, Fatigue, Achievement, Difficulty	1) Effect of 5 background colors (white, red, green, blue, yellow) on 50 subjects who had to search for information in a directory 2) Search and understanding	1) Time passes more slowly with white, blue, green backgrounds 2) No effect on color on time pass A white background allows easier reading but a slower search and more difficult comprehension	Only a few colors were used for this experiment, it is not easily generalizable.

Reference	Dependent variable	Independent variable	Scales	Experiment	Results	Critique
Scharff and Ahumada, (2002)	Text readability	Text color with different modes - Transparent - Opaque - Weak contrast (with screen background)	Text Contrast, Adjusted Background, RMS Contrast, Adjusted RMS, Contrast, Global Masking, Index, Adjusted Index	Experiment I: Measuring the effects of transparent text: It employed a 2 (text transparency type) x 2 (text contrast) x 3 (background) within participants design Experiment II: Measuring the effects of very low contrast one color combination (gray on gray) and one background luminance level	Both experiments showed significant main effects for all variables, and that all interactions were significant.	No measure of memorization
Erickson and Block, (1999)	Effects of color readability on subjects with mental deficiencies	Colors	Testability of the "Color Vision Testing Made Easy" color vision test and with a test using simple geometric figures that are easily identified	Readability / Mentally handicapped persons	The overall rate of testability was 93.2% for the 1078 athletes screened. The frequency of males identified as color deficient was similar to that expected in the general population; only two females (in Spain) failed the color vision screening.	Testability of a color vision screening test in a population with mental retardation, no measure of memorization
Scharff and Hill, (2000)	Text readability	Text color and screen background color	Several discriminability measures were examined (plain, a periodic texture, and four spatial-frequency filtered textures created from the periodic texture).	Readability / Screen background with texture	Search times indicate that these background variations only affect readability when the text contrast is low, and that spatial frequency content of the background affects readability.	Discriminating ability measures for predicting readability of text on textured backgrounds, no measure of memorization
Ridpath <i>et al.</i> , (2000)	Readability of images containing text	Text color and image background color	Scale ranging from "impossible to read" to "readable without effort" » presents on screen	149 subjects and 42 samples Images having different text colors on different background colors. It was necessary to note the readability of images. Images in GIF format (modification of text impossible) using the 216 safe colors.	Readability increases as the difference of clarity between the text color and the background color increases. Regardless of the direction of this difference, clarity is an important factor for determining the readability of a text on a colored background	Testing the readability of web page colors, no measure of memorization

Reference	Dependent variable	Independent variable	Scales	Experiment	Results	Critique
Hill and Scharff, (1997)	Reading speed on screen	Foreground and background colors	Readability / Text color and screen background color	The effects of 6 foreground/background color combinations (color), 3 font types (Arial, Courier New, & Times New Roman), and 2 word styles (Italicized & Plain) on readability of websites were investigated. Participants (N=42) scanned simulated websites for a target word; readability was inferred from reaction time (RT).	In general these results suggest that there is no foreground/background combination, font, or word style which leads to the fastest RT (i.e. best readability), but rather a designer must consider how each variable affects the other(s).	Readability of websites with various foreground/background color combinations, no memorization process measured.
Agarwal and Hedge, (2008)	Aesthetic evaluation and perception of e-retailer consumer trust product preference and purchase intention	Background color	Background color, white space, thumbnail image location and thumbnail image size were varied	Conjoint analysis and optimal design methodologies sixteen web page prototypes assessed through an online survey	Subtle design manipulations had significant effects on consumer evaluations of web page aesthetics and perceptions of the e-retailer	Background color only
So and Smith, (2002)	Decision performance and accuracy Gender, decision-making, task analysis	Graphics color (histograms)	Likert scale indicating their confidence in their choice	93 subjects have to measure the complexity of color and black & white histogram information	Women tend to use color in their histogram choice more than men and color seems less important for men	Comparison based on chromatic vs. a-chromatic colors only
Mandel and Johnson, (2002)	Purchase intention	Appearance / choice according to the color of the screen background of attractive products (or not?) Car : 1) orange red & 2) green with dollars. Sofa : 1) blue with clouds & 2) green with cents	7-point Likert scale on the importance of security and price	385 subjects have to allocate 100 points according to their preferences; A administration of online questionnaire	Subjects mention in advance the attractive products, the picture of which kept their attention more than the rest	Color and pattern were measured rather than colors only
Hall and Hama, (2003)	Reading speed Information memorization after reading	- Black text /White background - White text /Black background - Light blue text /Dark Black background - Turquoise text/Black background	10-point Likert scales	Readability test of 136 participants of 2 web pages with chromatic manipulation - multiple choice questionnaire	Elimination of different quite incoherent types of memorization (retention due to aesthetics and not always to contrast)	Comparison of graphic charts with no modification of the levels of brightness and saturation.

Gorn *et al.*, (2004) focusing on the impact of the three color components on downloading time perception demonstrate that a lengthy waiting time influences the user's appraisal of the Internet site and can lessen his/her desire to recommend it to others. Kiritani and Shirai (2003) show that the effects of screen background colors on time perception vary according to the tasks performed by Internet users. When reading a text written on a white, blue or green screen background, users have the feeling that time passes more slowly. When users merely conduct a simple search and only need to understand the meaning of a sentence, then the screen background color does not have any impact on how they perceive time duration.

Hill and Scharff (1997) have demonstrated the importance of contrast (foreground color vs. background color) when searching for information within a page. They obtained better readability scores when resorting to chromatic colors (green foreground color on yellow background color). During an experiment where colored labels had been placed on screen backgrounds, Camgöz *et al.* (2002) observed that brightness, saturation and hue had a specific impact on each colored screen background.

Biers and Richards (2002) have studied the impact of background color on the perception of promoted products and found that backgrounds with cold hues, such as blue, increased product value and reduced the risk of purchase postponement, especially with regards to regular Internet users. Hall and Hanna (2003) studied the impact of background and foreground colors on how readability was perceived and aesthetic aspect experienced, as well as on the retention of information and on intentions. According to them, sites promoting knowledge transfer must display black texts on white backgrounds, achromatic colors with maximum contrast. In addition, they indicate that e-commerce websites should merely use chromatic colors due to the higher aesthetic appreciation score which is correlated to higher purchase intention. Blue is the favorite hue for purchase intention. These results underline that when studying color on a website, it is important to take into consideration color components (hue, brightness and saturation), as well as the contrasts of the foreground and background colors.

A number of studies have shown that color has a positive effect on consumer mood (Wu *et al.*, 2008) and buying intention (Wu *et al.*, 2008 ; Rouillet, 2004). However, color has mainly been addressed in terms of warm and cold hues (Coursaris *et al.*, 2008; Papachristos *et al.*, 2005) and has not examined with respect to its components, hue, brightness and saturation. Most of the studies linking color and e-commerce take into account balance or brightness as variables of colors (Brady and Phillips, 2003) or combinations of colors (Humar *et al.*, 2008), which do not allow for comparing the effects of the components of the colors. Memorization doesn't seem to be recognized as an important variable in e-commerce considering the poor amount of research on this topic. For example, Hamilton and Luo (1999) have shown that the degree of complexity of an e-commerce website varied according to the colors of the interface which helped the consumer to be concentrated. However, many studies on the effects of color on readability exist (Hill and Scharff, 1997, 1999; Hall and Hanna, 2003). In addition, research has not studied how memorization affects buying intention.

RESEARCH MODEL

The proposed model follows the general pattern of consumer behavior. It follows the one from Engel *et al.* (1978) and introduces three innovative contributions in the consumer behavior analysis (Filser, 1994). It analyzes the variables that influence the consumer's decision process by distinguishing three categories:

- Characteristics of the individual;
- Characteristics of its social environment;
- Situational factors.

This model offers precision about the different stages of the perception of stimuli process, which comprise exposure, attention, understanding, acceptance and retention. It suggests measures of these different levels of perception. It finally breaks down the decision process into a sequence of five steps. The latter are commonly used in research on consumer behavior. The model explains how the colors of an e-commerce website and specifically their components - hue, brightness and saturation - can have an

impact on the buyer's affective state of mood and cognitive states of memorization and buying intention (Figure 1).

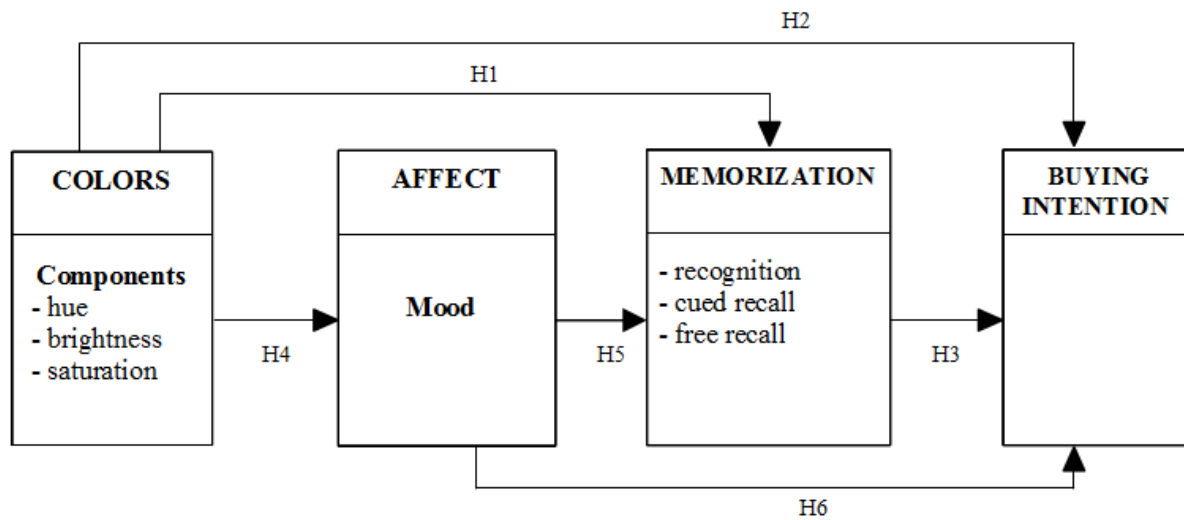


Figure 1: Research model

Memorization

Memorization is a very important factor for the large number of information-based websites that currently exist. It is important for e-learning applications, since the user goal is usually to retain the information beyond the time the page is being read. This also applies to information included in e-commerce websites, since consumer tasks are often facilitated by memorizing information while navigating. Drawing on offline settings, we argue that memorization can be influenced by the colors of an e-commerce website.

In order to understand the effects of color on consumer memorization we have to take into account the quality and quantity of information a consumer has memorized while visiting an e-commerce website. We posit that memorization varies according to the colors of the website, and especially according to the contrast between background and text colors, in agreement with the work of Hall and Hanna (2003). As we stated earlier, the aim of this research is to investigate the effects of the components of colors rather than colors themselves.

In general, information is stored according to an encoding process enabling one to sort out information thanks to criteria which will then allow one to retrieve this information. The role of these criteria is to connect a piece of information to other similar information already stored (Ladwein, 1999). In order to examine the information memorized by each participant, we resort to recognition and recall, two procedures belonging to a method of information retrieval based on overall stimulus in long-term memory. Be it free or cued, recall enables individuals to mimic mentally a stimulus to which they are not exposed during the evocation, for instance, their past reaction to a promotional action (Filser, 1994). Thus, we can hypothesize:

H1: The components (hue, brightness, saturation) of colors of an e-commerce website will have a positive effect on memorization

Buying intention

Intention is activated by a desire or a need (Darpy, 1997) and desire is viewed as an active process (O'Shaughnessy, 1992). Although buying intention is more than a mere desire, it is not a promise to buy (O'Shaughnessy, 1992), it is the outcome of a cognitively handled desire. According to Darpy (1997),

building on the studies of O'Shaughnessy (1992), Howard (1994) and Belk (1985), “*Intention is the result of a desire or a need handled on the cognitive level and leading to purchase planning*”.

Among the environmental factors recognized to produce important emotional and behavioral reactions on the consumer, color seems to play an important role. It serves to retain consumers longer on the e-commerce website according to certain criteria related to their perception of the interface. In particular, pleasure is increased with use of colors whereas boredom can result from a weak use of them (Lemoine, 2008). This duration can help maintaining user interest in a site (Bucklin and Sismeiro, 2003, Hanson, 2000) and give users more time to consider and complete purchase transactions (Bucklin and Sismeiro, 2003). By enhancing consumer interest, it helps to generate repeat visits, which lead to greater long-term sales (Moe and Fader, 2004). From a business investment point of view, Demers and Lev (2001) show that sites with longer visit duration also have higher monthly stock returns. Therefore, it can be assumed that e-commerce website colors are likely to have an impact on buying intention, as they can prolong the visit duration. According to Agarwal and Hedge (2008), the background color of e-commerce web pages is an important factor affecting purchase intention. Wu *et al.*, (2008) have found that warm colors of e-commerce websites have a positive effect on purchase intention. As already mentioned, we are interested in the effect of color components, hue, brightness and saturation. Therefore, we propose:

H2: The components (hue, brightness, saturation) of color of an e-commerce website will have a positive effect on consumer buying intention

There are many entries which are available in the memory and in the external environment. They can potentially be considered in the decision task, but only a few will be used to make a choice in a given situation. Tactical choices effectively originate from decision making regarding the products we buy, including:

- Considerations linked to the price (cheaper, use less of it, cost a cheaper price);
- Considerations linked to the performance (the product functions in these conditions, it owns these qualities);
- Considerations linked to the affect (I like the product, I love the product);
- Normative considerations (my father advised me to buy it, my mother always uses this product);

It is important to understand the procedures which determine which part from memorized information can be used for making a choice. For these reason, we propose:

H3: Memorization will have a positive effect on consumer buying intention

Mood, a mediating variable

We wish to bring to the fore the effects of colors on affect, which includes mood experienced when visiting the e-commerce website. Mood refers to affective states of mind less likely to reach our conscience. Moreover they last longer than emotions but are less intense (Forgeas, 1999).

Mood is linked to a color perceived as positive or negative according to the personal experience of an individual with a color (Boyatzis and Varghese, 1993). According to Odom and Sholtz (2004), different colors tend to incur different moods. Studies have demonstrated the association of colors and mood by using diverse methods such as the objective impressions (printings), the clinical observations, the introspection and the experimental investigations (Wexner, 1954). Chebat and Morrin (2006) measured the effects of cold vs. warm colors of a mall decoration on consumer perceptions. They showed that these were mostly driven by affective mechanisms such as mood, or by other cognitive states, such as the evaluation of the mall environment quality. Similar mechanisms can exist in an online context. Wu *et al.* (2008) have found that e-commerce website color has an important effect on consumer mood. However, their study focuses on warm and cold hues of website color and their influence on mood and does not examine the hue, brightness and saturation color components. In this study, we investigate the direct and interaction effects of the components of colors. Hence, we suggest the following hypotheses:

H4: The components (hue, brightness, saturation) of color of an e-commerce website will have a positive effect on consumer mood

Mood is generally considered as a mild affective state that may influence cognitive processes such as evaluation, memory and decision strategies (Gardner, 1985). However, the observed effects of negative moods have been less consistent than those of positive moods. For example, Cialdini *et al.*'s (1973) negative state relief model of helping asserts that people in a negative mood will behave more charitably than others if the opportunity has potential for direct social or egoistic approval, suggesting that helping behavior may be quite a complex phenomenon not fully addressed by simpler explanations such as mood states (Swinyard, 1993). Gardner (1985) observed that the effects of mood may have special impact in retail or service encounters because of their interpersonal or dyadic nature, a view also supported by others (Isen *et al.*, 1978; Westbrook, 1980).

H5: Consumer mood will have a positive effect on memorization

When people are in a good mood, they tend to have more favorable expectations for the future (Eysenck, 1976; Masters and Wyndol, 1976). Drawing on research in offline stores, good mood may contribute to consumers intention to return to a website at which they have made previous purchases (Isen *et al.*, 1978). We expect mood to be important in the context of online purchase since many consumers make purchases after having a pleasant time visiting a website. This is in line with the study of Wu *et al.* (2008) suggesting mood as a significant predictor of purchase intention. Thus we propose:

H6: Consumer mood will have a positive effect on buying intention

RESEARCH METHOD

Our research method includes both a qualitative and a quantitative study. An exploratory qualitative study was conducted first to allow for verifying the importance of the research variables and the necessity of including them in our model to be tested. The proposed research hypotheses were then empirically tested through a quantitative study conducted in a laboratory setting.

Qualitative study

The main objective of the exploratory phase was to investigate the empirical knowledge gained by regular consumers and expert users when browsing e-commerce websites. It mainly sought to confirm that colors have an impact on users' perceptions, so as to prepare our quantitative study for data collection. In this direction, the study explored long-term memory and the website factors that influence it, drawing from Eroglu *et al.*, (2003) suggesting that atmospheric cues affect consumer behaviour. The study was based on semi-structured interviews conducted with regular consumers and web designers, where we asked interviewees to speak about past visits to websites of their choice. The interview guide and the specific research objectives of the questions are shown in Table 2. From these interviews, topics referring to the affective states lived by the consumer in an online shopping situation emerged. These topics relate to the emotions and moods and show the importance attached by the consumers to the ease-of-use of a website. They also reinforce the proposed effects of variables such as color, as well as the quality of the images perceived by the consumers.

Table 2: Interview guide questions used for data collection and relationship to research objectives

Question	Research objective
1. Phase of introduction: use of Internet in general: a. Could you speak to me about your use of Internet? b. Do you often use the Internet for shopping?	Learning about the consumption and familiarity's experience of the consumer.
2. Phase of centering the subject:	Investigation into the long term memory in

<p>a. Now I would like you to remember your last visits to e-commerce websites to carry out activities for shopping on the Internet. By e-commerce websites, I understand the sites which offer products like books, CDs of music, DVDs, cars, travels, hotels, flights and train booking tickets, banking services, etc. Can you remember your visit to a particular website to seek information on a product or to buy this product?</p> <p>b. What do you think of this site in general ?</p>	<p>order to learn what is remembered by consumers after their visit to an e-commerce website.</p> <p>The consumer's thinking is also interesting to assess since we want to understand what is related with what is memorized.</p>
<p>3. Phase of deepening</p> <p>Topic 1: atmospheric elements of the commercial sites</p> <p>a. What do you think of the design of this website?</p> <p>b. What represents a commercial website which you have found rich, captivating and pleasant to visit?</p> <p>Topic 2: Emotions and feelings felt following the consultation of a commercial site</p> <p>a. Could you describe the feelings that you associate with an e-commerce website?</p> <p>b. user called his friend: <i>"It sometimes happens, that while surfing on an e-commerce website, the site holds my attention because it is beautiful, and easy to surf and to consult. It enables me to go quickly because I easily find the links which are of interest to me and I never feel lost when I use it. Links are easy to locate and help me when I am lost. The facility of reading the site gives me desire to spend even more time on it: the links are quite visible, the images are very clean, and I can perfectly distinguish such and such part of the page of a site, because the colors are used in an intelligent way, to delimit the parts"</i>.</p> <p>c. (To be read again several times if necessary)</p> <p>Your opinion?</p> <p>a. Do you think you have already experienced these states?</p> <p>b. If so, could you speak to me about an experience of this kind by describing an e-commerce website for example?</p> <p>c. According to you, why did you live these states?</p> <p>Topic 3: Antecedents of the behavioral approach</p> <p>a. What encourages you to buy on a particular website and not another?</p> <p>b. According to you what makes you spend more time on one website than on another?</p> <p>c. In your opinion what makes you switch to an e-commerce website?</p> <p>d. What are the factors which encourage you or discourage you from revisiting a particular website?</p>	<p>The aspects in terms of design counts in the consumer's appreciation. But at which level ? Qualitative adjectives (rich, captivating...) can enhance the consumer's description of a commercial website, as a way to help him.</p> <p>The vocabulary dedicated to feelings contributes to feed our understanding of aspects linked to the perception.</p> <p>The projective technique is helpful since consumers do not have to invent anything. They can try to remember a past navigation, which seemed close to a perfect one in order to compare it with a normal navigation on an e-commerce website.</p> <p>The interview is then based on the interviewee's perception after he has visited such a website. He is asked to describe this period in order to relate particular lived states. The reason why he experienced these states is then questioned with the objective to elicit sentences dedicated to emotional states.</p> <p>The question we asked in order to understand behavior when facing an e-commerce website targets the consumer's loyalty. Questions were thus oriented towards the ease of use and ease of surfing the website as well as questions linked to ergonomic and interest to the website aspects.</p>
<p>Phase of conclusion</p> <p>What makes you say, after having visited an e-commerce website: <i>"I have visited a really good website which inspires me to buy from it and to explore it more"</i>?</p> <p>Can you think of any ideal e-commerce website?</p>	<p>During the conclusion phase, we tried to get ideas related to the best conditions participants would like to have experience when shopping on the Internet.</p> <p>An emphasis on an ideal shopping experience on the Internet was then explored.</p>

Participants

Participants were online shoppers with different levels of expertise in terms of Internet use. Sample selection was primarily based on qualitative criteria. Since the qualitative study aimed at exploring online

consumer perceptions from e-commerce websites, our sample had to have previous experience with online shopping. In order to qualify for participation in the study, a respondent would have to reply positively to the question “*Have you ever bought a product or service from an e-commerce website?*”. Twenty one subjects, 10 females and 11 males were interviewed. Participants were grouped according to their expertise with e-commerce websites into expert users and regular users. A participant was selected as an expert user or not based on the answer to the question “*Are you a professional web designer?*”. Subjects characterised as expert users represented 29% of the sample, whereas most of them were regular Internet users. Finally, the sample was selected pursuing balance in terms of age and socio-professional background. The sample characteristics are presented in Table 3.

Table 3: Characteristics of the sample of respondents

Demographic characteristics	Category	Number of respondents
Gender	Female	10
	Male	11
Age	Under 25 years old	1
	25 - 34 years old	13
	35 - 44 years old	4
	45 - 54 years old	1
	55 - 64 years old	2
Internet familiarity	Expert	6
	Intermediate	7
	Beginner	8
Education level	Certificate	4
	High school	4
	2nd-year university diploma	4
	License / Master I /Master II	7
	Postgraduate / doctorate / post-graduate / Master degree no diploma	2
Profession	Executives and academics	2
	Intermediate occupations	3
	Manuel Workers	6
	Students	4
	Storekeepers and business managers	4
	Pensioners	2
Income per month	From 1000 to 1399 euros	9
	From 1400 to 1799 euros	8
	From 1800 to 2199 euros	4

Method

The interview guide was structured and open, allowing us to collect data on topics related to the respondents long-term memory and purchase experience in e-commerce websites (Table 2). Satisfying the criterion of saturation of the data (Mucchielli, 1991, p. 114), we interviewed 21 persons, with the aim to collect information from both regular and expert users. We adopted a neutral attitude with regard to them so as not to influence them in the way they answered. Participants were interviewed without being able to face a computer screen. This was to ensure that they answer only by using their memory to restore the information evocating their navigation on the e-commerce website of their choice. Every interview, the duration of which ranged from 13 to 47 minutes, was re-transcribed offering a verbatim of hundreds of pages.

Results

The exploratory qualitative analysis enabled us to note that color was actually an integral part of the atmosphere on e-commerce websites. Other atmospheric variables such as fonts, animations, images or image quality were also revealed during the analysis. However, the interviews show that color seems to be the most important one. Color was mentioned around 100 times during the interviews carried out. Table 4 presents a summary of the themes, constructs and modes evoked in the exploratory qualitative analysis. Given the exploratory nature of our research, the indicated percentages are not intended to be statistical representative but they rather serve to summarize the information collected in numbers.

Table 4: Summary of the exploratory qualitative analysis

Principal themes	Constructs	Modes	Evoked themes	Citation frequency among the 21 respondents		
Atmospheric elements of e-commerce websites	Colors	Organized in zones	Calm (part clarity) Not showing aggression Make the visit more pleasant Simplify website use (clear organization) Create an impression of sobriety and reassure	9/21	42,9%	
	-	Lively, sharp (saturated)	Make the Internet user get tired and lost Do not facilitate in locating border lines Create an impression of violence Make lose trust	6/21	28,6%	
	-	Bright (fluorescent)	Showing aggression Depreciate the website, (impression of promotion)	4/21	19%	
	-	Natural (photos of environment, of products)	Create a sensation more quickly Move closer to the product if the size of the photo is large	14/21	66,7%	
	-	Warm (feeling creation power)	Stimulate (excite)	13/21	61,9%	
	-	Cold (feeling creation power)	Sedative effect Impression of purified website	6/21	28,6%	
	-	Plentiful	Discount image Incite the user to move in the website	6/21	28,6%	
	-	Sobriety, elegance	Inspire trust	8/21	38,1%	
	-	Harmonious	Emphasize the content, aerate and structure it	7/21	33,3%	
	Mood	Sadness	Appearance	Download time of interface elements is too long	2/21	9,5%
-		Serenity	Ergonomic design	Less stress in comparison to purchases made in a traditional store	14/21	66,7%
-		Nervousness	Colors	Violence of colors Blink of animations or links Difficulty in locating links	5/21	23,8%
-		Frustration	Appearance and information	Unsuccessful search	5/21	23,8%

Beyond an element of the design of the website interface, color seems to comfort the consumer when it is soft and creates a feeling of assurance necessary for the act of purchase, in an environment to be 'tamed'. It supports the organization of information by highlighting useful zones systematically sought by the interviewed Internet users. When used in compliance with the contrasts, as conceived by Itten (1970), color can prove very timesaving, a major aspect in the relationship between consumers and websites.

With information search made easier by implementing ergonomics and human computer interaction rules, the colors encountered when browsing an e-commerce website enable Internet users to navigate it more easily, according to its layout.

Color scheme seems to be important for online consumers, affecting memorization and buying intention. Apparently information is more easily memorizable thanks to an appropriate color scheme. Readability built on a good contrast between the foreground and background colors helps consumers retain information more easily. Readability also facilitated consumers understand the interface and the online shopping interaction more easily. This made them feel more comfortable with the e-commerce website, enhancing their intention to purchase.

The conducted interviews also revealed that the ambience of the room where the respondents made their shopping was important. Some of them argued that shopping online while being at the office in a bright atmosphere was completely different from spending time on an e-commerce website, with a bed light, making the atmosphere sober and dark. The perception of the colors of a website can vary depending on the light of the room where the customer is physically present and the online shopping experience takes place.

Quantitative study

The results of the qualitative study have influenced the quantitative study that followed, both in terms of the research hypotheses as well as in terms of the design of the experiment. The importance of color and its effect on mood, memorization and buying intention implied by the results of the qualitative study led us to further examine color, mood, memorization and buying intention as variables in the proposed research model. We thus developed the research hypotheses proposing links among these four variables, guided by the results of the qualitative study. The research hypotheses were then empirically tested with a quantitative study in a laboratory experiment. Since the light of the room was found to be important for consumers when shopping online, it had to be considered for the empirical study. Therefore, a laboratory experiment was necessary to allow for controlling the ambient lighting of the physical setting. The results of the qualitative study also reinforced the importance to take into account the environment of the e-commerce website where consumers spend time shopping, particularly the color scheme. A website would thus have to be designed especially for the experiment, enabling control of the color scheme. Respondents referred to tangible goods, therefore, the development and use of an e-commerce website selling CDs seemed appropriate, similar to the type of e-commerce website they usually visit.

Thus, a laboratory experiment was conducted with 440 participants in order to test the proposed hypotheses. An e-commerce website selling music CDs was especially designed for the experiment. A respondent would visit the website and browse the available CDs which were grouped into categories. There were 57 CDs available in 19 categories (3 CDs/category). For each CD, participants could see the CD cover, the album title, the artist name, and seven information items, i.e. music category, online store price, music company price, sale percentage, delivery time, state (new or used) and delivery charge. This detailed information was displayed by clicking on the cover image or the title of a CD. In addition, the detailed information included a CD description of 160 characters (around 20 words), next to the CD cover.

Participants could select a category on the left side of the webpage and see the 3 CDs of this category on the right side of the same webpage. Participants had to look into the details of a minimum of two CDs of their choice, regardless of the category a CD belonged to. Participants could look at more than two CDs if they wanted to, from any category and add them to their shopping cart but they could not conduct real purchases.

Each participant visited the website with a color scheme which was randomly selected among the eight schemes prepared for the experiment, explained in the next section. A balanced distribution of the color schemes among all respondents was ensured. After viewing at least two CDs, an easy to see link appeared and respondents were asked to complete a questionnaire with questions about memorized information, mood state and buying intention. Participants were not able to proceed to the questionnaire unless they had visited at least two CDs, in order to ensure that they had viewed adequate information for

responding to the subsequent questions. Demographic data were also collected. All subjects were then tested for color blindness in a separate room using the highly reliable Ishihara test (Lanthony, 2005). This guaranteed the validity of our sample's responses, by keeping people with a perfect vision of colors. The Ishihara test is the most common color blindness test used today (Deeb and Motulsky, 2011). It consists of a number of plates, 24 or 38, the Ishihara plates, each containing a circle of dots which appear in random color and size. Within the circle there are dots forming a number which should be clearly visible to viewers with normal color vision and hard to see or invisible to viewers with defective color vision. To pass the test participants should recognize the number in every plate. Examples of Ishihara plates are presented in Appendix 1. The test was conducted in a separate room from the one in which the survey took place in order to prevent our respondents from being aware of the importance of color in our experiment and thus avoid any possible bias of the responses.

After discarding questionnaires that were incomplete or filled by color blind respondents 296 valid responses were used for the analysis, with each color scheme being visited by 37 respondents. One hundred and twelve answers were invalid and could not be used due to technical problems with the browser that didn't delete the temporary internet files folder. There were 32 color deficient participants, which account for approximately 8% of the males in the sample. This percentage is equal to the actual percentage of color deficient males in the world (Brémond, 2002). Color vision deficiency is sex-linked and is mostly expressed in males whereas it is very rare in females. Males with color deficiencies have a particular type of cone in the retina or one type of cone may be weak. Only forms of red-green color blindness (protan and deutan defects) are encoded on the sex chromosome and occur more often among men. Tritan defects and achromatopsia (complete color blindness) are evenly distributed between men and women. Those forms of color deficiencies are not very common (Deeb, 2004).

Respondent characteristics

Participants were drawn randomly from a list of Design School of Nantes students and personnel who had previously given their consent to participate in design experiments carried out in the prepared laboratory. Students received course credits for their participation. The respondent characteristics are presented in Table 5.

Table 5: Characteristics of the sample of respondents

Demographic Characteristics	Category	Number of respondents
Gender	Female	160
	Male	136
Age	Under 25 years old	242
	25 - 34 years old	29
	35 - 44 years old	13
	45 - 54 years old	11
	55 - 64 years old	1
Internet familiarity	Expert	38
	Intermediate	43
	Beginner	19
Education level	Certificate	2
	High school	166
	2nd-year university diploma	49
	License / Master I /Master II	36
	Postgraduate / doctorate / post-graduate / Master degree no diploma	42 1
Profession	Executives and academics	32
	Intermediate occupations	3
	Manuel Workers	2
	Students	244
	Storekeepers and business managers	4
	Pensioners	1
	Other (to clarify)	10
Income per month	From 0 to 500 euros	247
	Under 1000 euros	15
	From 1000 to 1399 euros	11
	From 1400 to 1799 euros	5
	From 1800 to 2199 euros	9
	From 2200 to 2599 euros	9

The use of students as subjects has often been questioned in terms of their appropriateness as a sample. However, in our study, students are deemed suitable as a sample, as they share many characteristics with the profile of Internet users population, such as age. As shown by several studies, Internet users tend to be young adults, while the Internet usage penetration within the age groups of 18-29 raises up to 95% (Zickuhr, 2010; Pew Research Center, 2010). Hence, although our sample presents a bias towards younger subjects, it can arguably be acceptable as representative of Internet users. In addition, our study benefits from the use of students since they are considered as an important group of online consumers (Delafrooz *et al.*, 2010) and are useful as a sample for empirical studies in e-commerce, in line with previous research (e.g. Kim *et al.*, 2008).

Our sample would also arguably be stronger in terms of representativeness if it was cross cultural. However, although the population of respondents was primarily native Continental French, it included

foreign students, with different cultures, as in any school or university settings. In this sense, our sampling frame does not imply a serious threat to the validity and generalizability of our results. However, a replication of the experiment with a more culturally diverse sample would allow for richer data collection and findings.

Experiment design

Carrying out the experiment under laboratory conditions allows us to draw valid conclusions about the groups surveyed (Jolibert and Jourdan, 2006). Internet enables one to conduct non-intrusive studies, meaning that Internet users are not even aware that their behavior is being analyzed (Dreze and Zufryden, 1997). However, when conducting a study focusing on color, one has to control and neutralize three major elements: screens, ambient light, and, above all, the participants' color perception (Fernandez-Maloigne, 2004). Since, these elements cannot be controlled in a distance study carried out over the Internet, a controlled laboratory setting had to be used for our study. Screens were calibrated using a probe to ensure that the colors were displayed as defined. The color of walls was neutral grey. The grey color of the wall prevents a bad reflection of ambient light on the screens, which avoids color distortion on the screen. By neutralizing the colors of both the ambient light and the walls we were confident that we avoided any distortion. The brightness of the room was then set at 1000 lux to guarantee that the colored appearance of the websites used for the experiment would not be biased by a too dim or a too bright room light. Finally participants had to pass the Ishihara test for color blindness. Further, detailed information how each of the three elements was controlled can be found in Appendix 1.

The experiment was a factorial design which included 8 treatments (4 x 2) related to 8 color schemes developed for the experiment website (Table 6). In order to measure the differences in color perception, we have created 8 different color schemes by varying hue and brightness and keeping the saturation rate constant among the schemes. In accordance with Gorn *et al.* (2004), we set the saturation levels at 100%, because at that level, the hues are most distinct. The color stimuli were modified in accordance with Munsell's (1969) system, considered as the most accurate one (Aumont, 1994), which enables defining precisely several levels of brightness and saturation for each hue.

















Several studies on the impact of culture on the behavior of Internet users and consumers draw attention to the varying importance of design elements of a website across cultures (Maguire, 2011). Among these, colors are a significant variable as their perception and impact is strongly influenced by culture. Colors can convey different semantics depending on the cultural contexts (Filsler 1994). Thus, culture is a parameter that should be controlled in a study on the effects of colors of an e-commerce website. In order to neutralize this aspect we based our experiment on a color selection driven by research on readability, a characteristic which is not culture dependent (Hill and Scharff, 1997). The design of the website was also not too busy, leaving sufficient room for reading easily the commercial information as well as for satisfying principles of website ergonomics such as the navigation bar and the search engine visibility.

An easy-to-read text on a screen, thanks to a sufficiently strong contrast between the background and foreground color, is easier to memorize (Hall and Hanna, 2003; Scharff and Ahumada, 2002, Scharff and Hill, 2000; Hill and Scharff, 1997). In order to validate that a combination of background and foreground color was the best for memorization when the contrast was the strongest, we needed to rate each combination of colors in terms of contrast ratio. We thus measured the latter to provide a gradient scale between each combination of background and foreground color, which corresponds to a rank with “-“ and “+” symbols in Tables 5 and 6. We first differentiated each color scheme resulting in Table 5, which was then used to produce Table 6 summarizing all the information required to explain the contrasts ratios.

The contrast was measured by the Color Contrast Analyser (CCA) 1.1 for Web Pages of the Web Accessibility Tools Consortium (WAT-C, 2005). Contrast ranks ranged from “+++” to “+”, for strong ones and from “-“ to “--“ for low ones, according to the CCA. For example, a contrast ratio of 21 was ranked as “+++” whereas a contrast of 1,82 was ranked as “-- “. CCA was created with the aim to design easier to read web interfaces, in accordance with the W3C consortium. By taking into account the W3C and Web Accessibility Initiative (WAI) guidelines, the use of color becomes more professional and the

















choices web designers make are more informed in terms of usability, as well as in terms of human computer interaction in general.

Table 6: Contrast ratio order according to color schemes

	Background	Foreground	Contrast ratio	Rank
1			21	+++
2			21	+++
3			6,95	++
4			6,95	++
5			6,71	++
6			3,26	+
7			2,65	--
8			1,82	--

To set our first experiment treatment we used the color scheme used by Hill and Scharff (1997) which supported the best readability rate in relation to contrast and we chose as chromatic colors a yellow background (Magnolia yellow) and a green foreground (Newsvine green). Starting from this scheme, we reduced the brightness level of the two colors so as to obtain the second experiment treatment. For experiment treatments 3 and 4 we kept the same colors but switched foreground and background colors. Experiment treatments 5, 6, 7 and 8 are based on black and white (achromatic colors), the most frequently used colors on e-commerce websites. Brightness and saturation levels were identical with those used for chromatic colors in experiment treatments 1, 2, 3 and 4 respectively (Table 7).

Table 7: Factorial Design of the Experiment

Plan	Background			Foreground			Contrast	Plans explanations		
	Name	H	B	S	Name	H			B	S
1	 Magnolia Yellow	60	100	20	 Newsvine Green	120	40	100	6,95* Passed at Level 2 (++)	(Hill and Scharff, 1997) showed that the sharp contrasts of this scheme offered users the fastest reading speed possible among chromatic colors.
Hex.	#FFFFD0				#006700					
2	 Magnolia Yellow	60	100	20	 Granny Apple Green	90	80	100	1,82* Fail (-)	Same color scheme as in the Plan 1 with an increased foreground color brightness (from 40 to 80).
Hex.	#FFFFD0				#6BD500					
3	 Newsvine Green	120	40	100	 Magnolia Yellow	60	100	20	6,95* Passed at Level 2 (++)	Same colors as in Plan 1. Foreground and background colors were switched.
Hex.	#006700				#FFFFD0					
4	 Newsvine Green	120	40	100	 Sunflower Yellow	60	100	60	6,71* Passed at Level 2 (++)	Same color's scheme as in Plan 3 with an increase in foreground color saturation (from 20 to 60). The color which should have been used for the text of the experimental plan 4, in order to preserve rates of luminosity and saturation in relation to the background color, could not be preserved. Indeed, this scheme could not be used given the lack of contrast between the two colors (foreground/background) which made the reading impossible on a more or less old or difficult screen, for individual presenting deficiencies with color's vision we refer to the directives of the w3c. We thus varied its degree of saturation.
Hex.	#006700				#FFFF6B					
5	 White	0	100	0	 Black	0	0	0	21,00* Passed at Level 3 (+++)	This scheme is the most widely used one on e-commerce websites.
Hex.	#FFFFFF				#000000					
6	 White	0	100	0	 Grey	0	60	0	2,65* Fail (-)	Same color scheme as Plan 5 with increased foreground color brightness (from 0 to 60).
Hex.	#FFFFFF				#9C9E9E					
7	 Black	0	0	0	 White	0	100	0	21,00* Passed at Level 3 (+++)	Same colors as in Plan 5. Foreground and background colors have been switched.
Hex.	#000000				#FFFFFF					
8	 Black	0	0	0	 Grey	0	60	0	3,26* Fail (+)	Same scheme as in Plan 7 with a decrease in foreground color brightness (from 100 to 60).
Hex.	#000000				#9C9E9E					

* Text or diagrams and their background must have a luminosity contrast ratio of at least 5:1 for level 2 conformance to guideline 1.4

Figure 2 shows a screenshot of our experiment website. In this particular example, the background color is Magnolia Yellow and the foreground color is Newsvine Green representing experiment plan 1. As it can be seen, the experiment website didn't have any other colors than the foreground and background ones. The design was simple, with very limited use of graphics such as the store logotype and the shopping cart logotype, in order to reveal only the colors selected for the color scheme of each factorial plan (background, foreground). Screenshots of the experiment website for each of the 8 plans are provided in Appendix 2.

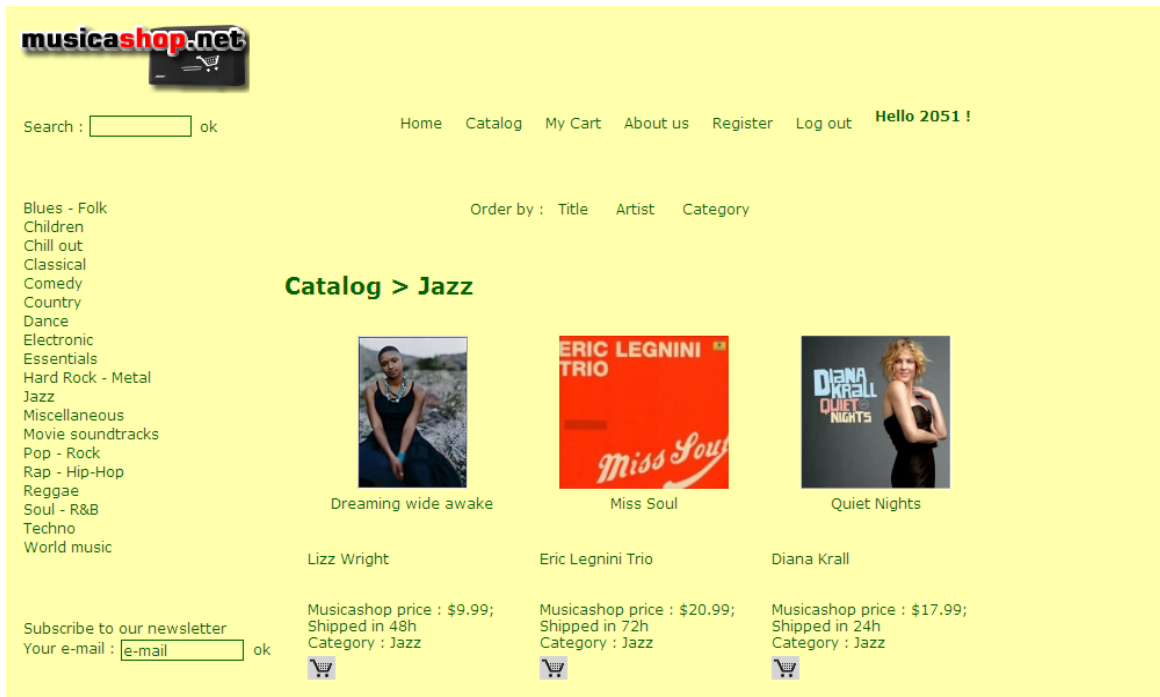


Figure 2: Experiment website

Measures

Memorization

Memorization was measured by measuring recognition, cued recall and free recall.

To measure recognition, participants were asked to recognize two CD covers, each among two other covers of different albums by the same artist. Recognition scores ranged from 0 to 2, one for each CD cover they could recognize. Measuring recognition was not deemed useful since the participants answered to the questionnaires a few minutes after visiting the e-commerce website and 100% of them recognized both CD covers. Thus, we decided not to include recognition further in our analysis.

Cued recall was measured by asking the respondents to answer to a question with 3 alternative values (correct, wrong and "I don't know") for each of the seven information items related to a CD cover. Scores could thus be graded from 0 to 7 for each item visited. Since participants were required to check out two CD covers, scores for cued recall ranged from 0 to 14.

In order to measure free recall, participants were asked to answer to an open-ended question related to an image about the CD cover they had just seen. The question was "What do you remember from the information associated with this CD cover?". Free recall was measured by counting the number of the items that participants could recall from those used in the CD description. Since participants could see two CD covers, each having a 20-element description, free recall value ranged from 0 to 40.

The score of commercial information memorization was the sum of the recognition score, cued recall score and free recall score, ranging from 0 to 56.

Mood

To measure mood we used Mayer and Gaschke's (1988) Brief Mood Introspection Scale (BMIS). Participants were asked to reply to the question "*Do you feel _____?*" for a list of 16 items rated on a 5-point Likert scale ranging from 'Definitely do not feel' (1) to 'Definitely feel' (5), and for each of the 16 items select the answer that best expressed their mood. We selected to use BMIS because it provides a quite exhaustive range of moods and is easy to supervise. The scale and its validity and reliability are presented in Appendix 3.

Each participant passed a pre-test administrated before the start of the experiment. This pre-test measured mood, using BMIS, in order to enable linking the affective states of the participants with the website characteristics. The results we obtained after the visit of the website then refer to the mood experienced on the experiment e-commerce website.

As an affective state, mood is characterised by its duration and intensity as mentioned earlier. In addition, it is not possible to link the affective states of participants with the websites characteristics without measuring the mood before the experiment. We thus used the induction method before the experiment. Its objective is to induce an artificial and controlled affective state during a short period of time, in order to make participants attain a state that should be similar to a natural affective state. For deontological reasons and in order to avoid cognitive failures in the activity of the participants, the intensity of the induction cannot be too strong. The induction phase is framed by two BMIS questionnaires in order to assess its effectiveness. Participants were divided into groups and were asked to complete the first BMIS. The researcher waited until all participants in the group have completed the questionnaire, then, to his signal, the induction procedure started. The assignment of this phase was as follows: "*report a lifetime experience that reflects a happy event (or sad). This is anonymous; we encourage you to describe concrete and precise life experiences. You have 10 minutes and three sheets to make your story. Once finished, fill in the questionnaire and wait until the researcher tells you to continue*". After ten minutes, the experimenter indicates the end of writing the autobiography and invites participants to start the questionnaire. Once the participant finishes to complete the BMIS, the experimental phase, visiting the experiment e-commerce website, starts. After visiting the website, and participants complete the second BMIS questions among other questions which are part of the questionnaire used for data collection. Analytical statistics then take into account results of the two BMIS.

Buying Intention

We used a four items scale developed by Yoo and Donthu (2001). The items were measured on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Already used in a similar context, the validity and reliability of the scale was good, presented in Appendix 4.

DATA ANALYSIS AND RESULTS

Data were analysed using General Linear Model (GLM) and ANOVA. We used GLM to test the effect of the color components (hue and brightness) on mood, memorization and buying intention, and variance analyses (ANOVA) to test the significance of the links between variables and the difference among treatments. The effect of saturation on the dependent variables of our model was not possible to be tested because, as explained earlier in the experiment design, saturation was set constant in order to facilitate the measurement of hue and brightness. We also examined interaction effects between hue and brightness with a series of regressions on each of the dependent variables. Regression analysis was used to test the effect of mood on memorization and the effect of memorization on buying intention. The results are analyzed in the following paragraphs and are summarized in Figure 3:

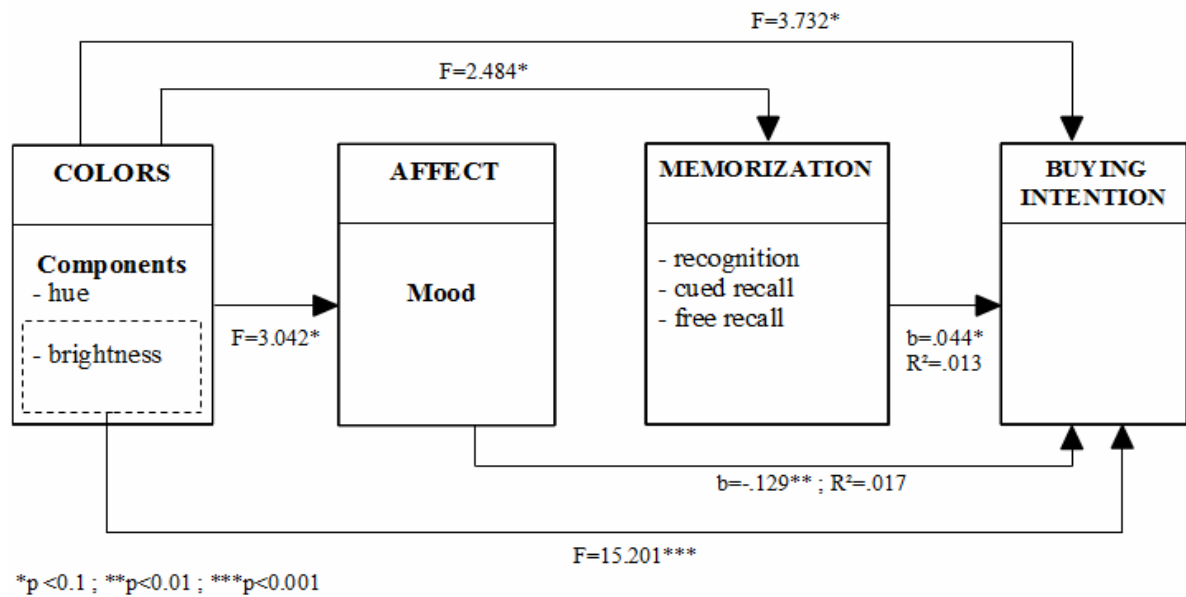


Figure 3: Summary of GLM, ANOVA and regression results

Direct effects of the colors of the color scheme on memorization

The GLM analysis did not show a significant effect of color on cued recall. The results in Table 8 indicate that neither hue ($p=0.750$) nor brightness ($p=0.381$) have a significant direct effect on cued recall. Furthermore, we did not find an interaction effect between hue and brightness on cued recall.

Hue and brightness were not found to have a significant direct effect on free recall either. However, a significant interaction effect of hue and brightness on free recall ($F=2.484$; $p \leq 0.061^*$) was found. R^2 is 3% which is low but sufficient. We can thus accept hypothesis H1, indicating that website color components, hue and brightness, have an interaction effect on the memorization of the consumer.

Table 8: Effects of Color scheme colors on cued and free recalls

Effects of color components (hue, brightness) on cued recall			
	DF	F	p-value
Hue	3	0.404	0.750
Brightness	1	0.771	0.381
Hue x Brightness	3	0.616	0.616
Effects color components (hue, brightness) on free recall			
	DF	F	p-value
Hue	3	0.288	0.834
Brightness	1	0.049	0.835
Hue x Brightness	3	2.484	0.061*

*p < 0.1

Based on the ANOVAs carried out, we noted that the interaction effect of hue and brightness on free recall is most significant when hue 2 (background color = *Newsvine Green*, foreground color = *Magnolia*

Yellow or *Sunflower Yellow*) was employed ($F = 4,048$; $p \leq 0.048$). With a low level of brightness (brightness 1) participants remember the content of the website better than with a high level of brightness (brightness 2) (Figure 4).

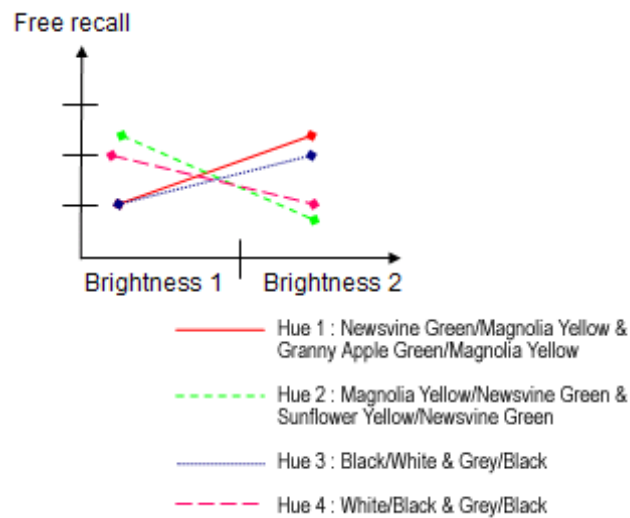


Figure 4: Effects of brightness on free recall

From this result, we understand that a lower contrast between background color and foreground color enhances the memorization of the commercial information given on a website.

Direct effects of the colors of the color scheme on buying intention

The results of the GLM analysis demonstrate that the color scheme of an e-commerce website is very influential on buying intention (Table 9). Brightness has a significant positive effect on buying intention ($F = 15.201$, $p \leq 0.000$) (Table 9). In line with our results for memorization, we note that when the background and foreground colors' brightness is not too strong, buying intentions are the highest (Table 8).

Table 9: Effects of color scheme colors on buying intention

	DF	F	p-value
Hue	3	0.349	0.790
Brightness	1	15.201	0.000***
Hue x Brightness	3	3.732	0.012*

* $p < 0.1$; *** $p < 0.001$

The GLM analysis also shows that hue and brightness have a positive interaction effect on buying intention ($F = 3.732$; $p \leq 0.012$).

The results of the ANOVA show that the effect of brightness on buying intention is only significant for hues n°1 (background color = *Magnolia Yellow*, foreground color = *Newsvine Green* or *Granny Apple Green*) and n°2 (background color = *Newsvine Green* and foreground color = *Magnolia Yellow* or *Sunflower Yellow*), i.e. with chromatic hues. Brightness but has no significant effect on buying intention in the case of black and white hues. This result differs from Hall and Hanna (2003) finding that color combinations do not have a significant effect on consumer purchase intention. When contrast is higher and brightness increases, buying intention increases (Figure 5). Therefore, H2 is accepted.

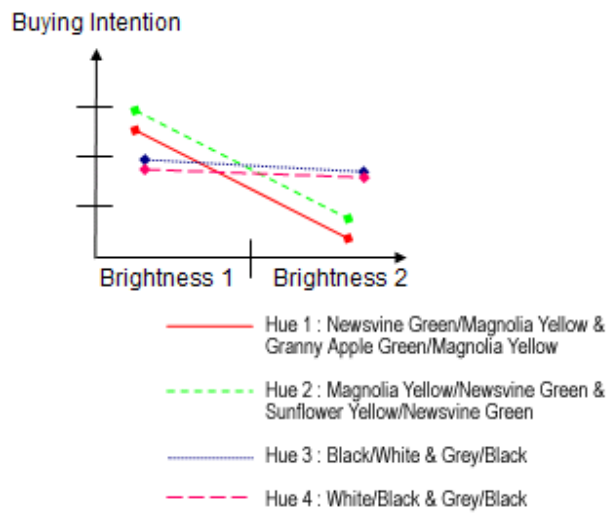


Figure 5: Effects of brightness on buying intention

Effect of memorization on buying intention

A simple regression enables us to observe that free recall has a positive effect on buying intentions (Table 10). The more information an individual memorizes about a product, the stronger her or his buying intention will be. Thus, hypothesis H3 is accepted.

Table 10: Regression between memorization and buying intention

	Buying intentions
Memorization	0.044*
Constant	2.096**
F = 3.824 ; R ² = 0.013	

* p < 0.1 ** p < 0.01

Direct effects of the colors of the color scheme on mood

GLM analyses show that hue and brightness have a significant interaction effect on negative mood (F = 3.042; p ≤ 0.029) (Table 11). In this sense, we can accept hypothesis H4.

Table 11: Effects of color scheme colors on mood

	Effects of color scheme colors on positive mood			Effects of color scheme colors on negative mood		
	DF	F	p-value	DF	F	p-value
Hue	3	0.374	0.772	3	1.159	0.326
Brightness	1	0.041	0.840	1	0.334	0.564
Hue x Brightness	3	0.916	0.434	3	3.042	0.029*

*p<0.1

ANOVAs show that color schemes based on hues n°1 (foreground = *Newsvine Green* or *Granny Apple Green* and background = *Magnolia Yellow*) and n°4 (background = *Black* and foreground = *White* or *Grey*) allow for an interaction effect between hue and brightness. When hue n°1 (*Newsvine Green/Magnolia Yellow* and *Granny Apple Green/Magnolia Yellow*) is used, an increase of the brightness level entails a significant increase of negative mood ($F = 3.066$; $p \leq 0.084$), while with hue n°4 (*White/Black* - *Grey/Black*), an increase of the brightness level decreases negative mood ($F = 3.815$; $p \leq 0.055$).

Effect of mood on memorization and buying intention

Since positive mood was not found to be affected by color, the effect of mood on memorization and buying intention was tested by examining the effect of negative mood on these variables. Two simple regressions give evidence that negative mood has a significant and negative impact on buying intention ($b = -0.129$; $p \leq 0.01$), but does not have a significant effect on memorization (free recall) (Table 12). Therefore hypothesis H5 is not accepted, while hypothesis H6 can be accepted.

Table 12: Regression between negative mood and buying intention

	Buying intentions
Negative mood	-0.129**
Constant	- 8.215E-17
F = 4.901 ; R ² = 0.017	

* $p < 0.1$ ** $p < 0.01$

DISCUSSION

Experiments on the behavior of Internet users are still relatively rare. At the same time there is a paucity of research distinguishing among the three components of color, hue, brightness and saturation in e-commerce websites. Building on Drugeon-Lichtlé (1996, 2007, 2009) and Gorn *et al.* (2004)'s works and understanding the importance to distinguish the three components of color, this study makes a contribution in this research area by examining these three color components in e-commerce. Indeed, it helps to discover new effects on consumer behaviour and responses that we did not know before. Our research enabled us to bring to the fore the effects of the colors used on e-commerce websites on consumer memorization and buying intention. It also shows that negative mood as a mediating variable reinforces these effects.

We thereby found that a lower contrast between background color and foreground color enhanced memorization. In other words, the retention of information is higher when the latter is more difficult to read. Such a result existed in psychology (Hill and Scharff, 1997; Scharff and Ahumada, 2002; Hall and Hanna, 2003) but there are not any research studies explaining this in e-commerce. In addition, although hue and brightness were not found to have a significant effect on memorization, they have an interaction effect on memorization and, in specific, on free recall. This interaction effect is most significant with chromatic colors. Green and yellow hues, which are chromatic ones, are more likely to enhance the memorization of the displayed information than black and white (achromatic colors). Chromatic colors induce better memorization scores, thus the effect of interaction of chromatic hues at particular levels of brightness, produce better memorization scores. The contribution of hue is thus not neutral; it can lead to better scores of memorization when it is properly combined with brightness.

Hue and brightness were not found to have a significant direct effect on cued or free recall. This seems reasonable since the hue or brightness of the text of the website (foreground color) and the hue and brightness of its background do not necessarily have to facilitate the retention of information.

Participants provided equivalent answers to closed questions about the content of the website (cued recall), regardless of the colors of the color scheme. These questions actually helped participants to memorize information in that they accurately added up the information that could be easily memorized. Instead, colors were more important in free recall, when no help was provided and participants had to remember what they saw on the website.

Brightness has a positive effect on buying intention, which is only significant for chromatic colors. In addition, hue and brightness have a significant interaction effect on buying intention. Low brightness favours a stronger buying intention. However, a too strong brightness can also discomfort the consumer and limit its desire to buy. When contrast is higher and brightness increases, buying intention increases. Similarly, it seems that a high brightness of the color scheme, and therefore a sharp contrast between background color and foreground (text) do not lead to a stronger buying intention.

Furthermore, we found an interaction effect between hue and brightness on mood. This is even more significant for chromatic hues. We can argue this by explaining that the decrease in contrast due to the increased lighting of the foreground color on the background one, discomforts respondents and put them in a negative mood when colors are chromatic. The visual comfort caused by the use of chromatic colors, which is not very common as explained earlier, should not be damaged by a too bright appearance.. Indeed, when someone has to guess what is written in front of him, affective and cognitive states are modified, resulting in a decreasing mood. Our results show that the effect of color was significant only for negative mood.

Purchase intention was found to be influenced by negative mood. Indeed some color schemes show that when brightness is high, negative mood increases. On the other hand, when negative mood is high, buying intention are weaker. It thus seems normal to find that higher brightness leads to weaker buying intention. The intention to buy diminishes when the colors of the e-commerce website seem unpleasant (negative mood) in the eyes of the consumer.

However, the effect of mood on memorization was not found to be significant. Customers memorize the commercial information provided on an e-commerce website better when colors result in a negative mood. This happens when the background and foreground colors create an unpleasant contrast to the respondents. Indeed, for some color schemes, the brighter colors are, the stronger the negative mood becomes. At the same time, a strong negative mood leads to strong memorization. It thus seems normal to find that a higher brightness of the color scheme leads to weaker memorization.

Memorization and in particular, free recall, was found to have a positive effect on purchase intention. The more a consumer memorizes information about a product, the more he intends to buy it. This result should be clarified because it would be interesting to know what information is effectively stored. Further analysis of the results of this experiment would allow us to answer to this question. Repeating the experimentation with the same respondents after a certain period of time could effectively help us to answer more accurately.

These results on color had not been revealed in previous work studying the three components of color in a similar experiment. Rather than comparing warm and cold hues, we focused on hue and brightness. We found that hue is important online, especially when measured with brightness, in line with previous findings about the brightness component of color (Drugeon-Lichtlé, 2009; Valdez and Mehrabian, 1994; Gorn *et al.*, 1997, 2004 and Camgöz *et al.*, 2002). Our results on the effect of color on memorization are in line with Hall and Hanna (2003), whereas the effect of color on mood as well as the effect of mood and memorization on buying intention have not been studied in previous research. Although the effect of color on emotions has been the research topic of several studies such as Valdez and Mehrabian (1994) and Lichtlé (2007), the effect of color on mood had not been previously examined in literature. Finally, our results regarding the effect of mood on memorization differ from those of Chebat *et al.* (1995) finding that positive mood increases memorization. In comparison to their work referring to offline shopping environments, our work suggests that it is negative mood that enhances memorization. The main difference between these two studies stems from the different nature of the shopping environment (online vs. offline). In particular, the psychological stimulation between a shopper in the offline environment and an online shopper appears to be different. Online shopping entails a cognitive effort of consumers to read information on screen, an effort that is missing from traditional shopping. Readability

in the offline environment is not as important as online, as the input consumers receive about products comes from the physical setting and not from the computer screen, which is the primary means of receiving information for the online consumer. Arguably, readability can influence affective states, and mood in particular. Therefore, negative mood can occur more easily online, influenced by readability, by commercial information which is too difficult to read. However, due to the additional effort required for reading, information that is difficult to read is also difficult to forget and is retained in consumer memory. This could explain the paradox of negative mood influencing positively memorization. In offline shopping, negative mood could arise from factors other than bad readability, lacking, thus, a positive effect on memorization.

CONCLUSIONS, IMPLICATIONS AND FUTURE RESEARCH

According to Gefen *et al.* (2003), an e-commerce website is an information technology and it is the primary interface with an online vendor. Therefore the design of an e-commerce website is of paramount importance for e-commerce success, influencing customer interaction and behavior. This is recognized by a large stream of research in information systems which have studied web design and have focused on perceived website quality and website characteristics as factors explaining online consumer behavior (Torkzadeh and Dhillon, 2002; Singh *et al.*, 2005; Hampton-Sosa and Koufaris, 2005). Color constitutes an important variable for the design of e-commerce websites, as reported in information system studies, especially in usability, human-computer interaction and e-commerce literature (Lee and Koubek, 2010; Coursaris *et al.*, 2008; Agarwal and Hedge 2008; McCracken *et al.*, 2003). In this study, we examined how color, a key attribute of the technological aspect of a website, influences consumer memorization, mood and purchase intention. In addition, in doing so, we address color in terms of its components, hue and brightness.

This study examines color in the context of e-commerce and website design with respect to its components, brightness and hue. In this approach, it extends previous research which focuses only on the hue component of color, and which compares warm and cold hues or combinations of hues.

Our study examines memorization in the context of e-commerce. We introduce memorization as a factor influencing buying intention, contributing to the existing body of literature on antecedents of buying intention in e-commerce. We also examined two factors influencing memorization, color and mood. We found that website color components, hue and brightness, have an interaction effect on consumer memorization. In addition, our results indicate that negative mood also leads to better memorization.

Furthermore, our findings show that the color of e-commerce websites affects consumer mood. While this is in accordance with Wu *et al.* (2008), our results also show that color hue and brightness jointly influence mood. In addition, our study shows that the color of e-commerce websites also influences purchase intention. Extending previous work showing that warm colors positively influence purchase intention (Wu *et al.*, 2008) our study contributes as it shows that brightness has a positive effect on purchase intention for chromatic hues and that hue and brightness have an interaction effect on purchase intention. Finally, our study shows that purchase intention is influenced by mood, in line with Wu *et al.* (2008). Overall, our study also provides easy to replicate standards for laboratory conditions, when conducting experiments on colors on the Internet. It seems that a study on color should compare hue and brightness rather than warm and cold colors when trying to examine what consumers recall and what leads them in purchasing. Indeed, in everyday life there is no support helping consumers to recall the content of an e-commerce website they visited or to compare it with another offer.

Our study provides findings on color that can inform and guide the design of websites in e-commerce so that they are effective for attracting customer purchases. By looking into mood and memorization, as variables which are antecedents of buying intention and are influenced by color, our study further contributes in information systems. The research implications are most important for memorization, as it is proposed as a new factor predicting buying intention of online consumers. Our results on the effect of color hue and brightness on mood and memorization are not only relevant to e-commerce web design but to web interface design in general and are also of value for research in web aesthetics, usability and

human-computer interaction. Hence, our findings are relevant and important to information systems researchers, particularly to those active in the areas of usability, human-computer interaction and e-commerce or the intersection of these areas.

These results must be related to the research conducted by Silverstein (1987) who noticed that monochrome screens entailed more eyestrain and overall tiredness. Therefore, e-vendors should be aware of this and choose carefully the hues of the foreground and background colors that they will use on their site so as to adjust them to their target. They should also take into account the aesthetic and functional impact of those colors: their contrast facilitates finding information on a webpage. Moreover, low brightness fosters better memorization scores and stronger buying intention. Consumers recall information more easily when they had difficulty reading on an e-commerce website, however, they did not necessarily feel like buying a product from this website. This holds especially for chromatic colors.

As with any research, this study comes with limitations. First of all, data were collected from participants interacting with a website designed for the experiment and not a real online store. In addition, the experiment website was an online store selling only CDs and not other products that could possibly produce different results. Furthermore, saturation as well as recognition variables were not possible to be measured. Finally, generalization of findings to all colors should be made with caution.

The difference of perception of colors among cultures should also be taken into account. Our sampling frame was a student population, primarily French, and we did not control for culture as an intervening variable. Future research with a color scheme varying according to the culture of the respondents could bring further and more detailed results. This entails the need for a cross-cultural study with samples with distinct color preferences as well as diverse semantic associations of color. Research across cultures is also needed to test how online consumer mood, memorization and buying intention and the links among them may be influenced and vary by cultural characteristics. As implied by a number of studies (Singh and Baack, 2004; Cyr *et al.*, 2010) e-commerce websites are not culturally neutral and their design characteristics can have different effects depending on culture. Hence, further work would be necessary to enhance our understanding towards a culturally informed design of effective e-commerce websites.

Future research related to the measurement of memorization or buying intention of online consumers, should undoubtedly take into consideration other brightness and saturation rates. As explained earlier, studying the long memory would probably bring more useful results regarding the effects of colors. This would require a replication of the experiment some months or years after the first one, with the same respondents, the same laboratory conditions and the same colors for the website. Coupled with the use of sound on e-commerce websites, further studies would enable us to reach a better understanding of the effects of the atmosphere pervading e-commerce websites on consumers, adopting a holistic rather than an individual approach to the phenomenon. Finally, besides hue, saturation and brightness, further research should examine the three other color components, texture, brilliance and matt effect, used in virtual worlds such as Second Life and in new e-commerce websites using the glossy effect for example.

This research illustrated the combinations of the most successful colors for web stores by taking into consideration the color hue, brightness and saturation. It also underlines the importance of chromatic colors and reinforces the need to include chromatic colors in web design, especially since most e-commerce websites use mainly achromatic colors. These results can contribute to help the designers of e-commerce websites particularly with regards to the combinations of colors of content zones (supporting the commercial information) and navigation zones (supporting the utilitarian information). The use of a combination of adequate colors (a) in the contents and (b) in the navigation, by respecting the territories of each of them by the use of borders or adequate colors when they are close one to the other, will allow designers to make the color scheme more pertinent in transforming the intention into act of purchase.

The ability of people to distinguish colors, or the inability of some to differentiate among them constitutes an issue to be considered during the design of an interface in order to increase its usability. With 8% of color blind people in the male population (Lanthony, 2005), brands have to use proper colors that are easily distinguishable by them. The W3C and WAI provide solutions for web designers on this topic by suggesting the use of “web safe colors”. Among the 256 colors that can be displayed on traditional computer screens, only 10 are viewed by color blind people on the Internet. Colors should be manipulated, so that the consumers lose no information because of a contrast or of a harmony which they

do not perceive. This should be taken into account early in the design phase of any e-commerce website. It seems evident that this applies to people affected by color blindness or by another disease affecting the vision of colors, for whom access to information outweighs the aesthetics of an e-commerce website. Besides, the growing percentage of seniors using e-commerce, requires taking more seriously into consideration the management of colors within the wider context of enabling access to the information. This can be improved with the choice of better contrasts between the foreground color (text) and the background color. As sight decreases with age, e-sellers should provide an even easier way for seniors to read information, as assistance in their shopping experience. Thus, playing with brightness and saturation levels of safe colors carefully selected for the text and background, making the website readable for old and color blind people, can be a critical success factor in terms of ROI.

REFERENCES

- AGARWAL A and HEDGE A (2008) The impact of web page usability guideline implementation on aesthetics and perceptions of the e-retailer. *Proceedings of the Human Factors and Ergonomics Society*, September 2008, vol. 52, n°6., 528-532.
- AUMONT J (1994) Introduction à la couleur : des discours aux images, Paris, Armand Colin.
- BELK R W (1985) Issues in the Intention-Behavior Discrepancy, In Sheth Jagdish N., eds. *Research in Consumer Behavior - Volume 1*. CN:Greenwich: JAI Press: 1-34.
- BELLIZZI JA and HITE RE (1992) Environmental Color, Consumer Feelings, and Purchase Likelihood, *Psychology and Marketing*, 9, September-October, 347-64.
- BEM SL (1974) The Measurement of Psychological Androgyny, *Journal of Consulting and Clinical Psychology*, 1974 Apr, 42(2), 155-162.
- BIERS K and RICHARDS L (2002) Web Page Background Color Evaluative Effect On Selected Product Attributes, working paper, Utah State University.
- BRADY L, and PHILLIPS C (2003) Aesthetics and usability: a look at colour and balance. *Usability News*, 5(2), <http://www.surl.org/usabilitynews/112/pdf/Usability%20News%20112%20-%20Phillips.pdf>
- BREMOND É. (2002) *L'intelligence de la couleur*, Paris, eds. Albin Michel.
- BOYATZIS CJ and VARGHESE R (1993) Children's emotional associations with colors, *The Journal of Genetic Psychology*, 155(1), 77-85.
- BUCKLIN R E and SISMEIRO C (2003) A model of web site browsing behavior estimated on clickstream data, *Journal of Marketing Research*, 40, 3, 249-267.
- CAMGÖZ N, YENER N and GÜVENÇ D (2002) Effects of hue, saturation, and brightness on preference, *Color Research & Application*, 27, 3, 199-207.
- CHEBAT, J.-C., GELINAS-CHEBAT, C., VANINSKI, A., AND FILIATRAULT, P. (1995) The Impact of Mood on Time Perception, Memorization, and Acceptance of Waiting. *Genetic, Social, and General Psychology Monographs* 121(4), 411-4.
- CHEBAT J-C and MORRIN M (2006) Colors and cultures: exploring the effects of mall decor on consumer perceptions. *Journal of Business Research*, 60(3), 189-196.
- CIALDINI RB, DARBY BL and VINCENT JE (1973) Transgression and Altruism: A Case for Hedonism. *Journal of Experimental Social Psychology*, 9(6), 502-516.
- COURSARIS C, SWIERENGA S and WATRALL E (2008) An Empirical Investigation of Color Temperature and Gender Effects on Web Aesthetics, *Journal of Usability Studies*, (3)3, 103-117.
- CYR D, HEAD M and LARIOS H (2010) Colour appeal in website design within and across cultures: A multi-method evaluation, *International Journal of Human-Computer Studies*, 68(1-2), 1-21.
- DARPY D (1997) *Une variable médiatrice du report d'achat : La procrastination*, Communication au 13ème Congrès International de l'AFM, Toulouse.
- DELAFFROOZ N, PAIM LH and KHATIBI A (2010) Students' Online Shopping Behavior: An Empirical Study, *Journal of American Science*, 6(1), 137-147.
- DEEB SS (2004) Molecular genetics of color-vision deficiencies, *Visual Neuroscience*, 21(3), 191-6.
- DEEB SS and MOTULSKY AG (2011) Red-Green Color Vision Defects, In: Pagon RA, Bird TD, Dolan CR, Stephens K, (eds). *GeneReviews*, Seattle (WA): University of Washington, Seattle; 1993-2005 [updated 2011 Sep 29].
- DEMERS E and LEV B (2001) A rude awakening: internet shakeout in 2000, *Review of Accounting Studies*, 6(2-3), 331-359.
- DIVARD R and URIEN B (2001) Le consumer vit dans un monde en couleurs, *Recherche et Applications en Marketing*, 3-24.

- DONOVAN RJ and ROSSITER JR (1982) Store atmosphere: an environmental psychology approach, *Journal of Retailing*, 58(1), 34-57.
- DREZE X and ZUFRYDEN F (1997) Testing Web Site Design and Promotional Content, *Journal of Advertising Research*, 37 (2), 77-91.
- DRUGEON-LICHTLÉ M-C (1996) Les effets des couleurs d'une annonce magazine sur les émotions du consumer : conceptualisation et résultats d'une étude exploratoire, Actes de l'Association Française de Marketing, 12, Poitiers, éd. Michel Kalika, 445-458.
- DRUGEON-LICHTLÉ M-C (2002) Couleur d'une annonce publicitaire, goûts des individus et perception des marques, *Décisions Marketing*, April/June, 26, abi/inform global, 29.
- DUNN B (1992) Choice of Color for Product Can Be Critical Factor, *The Gazette*, August 10, 6.
- ENGEL JF, KOLLAT DT and BLACKWELL RD (1978) *Consumer Behavior*, 3rd edition, Hinsdale, Dryden Press, II.
- ERICKSON G B and Block S S (1999) Testability of a color vision screening test in a population with mental retardation, *Journal of the American Optometric Association*, 70(12), 758-763.
- EROGLU S A, MACHLEIT K A and DAVIS L M (2001) Atmospheric qualities of online retailing: a conceptual model and implications, *Journal of Business Research*, special issue on Retail Strategy and Consumer Decision Research, 54, November, 177-184.
- EROGLU S A, MACHLEIT K A and DAVIS L M (2003) Empirical Testing of a Model of Online Store Atmospherics and Shopper Responses, *Psychology & Marketing*, 20, 2, 139-50.
- EYSENCK M W (1976) Arousal, learning, and memory, *Psychological Bulletin*, 83, 389-404.
- FERNANDEZ-MALOIGNE C (2004) Quelle métrique pour l'évaluation de la qualité couleur d'une image numérique ? Application à la compression JPEG2000, CAM Conférence, Paris, octobre.
- FILSER M (1994) *Le comportement du consommateur*, Précis Dalloz, Paris.
- FILSER M (2003a) Le marketing sensoriel: la quête de l'intégration théorique et managériale, *Revue Française du Marketing*, 194, 4/5, Septembre, 5-11.
- FILSER M (2003b) Vingt ans de recherches en comportement du consumer, in : Rémy, I. Garabuau-Moussaoui, D. Desjeux and M. Filser, (eds), *Sociétés, Consommation et Consommateurs*, L'Harmattan, 15-20.
- FORGEAS J P (1999) Network theories and beyond, T. Dalgleish and M. J. Power (eds.), *Handbook of Cognition and Emotion*, 591-612, Chichester, Wiley.
- GARDNER MP (1985) Mood states and consumer behavior: a critical review, *Journal of Consumer Research*, 12(3), 281-300.
- GEFEN D, KARAHANNA E and STRAUB DW (2003) Trust and TAM in Online Shopping: An Integrated Model. *MIS Quarterly*, (27)1, 51-90.
- GORN G, CHATTOPADHYAY A, SENGUPTA J and TRIPATHI S (2004) Waiting for the web : how screen color affects time perception, *Journal of Marketing Research*, XLI, May, 215-225.
- GORN G, CHATTOPADHYAY A T YI and DAHL D W (1997) Effects of color as an executional cue in advertising: they're in the shade, *Management Science*, 43, 10, 1387-1400.
- HALL RH and HANNA P (2003) The Impact of Web Page Text-Background Color Combinations on Readability, Retention, Aesthetics, and Behavioral Intention, *Behavior and Information Technology*, 23(3), 183-195.
- HAMILTON M and LUO R (1999) *Impact of Animation and Color Complexity on Web Site Effectiveness*, Working Paper, Department of Communication Sciences, University of Connecticut, 1-10.
- HAMPTON-SOSA W and KOUFARIS M (2005) The Effect of Web Site Perceptions on Initial Trust in the Owner Company, *International Journal of Electronic Commerce*, 10(1), 55-81.
- HANSON, WA (2000) *Principles of Internet Marketing*, South-Western College Publishers, Cincinnati, Ohio.
- HILL A and SCHARFF L V (1999) *Readability of computer displays as a function of color, saturation, and background texture*, éd. D. Harris, Engineering Psychology and Cognitive Ergonomics, 4, 123-130.
- HILL A and SCHARFF L V (1997) *Readability of websites with various foreground/background color combinations, font types and word styles*, Proceedings of 11th National Conference in Undergraduate Research, 2, 742-746.
- HOWARD J A (1994) *Buyer Behavior in Marketing Strategy*, Englewood Cliffs, NJ: Prentice Hall.
- HUMAR I, GRADISAR M and TURK T (2008) The Impact of Colors on the Speed of Reading Web Pages on a CRT monitor, *International Journal of Industrial Ergonomics*, 38 (2008) 885-899.
- ISEN A M, SHALKER T E, CLARK M and KARP L (1978) Affect, accessibility of material in memory, and behavior : A cognitive loop, *Journal of Personality and Social Psychology*, 36, 1-12.
- ITTEN J (1970) *The elements of Color*, New York, Van Nostrand Reinhold Company.
- JOLIBERT A and JOURDAN P (2006) *Marketing Research, Méthodes de recherche et d'études en marketing*, éd. Dunod, Paris.
- KANG K-S and CORBITT B (2001) Effectiveness of graphical components in web site e-commerce application – a cultural perspective, *Electronic Journal on Information Systems in Developing Countries*, 7(2), 1-6.

- KIRITANI Y and SHIRAI S (2003) Effects of background colors on user's experience in reading website, *Journal of the Asian Design International Conference*, Academic Journal, 1, 64.
- KIM D, FERRIN DL and RAO HR (2008) A trust-based consumer decision-making model in electronic commerce: The role of trust, perceived risk, and their antecedents. *Decision Support Systems*, 44(2), 544-564.
- KOTLER P (1973) Atmosphere as a marketing tool, *Journal of Retailing*, 49, Winter, 48-64.
- KOYANI S, BAILEY R and NALL P. (2006) Research-Based Web Design and Usability Guidelines. www.usability.gov.
- LADWEIN R (1999) *Le comportement du consommateur et de l'acheteur*, Paris, Economica.
- LANTHONY P (2005) *La perception des couleurs sur écran*, Intervention dans le cadre d'un séminaire sur la couleur, 3C S.A., Abbaye de Royaumont - France, Juin 2005.
- LEE S and KOUBEK RJ (2010) The effects of usability and web design attributes on user preference for e-commerce web sites, *Computers in Industry*, 61, 329-341.
- LEMOINE J-F (2003) Vers une approche globale de l'atmosphère du point de vente, *Revue Française du Marketing*, 194, Septembre, 83-101.
- LEMOINE J-F (2008) "L'influence de l'atmosphère des sites web marchands sur les réponses des internautes", 24ème congrès international de l'association française du marketing, Paris, 15 et 16 mai 2008, CDRom.
- LICHTLÉ M-C (2009) Pour favoriser la mémorisation d'une marque, un annonceur a-t-il intérêt à utiliser des couleurs étonnantes ?, *Gestion 2000*, Vol. 26 n° 5, sept.-oct. 2009.
- LICHTLÉ M-C (2007) The effect of an advertisement's colour on emotions evoked by an ad and attitude towards the ad The moderating role of the optimal stimulation level, *International Journal of Advertising*, 26(1), 37-62.
- MAGUIRE M (2011) Guidelines on Website Design and Colour Selection for International Acceptance, 6769 LNCS (PART 1), 162-171
- MANDEL N and JOHNSON E J (2002) When web pages influence choice: effects of visual primes on experts and novices, *Journal of Consumer Research*, 29(2), 235-245.
- MASTERS J and WYNDOL F (1976) Effects of Affective States on Noncontingent Outcome Expectancies and Beliefs in Internal or External Control, *Developmental Psychology*, 12, 481-82.
- MATTELART A (1996) *The Invention of Communication*, London/Minneapolis, University Minnesota Press.
- MAYER JD and GASCHKE YN (1988) The experience and meta-experience of mood, *Journal of Personality and Social Psychology*, 55, 102-111.
- MCCRACKEN, DD ,WOLFE RJ and SPOOL JM (2003) *User-centered Website Development: A Human-Computer Interaction Approach*, Pearson Prentice Hall Inc., Upper Saddle River, NJ.
- MEHRABIAN A and RUSSELL JA (1974) *An Approach to Environmental Psychology*, MIT Press, Cambridge, MA.
- MOE WW and FADER PS (2004) "Dynamic Conversion Behavior at E-Commerce Sites", *Management Science*, 50 (3), 326-35.
- MOSS G, GUNN R and HELLER J (2006) Some men like it black, some women like it pink: consumer involvements of differences in male and female website design, *Journal of Consumer Behavior*, London, 5, 4, 328-342.
- MUCCHIELLI A (1991) *Les méthodes qualitatives*, Que sais-je?, Presses Universitaires de France, Paris.
- MUNSELL A (1969) *The Munsell Colour Atlas*, Munsell Color Corp.
- NIELSEN J (2000) *Designing Web Usability*, Indianapolis, Indiana, New Riders Publishers.
- ODOM AS and SHOLTZ SS (2004) *The reds, whites, and blues of emotion: examining color hue effects on mood tones*, department of psychology Missouri Western State University, Copyright 2004 MWSC.
- OJANPÄÄ H and NÄSÄNEN R (2003). Effects of luminance and colour contrast on the search of information on display devices, *Displays*, 24, 167-178.
- O'SHAUGHNESSY J (1992) *Explaining Buyer Behavior: Central concepts and Philosophy of Science issues*, NY: Oxford University Press.
- PANTIN-SOHIER G (2004) Le rôle de la couleur dans la perception des traits de personnalité de la marque : une étude comparative Etats-Unis / Suède, 1ère journée de recherche AFM-AUDENCIA sur le Marketing et le Design - Janvier.
- PAPACHRISTOS E, TSELIOS N and AVOURIS N (2005) Inferring relations between color and emotional dimensions of a Web site using Bayesian Networks, Proceedings of Interact 2005.
- PEW RESEARCH CENTER (2010) Millennials. Pew Research Center, February 24. Available at: <http://pewresearch.org/millennials/>
- RIDPATH C, TREVIRANUS J and WEISS PLT (2000) *Testing The Readability Of Web Page Colors*, University of Toronto's Adaptive Technology Resource Centre, WWW9 conference in Amsterdam <http://www.aprompt.ca/WebPageColors.html>.
- ROTTER JB (1966) Generalized Expectancies For Internal Versus External Control Of Reinforcement, *Psychological Monographs*, 80(1), Whole N° 609.

ROULLET B (2004) *L'influence de la couleur en marketing: vers une neuropsychologie du consommateur*, Thèse de doctorat en sciences économiques et de gestion, Université de Rennes 1, Rennes, décembre.

SCHARFF LV and AHUMADA AJ JR (2002) Predicting the readability of transparent text, *Journal of Vision* 2(9), 653-666.

SCHARFF L V and HILL AL (2000) Discriminability measures for predicting readability of text on textured backgrounds, (C) 2000 OSA 14 February, 6, 4, *Optics Express* 81.

SCHMIDT KE and LIU Y (2005) Design of consumer product webpages: Experimental investigations of aesthetic and performance factors. *Proceedings of the Human Factors and Ergonomics Society*, 1743-1746.

SILVERSTEIN LD (1987) Human Factors for Color Display System: Concepts, Methods, and Research, *Color and the Computer*, éd. J. Durrett, San Diego, CA, Academic Press, 27-61.

SINGH N and BAACK DW (2004) Web Site Adaptation: A cross-cultural comparison between U.S. and Mexican Web sites, *Journal of Computer Mediated Communication*, 9(4).

SINGH N, DALAL N and SPEARS N (2005) Understanding Web home page perception, *European Journal of Information Systems*, 14, 288-302.

SO S and SMITH M (2002) Colour graphics and task complexity in multivariate decision making, *Accounting, Auditing & Accountability Journal*, 15(4) 565-593.

SWINYARD WR (1993) The Effects of Mood, Involvement and Quality of Store Experience on Shopping Intentions. *Journal of Consumer Research*, 20, 271-280.

TORKZADEH G and DHILLON G (2002) Measuring Factors that Influence Success of Internet Commerce, *Information Systems Research*, 13(2), 187-204.

TROUVÉ A (1999) *La mesure de la couleur*, Paris, CETIM, éd. Association française de normalisation (AFNOR).

VALDEZ P and MEHRABIAN J (1994) Effects of color on emotions, *Journal of Experimental Psychology*, General, 123, 4, 394-409.

WAT-C. (2005) Tools - Colour Contrast Analyser 1.1. Retrieved from the Web Accessibility Tools Consortium Web Site: <http://www.wat-c.org/tools/CCA/1.1>

W3C (2008) Publication Version 1.1 of the AccessiWeb repository created by the W3C, of the June 9, 2008, available at: <http://www.w3c.org/>.

WESTBROOK R (1980) Intrapersonal Affective Influences on Consumer Satisfaction with Products. *Journal of Consumer Research*, 7, 49-54.

WEXNER L B (1954) The degree to which colors (hues) are associated with mood-tones, *Journal of Applied Psychology*, 6, 432-436.

WU C-S, CHENG F-F and YEN DC (2008) The atmospheric factors of online storefront environment design: An empirical experiment in Taiwan. *Information & Management*, 45, 493-498.


YOO B and DONTHU N (2001) Developing and validating multidimensional consumer-based brand equity scale, *Journal of Business Research*, 52(1), 1-14.

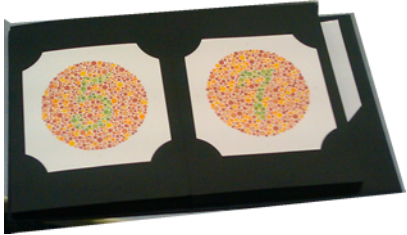

ZICKUHR K (2010) Generations Online in 2010, Pew Internet & American Life Project, Pew Research Center.

ZUCKERMAN M (1994) Behavioral Expressions and Biosocial Bases of Sensation Seeking, Cambridge: Cambridge University Press.

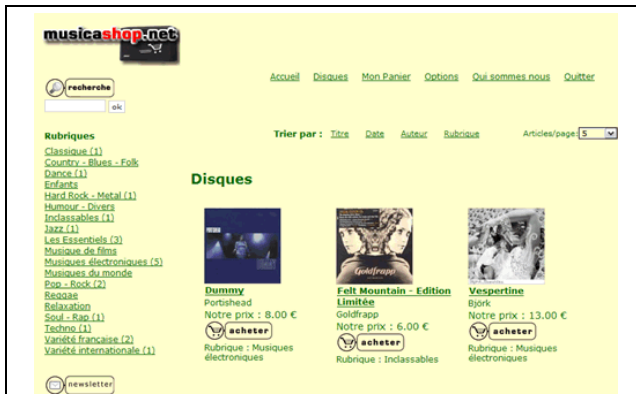
APPENDICES

Appendix 1: Devices and installation required to conduct the experiment properly

<p>Experiment room (Fernandez-Maloigne, 2004)</p>	<p>Measurements were taken at different intervals with a luxmeter:</p> <ul style="list-style-type: none"> - Keep a distance of about one meter between the back of the room and the screen, - Room lighting (ambient illumination), - High-quality assessment monitor, size 50-60 cm (22" - 26"). 	 <p>The luxmeter</p>
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<p>Participants (Lanthyony, 2005)</p>	<p>- An Ishihara's test for color blindness was conducted to guarantee that participants were not color-blind and thus in a position to provide valid answers.</p>	 <p>The Ishihara's test</p>
<p>Screens</p>	<p>All the screens used during the experiment were calibrated</p> <ul style="list-style-type: none"> - The screens must warm up for an hour before calibration; - A CRT display must be used rather than a plasma screen; - Ambient light compensation must be disabled; - The probe allows to generate the ICC profile; - Save the ICC profile which will be set automatically afterwards. 	 <p>The probe</p>

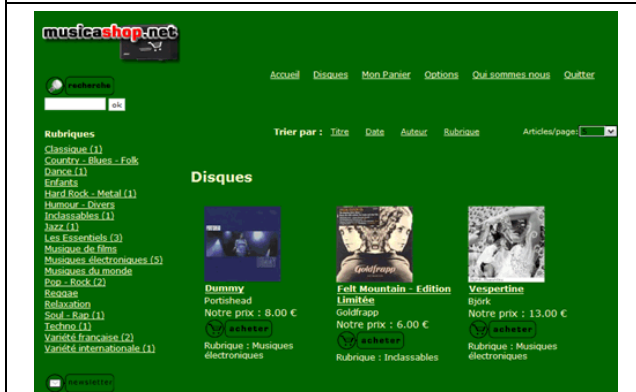
Appendix 2: Experiment website screenshots for the 8 color schemes



Experiment Plan 1



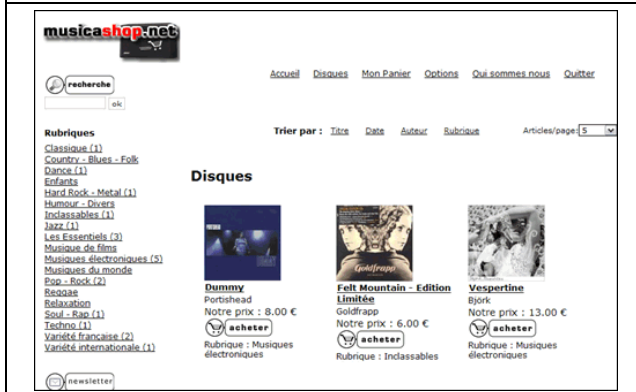
Experiment Plan 2



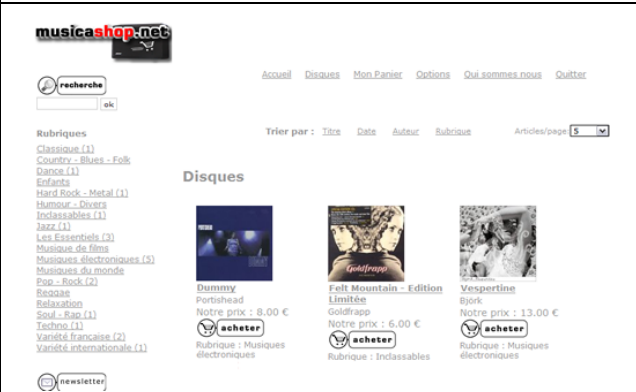
Experiment Plan 3



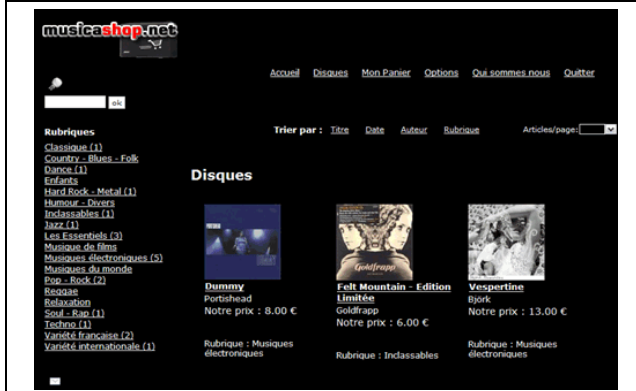
Experiment Plan 4



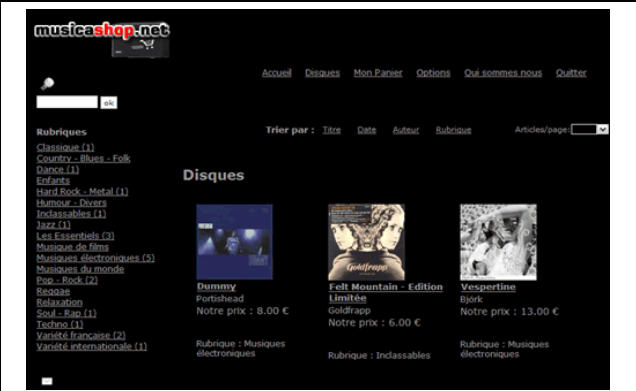
Experiment Plan 5



Experiment Plan 6



Experiment Plan 7



Experiment Plan 8

Appendix 3: Brief Mood Introspection Scale (BMIS) – (Mayer and Gaschke, 1988)

The scale is based on the question “Do you feel _____?” for each of the 16 items shown below. Each item was measured on a 5-point Likert scale ranging from 1 – ‘Definitely do not feel’ to 5 – ‘Definitely feel’

N°item	Item	Corrected Correlation	With out item	Quality of representation	Contribution to the factor 1	Contribution to factor 2
1	Happy (Hum1)	.377	.779	.505	-	.505
2	Fed up (Hum2)	.412	.846	.540	.658	-
4	Caring (Hum4)	.512	.838	.526	.725	-
5	Nervous (Hum5)	.537	.834	.712	.751	-
6	Satisfied (Hum6)	.411	.776	.631	-	.631
7	Grouchy (Hum7)	.486	.759	.628	-	.628
9	Sad (Hum9)	.588	.826	.653	.807	-
10	Jittery (Hum10)	.571	.772	.755	-	.755
11	Loving (Hum11)	.407	.776	.514	-	.514
12	Drowsy (Hum12)	.394	.854	.753	.583	.643
13	Lively (Hum13)	.544	.853	.600	.605	-
14	Gloomy (Hum14)	.634	.819	.746	.850	-
15	Tired (Hum15)	.459	.842	.661	.683	-
16	Active (Hum16)	.475	.778	.631	-	.631
Cronbach Alpha		0.814				
Eliminated Items		Peaceful – Hum3, Affectionate – Hum8				
Bartlett Sphericity Test		<i>Approximate Chi² = 985.340 – ddl = 28 – Sig. = .000</i>				
KMO value		0.854				
Recommended value					3.304	1.120
% of information		64.882				

Items were measured on a 5-point Likert scale ranging from 1 – Definitely do not feel to 5 – Definitely feel

Appendix 4: Buying intention scale (Yoo and Donthu, 2001)

N°item	Item	Corrected Correlation	Without item	Quality of representation	Contribution to the factor
1	I will certainly buy products coming from this website in the near future.	.791	.864	.825	.908
2	I intend to buy on this website in the near future.	.834	.837	.863	.929
3	It is likely that I buy on this website in the near future.	.791	.870	.824	.908
4	I plan to buy on this website in the near future.	.832	.865	.842	.927
Cronbach Alpha		0.899			
Eliminated Items		-			
Bartlett Sphericity Test		<i>Approximate Chi² = 563.367 – ddl 3 = – Sig. = .000</i>			
KMO value		.749			
Recommended value		2.512			
% of information		83.739			

Items were measured on a 5-point Likert scale ranging from 1 – ‘Strongly agree’ to 5 – ‘Strongly disagree’