



The use of colors in Technical Writing

How to take advantage of it

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Abstract

We come from different cultural and educational backgrounds and decided to analyze and focus on how colors may influence readability and, therefore, comprehension on technical documentation.

This matter came after we browsed a website from a marketplace corporation and we noticed that there was a lack of harmony and synchronicity between its marketing and documentation website. We noticed it mainly because the visual identity, particularly the use of colors and icons, was absolutely discordant.

It was remarkable that the two websites were developed by different teams, what could eventually reveal an internal noise in communication, or even some problem in the enterprise architecture.

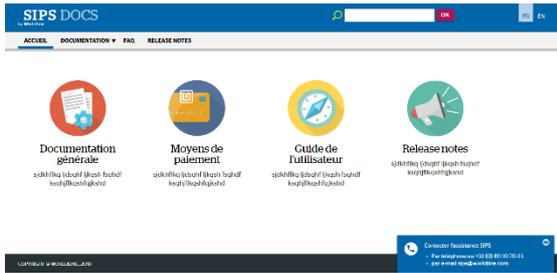
A simple misuse of colors can reveal much more than aesthetics, design or layout. And this seemed quite impressive to us.

The color approach however can be very large, with multi-disciplinary, underestimated, usually treated randomly and not too scientific under the gaze of the academic community. We want to show that it can be theory-based and, by means of a user test, we intend to prove – practically – that colors should be treated with the importance they deserve, far beyond aesthetics and layout.

After applying a user test, we noticed that users react differently face to face with a colored and a black and white document.

Introduction

In the past decade, there has been increased interest in research on color and psychological functioning. Although it is more commonly used in marketing materials than in technical writing, color can be used to add emphasis to key points in technical documents. If color is used correctly, it can be a powerful tool in online technical writing such as Web pages, Help files or printed technical documents.



Marketing Site

Technical Documentation Site

Marketing and Communication Departments often collaborate closely together. They are not only responsible for the external image of the company and what it represents according to its missions and values, but they are also responsible for the impact that the brand has on consumers, sales and turnover. In this point of view, every single detail is important: from graphic charter (the guidelines) or visual identity, from illustrations to colors, from logos to official songs displayed on videos. What we noticed when we created this research issue is that Marketing and Communication Departments are not always aligned with Technical Documentation Department and this might be a macro problem on corporate architecture and, on a micro scale, a key problem on technical documentation development, leading consequently to a lack of user comprehension.

Another issue that we noticed is that Technical Documentation Departments usually does not have the same budget as Marketing and Communication Departments and this can be quite limiting. However, it is possible to overcome this restriction by aligning these 3 departments, improving the internal communication and collaboration workflow and by using colors correctly.

We believe that technical writers should pay attention to the use of colors as much as they do to the content and as much as Marketing and Communication Departments do in order to establish the corporation style guide and graphic charter. According to our hypothesis, colors can have a major impact on user comprehension and a user test will allow us to detect this nuance on user comprehension. But what are the elements that improve memory performance and reading comprehension?

How the human cognitive system deals with the memorization process remains the centre of research among cognitive psychologists. A good use of colors helps people to improve memorization process. It

functions as a powerful information channel to the human cognitive system and has been found to play a significant role in enhancing memory performance.

To prove and argue our hypothesis, we conducted a survey among 10 people. Our user test focus on the effect of colors on comprehension and involves 2 different tests: a black and white and a colored test.

Before discussing the results of our user test analytically, we are going to develop some multi-disciplinary and theory-based arguments regarding the effect of colors on comprehension.

Materials and Methods



We started from a large and random perspective of an apparently improper internal use of colors at a marketplace company to focus more precisely then on the use of colors on technical writing and on how it leads to an easier readability and therefore comprehension.

Our scientific methodology is based on the assumption that colors help comprehension. We assume - hypothetically - that a strategic use of colors can be beneficial to understanding. The objective of this article is to test this subject and to give some guidelines to technical writers and communicators regarding this topic.

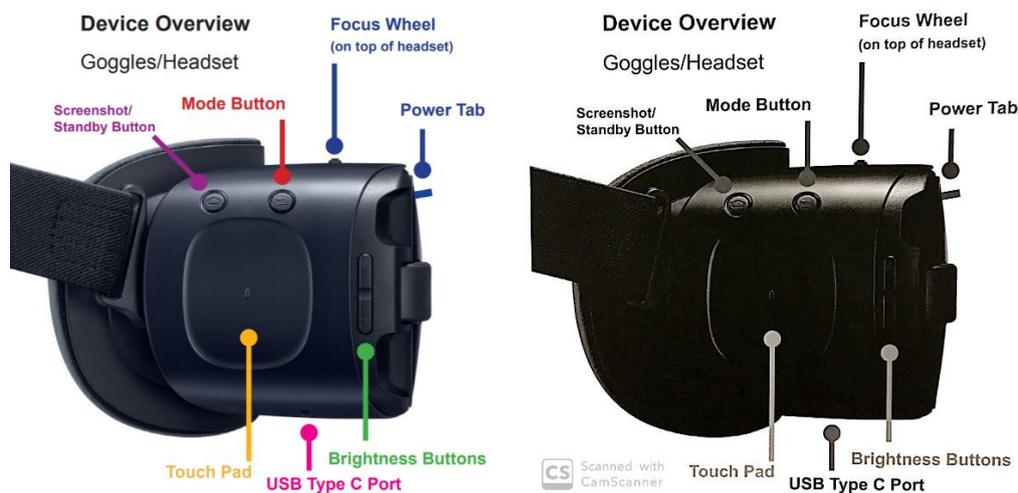
In order to do so, we created 2 different tests with exactly the same content and structure, but varying in the use of colors:

1. A black and white test
2. A colored test where colors are used strategically

These two tests were applied 5 times, that's to say, to 10 different people in exactly the same conditions: at the same time and with the same reading and answering time. Each person took only one test to answer, which means that each test was answered 5 times, from 5 different people. These tests were the basis of our statistical sampling that we are going to analyze and comment in this article.

Our interviewees answered the following questions (no consultation allowed):

1. What is the main subject of this technical guide?
2. Can you develop your global understanding in some lines?
3. What mandatory instruction was mentioned in this guide?
4. Can you please complete the missing buttons in this graphic?



Colored and Black and White Test

Inconsistent capitalization on anthropological points of view:

Relativism X Universalism

There are two currents of thought that establishes our cultural differences: Relativism and Universalism. The ideas of cultural relativists are often contrasted with the ideas of scholars propagating universalism. Cultural relativists stand for diversity of people and their cultures as the essence to humankind. The

universalists are doing the opposite – they emphasize the similarities within the humankind (Eriksen 2001:8). They are stating that there are essential human values and patterns common to all existing cultures. Out of those common patterns, they are making grand cross-cultural theories, which are supposed to explain the nature of man.

One of the proponents of universalism in anthropology is Donald Brown. According to him, “universals at the level of the individual are particularly likely to be close to human nature or to be actual elements of human nature - at the core of which are the evolved problem-solving mechanisms that constitute the human mind” (Brown 2004:48). Brown (1991) elaborates on already established distinction between universal, the generalized, and the particular: “Certain biological, psychological, social, and cultural features are universal – shared by all human populations. Others are merely generalized – common to several but not all human groups. Still others are particular – not shared at all” (Kottak 2011:35; emphases added). This statement is questionable, especially from the cultural relativist point of view: we are not able to seize and completely understand psychological traits, social features and cultural meanings in each particular culture that exists in this world. Because of that, it is very hard, if not impossible, to list and compare them without imposing an ethnocentric perspective.¹

Under the advent of Universalism, we created a hypothesis that the correct use of colors is useful and advantageous for all cultures across the world in the comprehension of technical writing. In order to analyse it, we not only proposed a user test, but we are also going to discuss some fundamental items to this subject, such as: cognitive sciences, visual memory, form and color psychology, contrast and neurosciences.

¹ Ethnocentrism, usually contrasted with cultural relativism, represents belief that one's culture is superior to other cultures (Kottak 2011:53).

Colors Psychology

Marketing already takes advantage of colors. And so does Design. Every single point of color influence is thoroughly studied to achieve its goal. It is believed that colors play an essential role on people's emotions, cultural meanings and preferences, as well as on company's image, mission and objective. As a result, colors play a role on buyer emotions and preferences and – therefore - on turnover.

Colors are influential because of our conceptual knowledge. Hues are almost meaningless. Color meanings (and their subsequent influence) depend on emotion and meaning we associate with a color.

Color is ubiquitous and is a source of information. People make up their minds within 90 seconds of their initial interactions with either people or products. About 62-90 percent of the assessment is based on colors alone. So, prudent use of colors can contribute not only to differentiating products from competitors, but also to influencing moods and feelings – positively or negatively – and therefore, to attitude towards certain products.

Many people have speculated over the last 80 years or so about the possibilities of using colored paper to boost response-rates to surveys and questionnaires, and several studies have been carried out. Most of these enquiries report no significant effects from using colored paper, although there have been some exceptions.

In one of the earliest studies, Gullahorn and Gullahorn (1963) tested green and white questionnaires in a survey of former Fulbright and Smith-Mundt grantees (N=7,370). Green questionnaires were found to increase response rate in a positive direction, 51 versus 49 percent, but the difference was not statistically significant. Pucel and colleagues (1971) also tested the difference in response rates for green and white questionnaires, along with several other "incentives." They surveyed students who graduated from vocational programs (N=1,100). No incentive by itself, including color, was found to significantly increase response rates, although color did increase response in a positive direction. The number of incentives, however, did increase response rates significantly. Matteson (1974) mailed pink and white survey questionnaires to members of a professional organization (N=2,040). Pink was chosen because it was thought to have the highest intensity (brightness). Matteson also varied the solicitation letter using a semi-personal and a form letter. Color did not significantly affect the response rate of those receiving the semi-personal letter (semi-personal letter recipients had significantly higher

response rates than form letter recipients). But for those receiving the form letter and pink questionnaire, there was a significant increase in the response rate at the five percent level (from 20 to 24 percent).

In a survey of university alumni of a student business honorary association (N=168), Crittenden, Crittenden and Hawes (1985) tested the effect of yellow versus white questionnaires. They tested yellow versus white because yellow was a psychological primary color, the brightness contrast between print on white and yellow paper was minimal, and both white and yellow had traditionally yielded high returns. The yellow questionnaire obtained a higher response rate than the white questionnaire (49 versus 37 percent).

Mike Brennan and Jan Charbonneau conducted a research and analyzed the various solutions to increase the response rates of surveys, namely the effects of colors in questionnaires: they came to the conclusion that colors were incentives to answer questionnaires and that using purple in mail surveys increased the response rates (Brennan and Charbonneau, 2005). Colors also enhance memory performance and influence users' retention. Researcher Dae-Young Kim assessed the strategy used by marketers and advertisers to attract consumers' attention in the tourism and hospitality sectors: her conclusion establishes a correlation between colors and memory (Dae-Young, 2010). Color pictures generate more working memory and remain more significantly in the long-term memory.

However, color alone cannot significantly increase response rate, improve memory and comprehension. We can use other elements to grab the attention of a reader and to improve readability such as: contrast, infographics, and forms.

Infographics are also appropriate media to optimize the understanding in a concise manner. Besides, technical communication is defined as "the discipline of transforming complex information into usable content for products, processes, and services" (Bleil, 2013). Color infographics are more effective than black and white ones. Colors are key elements for visual media as it partly drives users' attention: humans are more sensitive to chromatic variations than light changes; they focus more on contrasts than on light when they see images (Vazquez et al., 2010).

Contrast is used to make elements stand out and grab attention. Contrast, like proximity, creates a focal point in a visual design. A color contrast, for example, can redirect the attention of a reader to a more important part or message of a presentation.

Gestalt principles of form perception.

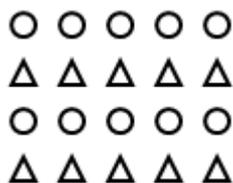
In the 30s and 40s, Gestalt psychology was applied to visual perception, most notably by Max Wertheimer, Wolfgang Köhler, and Kurt Koffka who founded the so-called gestalt approaches to form perception. Their aim was to investigate the global and holistic processes involved in perceiving structure in the environment. Some of these laws are as follows.

Law of proximity



The law of proximity posits that when we perceive a collection of objects, we will see objects close to each other as forming a group. In figure above, we perceive the MTV logo and the logo for the Europe Music Awards as forming a group in the top left corner and the logos of the sponsors as forming a group in the bottom right corner. The white space separating the two groups of logos is used to indicate 'grouping', and the proximity of the logos of each groups is thus used to this end. Thus, a semantic separation of 'organisers' from 'sponsors' is achieved via structuring the graphical layout in accordance with this simple principle of perceptual organisation.

Law of similarity



The law of similarity captures the idea that elements will be grouped perceptually if they are similar to each other. In the "preferences window" of the Opera browser, color is used to make the user group the menu items on the basis of their background color. The grey background of the first four menu items

thus "tie them together". The figure above is a typical textbook example of the principle of similarity, whereby we see the circles and triangles as forming four horizontal rows (or at least some configuration where triangles and circles are grouped depending on their shape). Objects similar to each other thus tend to be seen as a unit.

Law of Prägnanz (figure-ground)



Edgar Rubin, a Danish psychologist, was the first to systematically investigate the figure-ground phenomenon. The phenomenon captures the idea that in perceiving a visual field, some objects take a prominent role (the figures) while others recede into the background (the ground). The visual field is thus divided into these two basic parts. The logo of visitnorway.com can be viewed as both three separate elements of blue, green and navy color. It may, however, also be viewed as a person stretching his/her arms into the air.

Law of symmetry



The law of symmetry captures the idea that when we perceive objects we tend to perceive them as symmetrical shapes that form around their centre. Most objects can be divided in two more or less symmetrical halves and when for example we see two unconnected elements that are symmetrical, we unconsciously integrate them into one coherent object (or percept). The more alike objects are, they more they tend to be grouped.

In the above CSC Finland's logo is perceived as an integral whole although the two constituent geometrical shapes seem to be pointing in different directions and have differing colors.

Models of Human Memory

Human memory is commonly dichotomised to involve a short-term and longer-term memory storage. This dualistic nature of memory was proposed by the early investigators of memory, such as William James, and Waugh and Norman. The model proposed by Waugh and Norman, retained the concept of a primary and a secondary memory originally proposed by William James. Their model was regarded as the first behavioural model of memory due to its quantifying properties of primary memory. The earlier work on memory was well extended to lead to one of the influential models of the human memory system proposed Atkinson and Shiffrin. In their model, memory is made up of three structures; sensory register store, short-term store, and long-term store. Environmental stimuli will first reach the sensory register store. This memory store can register a huge amount of information, but the information is retained there very briefly. Information that is subject to a certain amount of attention is then moved to the short-term store. Information will be transferred to the long-term store for more permanent storage as a result of various types of control processes. It is said that the use of control processes such as maintenance and elaborative rehearsal, heuristic, or other memorization strategies are important to allow the information to be transferred from the short-term store to long-term store.

An alternative to the model of memory proposed by Atkinson and Shiffrin is the model proposed by Craik and Lockhart. They argued that the processes involved in memory were more important than the structures of the memory system. The memory processes are assumed to be on a continuum, from shallow sensory process to a deeper semantic memory process. The shallow memory processes involve a basic and surface analysis of the information, such as the physical and sensory characteristic of the information. Intermediate memory processing requires some degree of recognition and labelling and a deeper processing involves a higher degree of analysis like processing the meaning of the information and its link to the existing memory trace. It is assumed that deeper level of analyses contributes to a more lasting and longer memory ability. In other words, information will be stored in the long-term memory store as a result of the amount of analysis and processing done on the environmental input.

Therefore, it is important for the stimuli available in the environment to have the potential to activate the attention and to be involved in control processes or deeper level of processing in order for the stimuli to be better remembered. Previous studies have shown evidence that color is one of the variables that has this potential. Colors can influence the level of attention and also give rise to emotional arousal which contributes to control processes that will later enhance memory performance.

Color helps us in memorizing certain information by increasing our attentional level. The role played by color in enhancing our attention level is undisputable. The more attention focused on certain stimuli, the more chances of the stimuli to be transferred to a more permanent memory storage.

Factors that influence the effectiveness of Color Memory Performance

Some studies showed that colors can lead to better memory performance. There are however studies that indicate an opposing effect of color on memory. In short, effectiveness of color on memory performance is based on a few factors. First is the consistency of the colors used during encoding and retrieval phases.

Another factor that needs to be taken into account is when few colors or combination of colors are involved (as in background and foreground conditions). The right combination of colors is important because it can produce higher level of contrast, and this can influence memory retention. Higher level of contrast may refer to the color hue (the wavelength) and the luminance (brightness of the color) of the color. It was predicted that higher level of contrast will attract more attention and better visibility of an object or information.

Stimuli with white foreground on red background can have a higher level of contrast compared to the other color combination. Similarly, the use of a white color background with black color foreground has a better contrast level for memory retention for both short-term and long-term.

Conclusion and Discussion

Our research started with the idea that the correct and strategic use of colors would help readability and, consequently, comprehension. In order to analyze it, we proposed a user test with 2 open questions regarding the content in general and other 2 questions regarding the use of colors and its influence on memory and – therefore – assimilation and comprehension.

The two general questions were:

- ✓ What is the main subject of this technical guide?
- ✓ Can you develop your global understanding in some lines?

The two color-specific questions were:

- ✓ What mandatory instruction was mentioned in this guide?
- ✓ Can you please complete the missing buttons in this graphic?

Regarding the two general questions, there was not a huge difference in comprehension between the two guides (black and white and colored ones). The global understanding was present and correct, except from a major or minor development due mainly to the restricted reading time. But we noticed that – globally - the use of colors or the lack of use of colors did not interfere with the comprehension.

However, when we focus on the color-specific questions, we noticed that the content assimilation is significantly higher. For instance, 80% of people that read the colored guide answered the question about the missing buttons correctly, while only 20% did it right after reading the black and white guide. We believe that this difference presents strong evidence that the correct and strategic use of colors helps content assimilation and – therefore – comprehension. So, the accurate use of colors should be put forward and highlighted on technical writing, for the benefit of readers and users.

The other color-specific question result, concerning the mandatory instruction that was written in red in the colored guide and in black and white in the other one, was not so striking. We believe that it's due

mainly to a misunderstanding of the question. The question was not clear and direct enough, so answers in both user tests did not match our hypothetical expectations; that's to say, an equal percentage in both guides answered it correctly.

We showed that research on memory has provided a vast strategy that can be used to ensure successful retrieval. There appears to be a basis for associating color and its significant effect on memory abilities. In other words, color has the potential to increase chances of environmental stimuli to be encoded, stored, and retrieved successfully. The choice of colors and the manipulative aspects can, however, influence the extent to which colors can influence human memory performance.

Incorporating symbols and shading add interest and make line types distinguishable by colorblind viewers.

People suffering from color-blindness may encounter difficulties with certain documents containing colors. Pie charts, histograms, maps, etc. can be unreadable for these people.

Being friendly to colorblind people does not necessarily mean that one should not use colors. Even for colorblind viewers, colors are very useful cues to distinguish different objects easily and quickly. By carefully selecting colors that are easily recognizable to people with all kinds of color vision, one can maximize the effect of her/his presentations.

It's also important to avoid the situation where texts and objects are obscured with the background. For example, there should be enough contrasts in brightness and saturation between texts/objects and backgrounds. Avoid the combination of colors that have the same brightness but different only in hue. Red characters on green backgrounds is unreadable for colorblinds. Use either bright texts/objects over dark backgrounds, or vice versa. For non-colorblind people, red is the bright and vivid color. But for colorblinds, it is as dull as blue or dark green. Especially for protanopes, who cannot detect long wavelength of red light, dark red appears almost as black.

Even for bright vivid colors, colorblind people cannot sometimes distinguish the name of colors. When explaining figures, avoid using only color names and describe also shapes or positions. For example, avoid saying "this red cell". Instead, say "this red, round cells on the top left", for example.

We believe that technical writers must structure and adapt contents to their users and use colors to improve the understanding of every reader.

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