

Colored vs. black screens or how color can favor green e-commerce

Jean-Eric PELET*

University of Nantes, KMCMS, France

Panagiota PAPADOPOULOU

University of Athens, Greece

ABSTRACT

This paper presents the results of an exploratory qualitative study conducted with 26 consumers about their use of computer screen savers. The results show how the use of screen savers remains almost nonexistent. Unknown or taking too long to apply, this feature is not attractive to persons interviewed who do not use it for sustainable development purposes. The paper presents the results of this qualitative study, offering an interpretive analysis of the reasons and factors explaining this type of computer users behavior. The paper also discusses the potential of using screensaver functionality in e-commerce websites, particularly in the Mediterranean region. In this direction it looks into how this could be possibly provided by the establishment of two elements - a browser and a website extension, which will be tested in a future online experiment.

Keywords: color, energy, economy, sustainable development, green e-commerce

INTRODUCTION

In the European Commission, Information and Communication Technology (ICT) contribute to 2% of global greenhouse gas emissions (Gartner, 2007). Their environmental impact is therefore a concern that gradually receives research attention. A principal approach to address the environmental impact of Information Technology is to adopt a Green use — ‘reducing the energy consumption of computers and other information systems as well as using them in an environmentally sound manner’ (Murugesan, 2008). In this vein, in terms of management, information systems and marketing could potentially contribute to the effort to decrease these effects through electronic commerce. In particular, this could hold true with regards to the management of the screen saver for computers aiming to reduce their energy consumption and darken the color appearance of e-commerce websites. The display of a predominantly white interface is in fact more likely to "fatigue" than if the screen is black, or dark. But most of the e-commerce websites visited by French display dominant white colors (Figure 1).

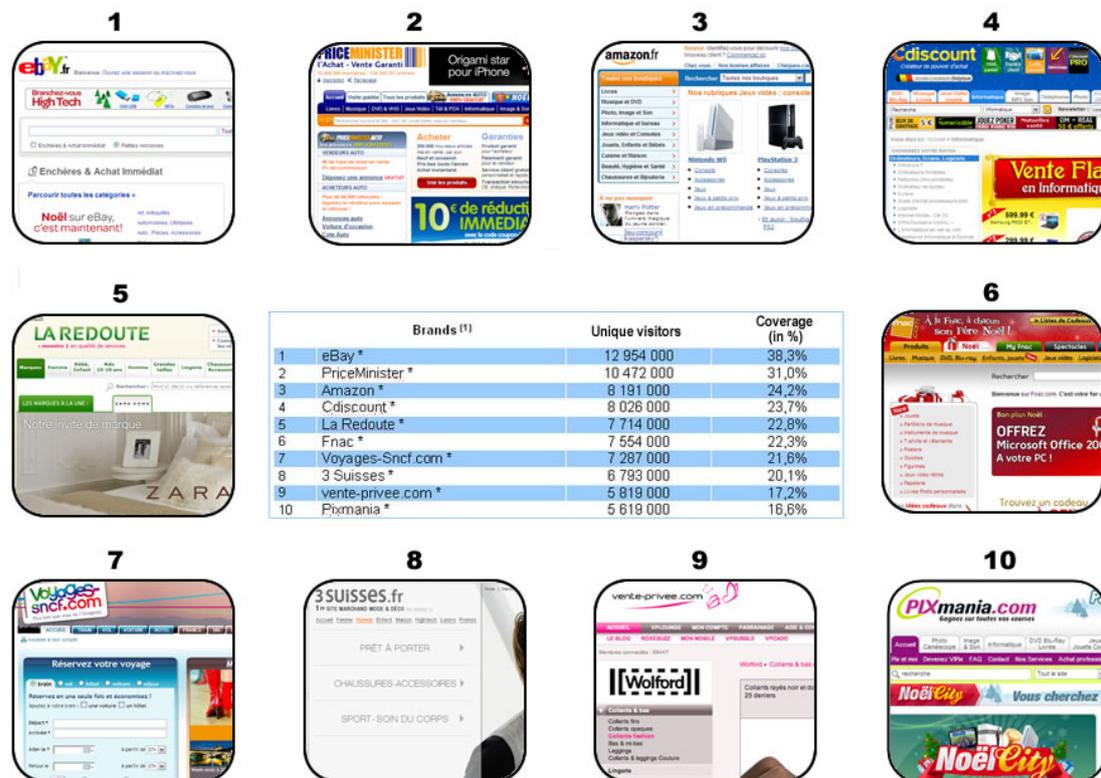


Figure 1: Presentation of the 10 most visited e-commerce sites in France (01/2010): all have a dominant color white or very clear (source: FEVAD 2010)

The aim of this paper is to understand whether consumers are likely to become more responsible in playing for sustainable development in the context of electronic commerce, through action on the screen saver of the computer or an equivalent system. A feature simple to implement like screen saver systems of existing computers can be a first line of research. An exploratory approach seems necessary in the attempt to answer this question. Indeed, despite the influence of the trend "sustainable development" on consumer behavior, there is not to our knowledge a model unified and useful for its study. As a result, the subject remains unexplored, both in terms of information systems or marketing.

By looking at consumer responsibility, we seek to grasp the opportunity for e-merchants, e-learning websites and the actors of information systems with a human machine interface in general, to contribute to the effort for decreasing greenhouse gas emissions. The user action on the light emitted by the screen seems indeed likely to reduce unnecessary power consumption as easy as clicking a button. This could be articulated as the research question: "the ability to click a button present on the browser or on an e-commerce website, changing the appearance of the interface to pollute less while guaranteeing the same content readability through a "intelligent curtain screen saver" after a certain period of inactivity, would it allow e-commerce players to promote reduction of greenhouse gases?"

Our work shows that by improving the appearance of colorful interfaces of e-commerce websites, the proper choice of contrasts between the dominant colors – screen background – and dynamic colors – text, buttons, images, tables, search engines – would allow to reduce the energy

consumption of screens when the curtain screen saver is used. This would appear after a period of inactivity of the user cursor corresponding to the standby screen.

In this research, we see that 1) screen savers are not used to save energy, regardless of the computer, public or private, 2) the majority of the most visited e-commerce websites in France in 2009 - 2010 have a dominant white color corresponding to the hue which is the largest consumer of energy for a screen. Hence the choice of a black screen saver allows to save as much energy as possible. This paper presents the interest to use it in a sustainable development perspective.

To determine the perception and use of consumers about the effects of a screen saver, the results of an exploratory study conducted among 26 persons are presented. They follow a review of the literature on the energy consumption of different types of computer screens in organizations and among individuals, and a comprehensive definition of responsible consumer. The paper presents and analyzes the results of the preliminary study and offers a discussion of screen saver use in e-commerce for environment protection before reaching its conclusion describing future research.

CONCEPTUAL RESEARCH FRAMEWORK

The screens and footprint of greenhouse gas emissions

This part initially presents the consumption of websites of white colors, which are more energy consuming than those displaying more black. A review of the literature on energy consumption depending on the type of monitor screen follows.

The current proposed solutions to display more black than white (for example the Blackle website¹ like a "*black google*") do not have interesting results in terms of satisfaction since a negative contrast (white on black) has bad results in terms of readability and memorization (Pelet and Papadopoulou, 2010a). The contrast caused by the dynamic color (gray) on the dominant color (black) is likely to cause effects opposite to those expected, as it doesn't help users, on the contrary, it makes the content more difficult to read. Indeed, it has been shown that negative contrast (light text on dark background) caused by a dark dominant color and a light dynamic color cause negative moods that can lead to leave the site because it is more tiring than a positive contrast (Pelet and Papadopoulou, 2009).

The ecological footprint defined by the WWF (World Wide Foundation) as "*a measure of the pressure exerted by man over nature*" shows that a user can help to reduce it by a different use of its computer screen. The footprint represents a tool allowing to assess the area necessary for a population to respond to its consumption of resources in order to absorb its waste.

At company level, the contribution of ICT in the emission of greenhouse gases until 2007 was about 2%. Some predictions state that the global footprint of ICT could note a growth of 6% for 2020 (Infos-Industrielles, 2007). Faced with this alarming situation and within the perspective to promote and encourage better use of energy efficiency, several proactive measures have emerged, including: the European Programmes, the "*Energy Efficiency*" Programme of the general direction of the "Information and Media Society" and the U.S. program "EnergyStar" (Gartner, 2007). The latter is the origin of EC/106/2008 Regulation on labeling of office equipment. The label is a certification guaranteeing the energy efficiency of office equipment at both economical and ecological level (Breuil et al., 2008). The EnergyStar label offers with the proposed office equipment, the opportunity for companies to become more successful in terms of efficiency and energy return. The label proposes to companies a range of products, enabling

¹ <http://www.blackle.com/>

them to optimize and use energy more efficiently, for example by promoting the use of the laptop that uses 50% to 80% less energy than a desktop computer. EnergyStar also offers the opportunity for companies to have supporting data allowing to compare the energy consumption of LCD screens, plasma and CRT (Figure 2).



Figure 2: Format of LCD computer screens - Plasma – CRT

We present these three technologies, LCD, Plasma and CRT, used in computer monitors in Appendix 1.

Studies have shown that the production of a CRT screen computer accounted alone for an emission of 680kg of CO₂ and 1 250kg for a flat screen computer. A basic workstation represents, for use of 5 years, about 2000kg of CO₂ per year. A server is itself 536kg of CO₂ per year (Breuil et al., 2008). Meanwhile, the replacement of CRTs with flat screen requires 10 times more CO₂ in terms of energy consumption. The energy saved by better management of PCs and monitors in the offices would decrease from 23 TWh / year (Tera Watt hours / year) to 17 TWh / year if the screen saver was activated according to Kawamoto et al. (2001), about CRTs and flat screens.

Thus, a 15" LCD consumes 30% less energy than a CRT 15". Meanwhile, an LCD 17" consumes about 50% less than a CRT 17". This difference tends to decrease as the size of the screen increases. The results given by EnergyStar show that the rate of 8 hours per day, for two computers (LCD and CRT) of similar size, choosing an LCD monitor offers a saving of energy reaching over 100kWh/year (EnergyStar, 2009).

For its part, the European Union has set a major goal of reducing its energy costs by 20% by 2020 (Melquiot, 2009). The forecast for the achievement of these objectives are optimistic to the extent where 50% of the reduction of energy use come from just ICT. They would thus allow to save 1 to 4 times their own emissions on the rest of the economy. This is justified by example with firms that generalize the teleconference, allowing not to move.

At the individual level, energy consumption appears as an area where efforts can be further enhanced. The British for example represent alone one third of the total energy consumption (Melquiot, 2009). Among the proposed improvements, a visual display system regarding the use of electrical appliances active, standby or off is strongly recommended. This alternative aims to educate "people who simply do not make a direct link between the energy consumed by an appliance in standby and the pollution it causes," according to the Directorate General for Information Society and Media of the European Commission. French consumers have tended to replace their CRT screens with flat screens, with CRT televisions threatened of extinction. But the difference in energy between the two screens is remarkable as we have seen.

Screen savers

The screen saver, originally developed to extend the life of the battery of laptops, is now commonly used to automatically reduce the energy used by a computer switched on, when it is idle or is inactive (Webber et al., 2001). However, it is rather advisable to activate the "energy consumption management" as the screen saver does not save energy, on the contrary, unless it is

black. The screens operating in standby mode permanently or display colors in the form of texture rather than solid colors in fact require more system resources and therefore energy, as evidenced by this small collection of screen savers offered by default by the Windows operating system (Figure 3):

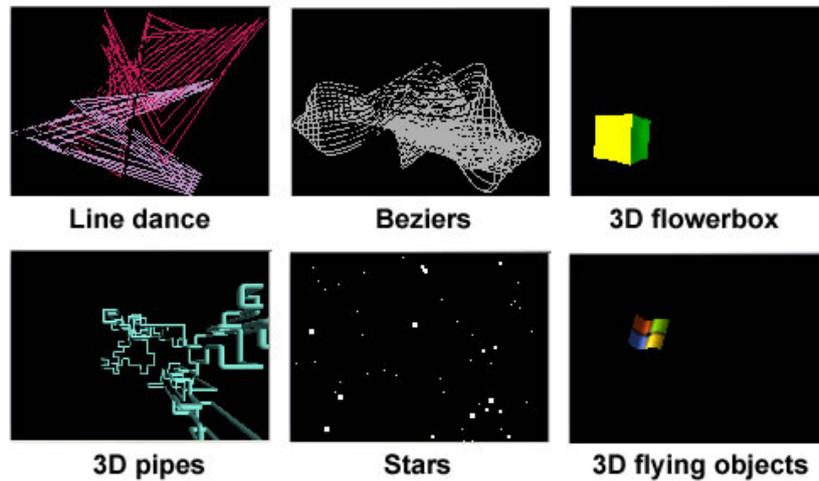


Figure 3: Screen savers - energy consumers of Windows

In addition, the screen saver presents an inconvenience for some users: when an activity has been started on the computer for example, the sudden release of the screen saver disturbs the user most of the time. It can be difficult for some users to get rid of it, since settings are not so obvious to understand and then modify. Setting the screen saver can then become time consuming because of the skills that are necessary for some users to configure it. These characteristics are evidenced in the exploratory analysis that we present later. Here is an example of processes allowing to configure a screen saver on most computer workstations equipped with Windows (French version) (Table 1).

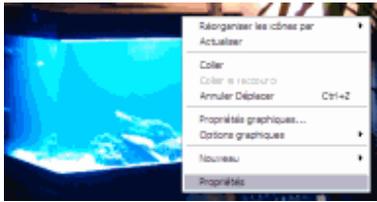
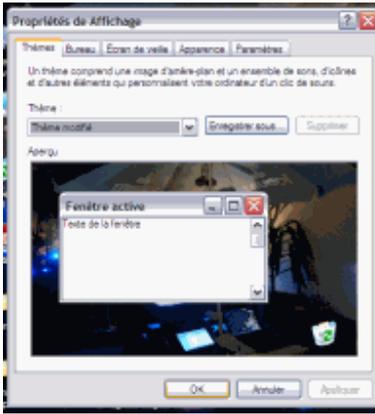
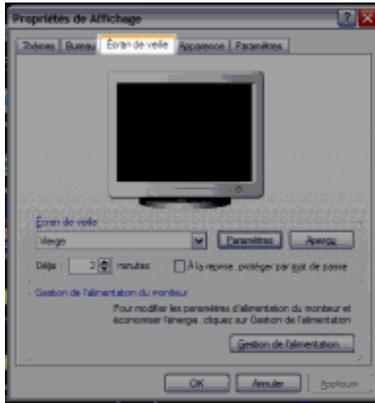
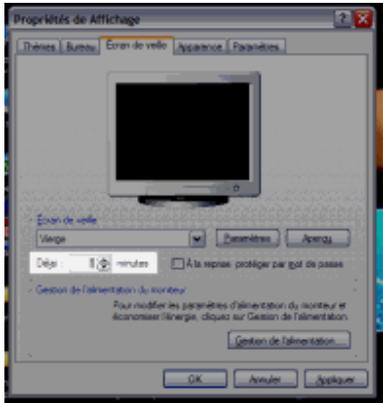
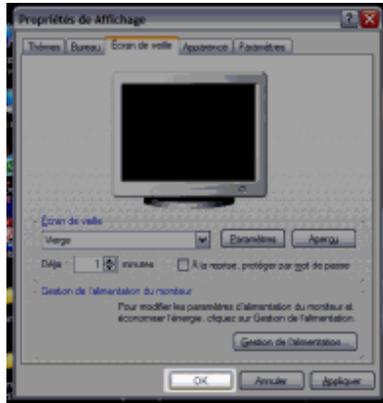
<p>1st click</p> <p>On the <i>desktop</i>, open the window to configure the screen saver and click on "Properties"</p>	<p>2nd click</p> <p>Choice of action to determine</p>	<p>3rd click</p> <p>Choice: "Screen Saver"</p>
		
<p>4th click</p> <p>Determination of time required before the screen saver goes off</p>	<p>5th and last click</p> <p>End of configuration that needs to accept all of the steps by clicking "ok".</p>	
		

Table 1: Steps needed to set up a screen saver on a computer in Windows

With so many steps, it may seem more simple and ecological to disable the "standby" feature that most modern electrical appliances, such as computers and monitors, have, unless a system really protective of the environment exists. The "standby" functionality of screens is strongly energy consuming since it contributes to a power consumption varying from 40 to 120 kWh / year. In this perspective, it is more advisable to use the latest version of the management of energy consumption, namely "SpeedStep", which is an advanced feature of the computer processor.

Public organizations are called to adopt in turn a policy to green procurement to support innovation in the field of energy efficiency. The action of the user deciding to modify its ecological footprint to reduce this consumption becomes that of a responsible consumer. By choosing when visiting an e-commerce website, to trigger a screen saver appropriate for it, the Internet user can help the reduction of releases of greenhouse gases.

Towards a Responsible Consumer

Research conducted by Autio, Heinonen and Heiskanen (2009) examines how young consumers construct their images of green consumption based on the narrative of ecological discourse. The participants recognize the differences in these green discourses; students speak in their dissertations to "*save the planet Earth*", "*do things responsibly*" and "*differentiate yourself from all to make a difference*". However, collective action to promote sustainable consumption does not appear in their research. According to the latter, green consumers do not complain, do not advocate or do not organize consumer action. The green consumption seems to be an action only on an individual basis where the activity is conducted in parallel but not as collective action among consumers. This brings us to the responsible consumer, more willing when it is only to adjust the screen saver on his computer or the computer he uses at work, than when being part of a group using the same computer.

The concept of « *socially responsible consumption* » has received considerable attention from the second half of the twentieth century. Researchers have suggested several names to describe such a profile such as "*socially conscious consumer*" (Anderson and Cinningham, 1972 ; Webster, 1975; Brooker, 1976; Engel and Blackwell, 1982), "*socially concerned consumer*" or "*concerned*" (Belch, 1979, 1982).

Mohr et al. (2001) defined the socially responsible consumer as "a person that bases its acquisition, use and possession of products on the desire to minimize or eliminate adverse effects and the desire to maximize long-term beneficial impact on society. " Note from this definition that social responsibility stems from an awareness of consequences of purchase and use on the community and the belief that the power a consumer holds can change entirely a way of consumption. Thus, the socially responsible consumer sacrifices his personal welfare at the expense of that of the community. Here, a person who would visit an e-commerce website, would it see it changing appearance after a certain period, in view of saving screen energy: the administrator of the e-commerce website attempts, from its side, to protect the environment by such action. The important thing becomes the public welfare and interests of the environment in accordance with the norms of society (Velasquez and Rostankowski, 1985). Social responsibility comes from individual accountability of consumption choices in order to achieve collective well-being (Bisaillon, 2005).

Socially responsible consumption: a social concern and concern for the environment

Several research studies show that socially responsible consumption includes both a social and an environmental dimension (Roberts, 1995; Antil, 1984; François-Lecompte and Florence, 2004). Consuming in a socially responsible way means, on the one hand, meeting the collective needs of the society in which the consumer represents an active member, and on the other hand, preserving the physical environment that surrounds us. At this level, attention must be paid to ecological concerns defined by Maloney and Ward (1973)² as "the set of specific knowledge and

² Quoted by Ling-ye, 1997

emotions, the level of susceptibility and the extent of behavior to respond to environmental problems and pollution.

This definition, as well as several other works on ecological concern (Balderjahn, 1988; Tucker et al., 1981; Dembkowsky and Hammer-Lloyd, 1994; Anderson and Cunningham, 1972; Webster, 1975; Singhapakdi and Tower, 1991; Zaiem, 2005) show that this concept has been studied following the three-dimensionality of the attitude:

- The cognitive dimension referring to "the subjective knowledge on environmental issues (Zaiem, 2005) reflects all the information and beliefs available to the individual regarding the screens and their energy consumption, as well as the standby mode and its direct link with the protection of the environment ;
- The affect which represents in ecology " all emotional responses related to perceived problems of the environment "(Zaiem, 2005) reflects the attitude adopted by a visitor of an e-commerce website using an intelligent screen saver system ;
- The conative dimension of environmental concern represents a tendency to act or even the actual behavior of an individual wishing to reduce energy consumption, this act being realized by the permanent and systematic activation and configuration of the screen standby energy saver.

In the next section we describe the exploratory study we conducted and then present the principal results that will provide answers to these three dimensions (cognition, affect and behavior) of consumer behavior.

RESEARCH METHODOLOGY: THE EXPLORATORY STUDY LEADING TO CONTENT ANALYSIS

To position our research with regard to literature and the perspective to verify and validate the experience we want to put in place, we are interested in the perception that consumers have about the screen saver on their computers. The criterion of data saturation being retained (Mucchielli, 1991), 26 people were interviewed individually in order to better understand the variables suggested to influence consumer behavior. We interviewed these individuals in order to gather information on their Internet habits and their perception of sustainable development in this regard. The interview guide used is presented in Appendix 2 and the description of our sample is shown in the table in Appendix 3.

We have adopted a neutral attitude towards the respondents so as not to influence them in the way they respond. After each interview was transcribed, with an average duration ranging from 4 to 17 minutes, we got a 93-pages verbatim. The interviews allowed us to notice that the screen saver appeared as a subject of a very limited interest to consumers. The qualitative data have been analyzed with a table summarizing all the results of our respondents, where each construct referred to a "1" weight as explained in the following example (Figure 4):

Each respondent [n°1 in the picture] has his own table file in which all the questions extracted from the interview guide were written. If a label [n°4] linked to a *cognitive, affective* or *behavioral* dimension [n°6] appeared when reading the transcript of a respondent's interview, a figure "1" [n°3] was marked in a *result* column. Then, we grouped the "result" columns of all our respondents in the final table in order to understand precisely what the answers meant, no matter who the respondents were. This yielded a total of 26 columns, with "1" or empty. Rows in this table indicated the different themes [n°5] issued from the interview guide. Topics and words related to a precise field appeared in a "result" column [n°2], showing the weight of each construct. This finally allowed us to formulate assumptions linking the answers with the respondent's profiles. Thus, each construct had a weight in a first table, made of rows presenting or not figures "1". Another table served to concatenate the 26 files in a summarizing table, enabling us to use the columns of the "1" to add rows and finally write the results obtained by adding all the figures "1"

		1	BILLIAERT Virginie	FAURE Baptiste	TAMBY Sonya	TRINH Cécile	TOTAL	
Construct	Theme	Labels					2	
1. Introductory phase: Using your computer screen	Using the screen saver	useless			1		1	
		it is useless					0	
		I regularly change					0	
		I changed it or other	1	1			5	
	Short description	black screen	1					1
		animated screen by windows						0
		animated screen with a slide show			1			1
		download a screensaver						0
		other					1	1
		annually						0
		occasionally						0
		monthly						0
		other			1			1
		protector of the environment	i don't know					1
	screen saves energy		1			1		2
	screen without animation		1			1		2
								0

Figure 4 :Part of the table used to concatenate the results of the 26 interviews

We present the results we obtained in the form of a synthesis of themes, constructs and modes evoked in this exploratory qualitative analysis in the following section.

RESULTS

Four trends emerge from the exploratory analysis that was conducted. Ignorance of what a screensaver is; the fact that it is used for purposes other than setting computer in standby mode; skepticism about its usefulness and the restrictive nature of its setting and finally the almost total lack of feelings experienced by users on the future of the screen saver to protect the environment. These results will be categorized according to the three components of the classical attitude model, namely the cognitive (information, beliefs), the affective (attitude, emotions) and conative or behavioral dimension (the tendency of behavior or behavior itself). We develop these points in the following lines.

Cognitive responses of the respondents: Ignorance of what a screen saver is and lack of information

Setting a screen saver black is not a priority, however, the screen saver described by the interviewees often does not correspond to what may be a economic screen saver, that is black. For the respondents, a screen saver represents a way to save the battery of the computer (12/26) and a way to have fun when we no longer use the screen (7/26) which means that the communication made on the energy consumption of peripheral devices such as screens seems that it could be largely increased. None of the respondents did not in any case have a precise idea about the impact of a black screen saver on the protection of the environment. Its use and especially the "sleep" function of the computer is not a widespread practice. In most cases, the persons interviewed did not know how to use or activate it with the computer settings. Some even do not know what a screen saver is, or how to set it. The screen saver is mostly perceived as

an animated screen with images representing a landscape or past holidays. Indeed, for some people, the screen saver should be aesthetically pleasing, pretty to look at like when it is animated by a slide show (9/26).

Affective responses of the respondents: indifference and skepticism

The interviewees in general attach no importance to the shape or color of the screen saver. They do not spontaneously bring value and give it only very little importance as they only set it very rarely or not at all. However, many recognize a direct link between the screensaver and the protection of the environment, constituting potential users of a black screen saver.

On the other hand, some respondents seem skeptical about the usefulness of a screen saver sometimes thinking that their computer does not have one (9/26). Its only use would be according to them of economic order: a reason that has nothing to do with the protection of the environment. Setting a screen saver is also increasingly perceived as a constraint (14/26), so simpler settings would make more sense. Some people have installed a screen saver on their computer, chosen among others because they liked the animation and the colors (9/26). Other people interviewed had no particular interest for their screen saver, but are still susceptible to the "friendly" aspect that it could generate. The screen saver is recognized as practical and economic, though not necessarily an essential feature. According to some respondents, it would be necessary to explain the use and usefulness of a screensaver. It seems that users, in their majority, do not seem against setting their screen saver if the topic on energy conservation is introduced before. This represents above all something fun and many of those interviewed did not see the screen saver as a tool so indispensable for sustainable development. The aspect of "sustainable development" and "energy conservation" is not a subject well known to computer users in connection with the screen saver. Even if they think that a screen for sustainable development is a screen that is activated quickly, they do not necessarily set it so as not to be annoyed when watching movies for example. The description made by some of them shows it is not used for its primary function of battery saver or protector of the environment, but more like a slide show or a system for amusement (18/26).

Behavioural responses of the respondents use the screen saver for other reasons / binding settings

According to the survey, the screen saver is not used (15/26). Of those questioned, some use very little of their screen saver by having changed it only once (5/26). Others have a black one that "can be configured at the time of purchase" as they mention (8/26). This screen is convenient for them. They use it in the perspective of saving energy so that their battery is discharged more slowly.

On the other hand, some respondents use the default settings offered by the system: black screen (8/26) or slide show (9/26). The majority mentions that they even "force" sleep mode by closing the computer. Ideally, a screen that would consume less energy would quickly resume its functionality when you use it again. Respondents generally did not really remember anything related to the settings of the screen saver. Having mostly not met any problems in setting it, some admit however that for a novice, the configuration is not very intuitive. It stems from this survey that the computers are considered as personal items to which very few people have access. For the interviewee to be interested in a black screen, its installation should be easy and fast to be able to be then configured itself. Hardly anyone configures their computer to automatically switch into sleep mode as the clicks are many and compelling. Thus, for some respondents, the screen saver is too complicated to configure in order for users to be sufficiently aware of.

ANALYSIS OF RESULTS

It is therefore clear from the interviews that if the energy saving which represents an intelligent screen saver setting turns out to be an important factor, and *"if the screen saver is nice, easy to implement and above all initiated by means of some information or an external person, one's sensitivity to "energy saver" screen savers grows"*. Some respondents feel no particular involvement with regard to the protection of the environment having little or never changed the screen settings (11/26). No particular emotion seems to be felt with the idea of protecting the environment through action on it. This group of respondents is not any more against the idea of acting for its protection because they see some usefulness. Indeed, some respondents may be more interested in a more "interactive" and "attractive" screen saver without explicitly specifying what they want. The expression "useful screen saver" is not so familiar to all respondents. Communicating this new concept to the general public and vendors is therefore essential. The same holds with the definition and operation of a screen saver.

Interviewees appear in all sensitive to the fact that a screen saver could be a good way to save energy. The feelings experienced in response to possible settings indicate that consumers do not yet seem ready to spend time to set the computer screen so that it participates in the protection of the environment. The answers collected allow us to estimate that this is related more to ignorance of the existence of the screen saver, or a lack of information by which the screen saver is capable of protecting the environment, rather than to a deliberate act of malevolence. Indeed, the projection made during the exploratory analysis (see interview guide Topic 3, Appendix 2), suggests the idea that awareness would change the situation in favor of the reduction of energy consumption, beneficial for the planet. 16 out of 26 respondents interviewed said that from the moment they learned that a gesture so little as setting the screen saver allowed to contribute in protecting the environment, they would make these changes in parameters in their computer.

This exploratory study was conducted to understand some phenomena related to computer use and sustainable development. The study we have presented aims to serve as a first step to extract the constructs that we wish to measure in a questionnaire taking part in a future quantitative study. This study shows the relative low interest or lack of interest of computer users in sustainable development. Regarding the power consumption of their computer, they don't seem aware about the possibility to protect the environment by switching their screen off when not using it. The exploratory study attests of this unfortunate state.

With these findings which are in no way representative of a possible action at a global level, we gained an initial understanding needed to allow us consider the subsequent confirmatory analysis. We wonder if an e-commerce website should, in an eco-citizen approach, change its appearance when the user does not use his mouse for example within one minute. We wish to examine whether a company that adopts a button to put a curtain of sleep helps position itself as an ethical company, oriented towards sustainable development. This interruption of the use being apprehended by the lack of movement of the mouse does not imply that the user is not reading the information displayed. If so, we can investigate on a company's interest to:

- choose to dress its website with colors that consume less energy for screens that display them. This would facilitate the emergence of a transparent black screen, optimized for reading to remain enjoyable
- allow continue reading content displayed on the screen even when it goes into sleep mode. Reading the text portions remains pleasant when the "curtain" falls through the use of a contrast selected not to affect the reading quality. It thus takes into account:

- a contrast less tiring for the eyes of people whose eyesight is reduced,
- a contrast allowing everyone to read the contents of the screen, there including people with deficiencies in color vision, such as color blindness,
- functionality less laborious to set up than the system configuration of Windows screen saver.

DISCUSSION

Internet users now have to take into account an increasingly sophisticated Internet with technical aspects to learn in order to surf easily and in parallel, ethical consideration for those who caution the sustainable development as a priority. Indeed, the prominence of advertisements, widgets or transparent flash used as pop up or inner windows on the Internet can easily be interpreted as an indicator for the increasing growth of the web as a collection of dynamic sites providing e-commerce, news, entertainment and social network facilities that have become the most popular destinations, whereas ten years ago web usage was focused on mostly static information and content delivery. These changes of the web also induce changes in user behavior. The growing number of dynamic web pages and web applications suggests that interaction with the web client is changing from single-window hypertext navigation to a new mode where several interaction paths are followed in parallel. Users are then faced with a new cognitive overhead when they browse the Web (Weinreich et al., 2006). This overhead is a factor inducing consumers to choose easy to remember paths to attain their target on the website, in order to simplify their foreseeable visit. This implies that they prefer to choose websites that are “intelligent” and on top of it, interested in the protection of the environment. As an example, simple websites are often smartly designed, with simplicity and with only essential features. They work without harnessing the computer too much and are not too hungry of energy. In this sense, the overhead resulting from the current web arena contributes to the adoption of technologies in favor of the protection of the environment.

On top of it, the ecological footprint becomes increasingly important in nowadays, making users more responsible than ever. This is true for commerce in general but also for e-commerce. It is now common to buy an item and deliver a percentage of the sale for the recycling process of the product called “Eco-out”³.

With this paper, we try to go a little further and help organizations to learn how to adopt these new solutions and participate in the protection of the environment. A simple action on the screen can apparently change a lot of aspects linked to the protection of the environment. Customers in their majority are ready to act in favor of the environment when using their computer, this is why it would seem normal to log on a website and then activate an energy saver curtain.

As the protection of the environment becomes a key issue for the socially responsible consumer, it affects his behavior, including the selection of vendors to purchase from. Within the context of electronic commerce, responsible consumers will seek to conduct online purchases and transactions in general on websites of vendors that actively care and contribute to energy saving. Companies that show their involvement by providing systems that are environment

³ Since 2006 all electrical and electronic products sold online or in store are subject to an Eco-participation in addition to the normal price. It is a visible and transparent information which concerns the price of each product. In accordance with European Directive 2002/96-CE and decree of July 20, 2005, Eco-systems provides a mission of general interest: setting up throughout the French territory. This is a national scheme for collect, clean up and recycle waste electrical and electronic equipment at end of life equipment.

friendly or 'green' should be more appealing to customers, new or existing ones, and would be preferred over others that do not. In this perspective, the interest and the actions of an online vendor towards reducing energy consumption and environment protection will be another, new factor for customer attraction and retention. Websites enabling a 'green' use of e-commerce could be a good step towards this direction. In particular, the deployment of an intelligent curtain screen saver in e-commerce websites can be an easy and simple solution, showing effectively the ecological concern of an online vendor.

Projecting an interest for the environment and contributing to its protection, such features can create or enhance consumer trust in an online vendor. Following the typology of McKnight et al. (2002) and McKnight and Chervany (2001-2002), trust in an online vendor can be defined in terms of consumer beliefs in the benevolence, competence, integrity and predictability of the vendor. These trusting beliefs in an online vendor are defined as follows:

- Trusting Belief - Benevolence is the belief that the online vendor cares about the customer and is motivated to act in the customer's interest and not opportunistically.
- Trusting Belief - Competence is the belief that the online vendor has the ability or power to do for the customer what the customer needs done.
- Trusting Belief - Integrity is the belief that the online vendor makes agreements in good faith, communicates honesty and fulfills promises.
- Trusting Belief - Predictability is the belief that the online vendor's actions (good or bad) are consistent enough that the customer can forecast them in a given situation.

Thus, by offering functionality that contributes to energy saving on their websites, online vendors can invoke consumer trust as they convey benevolence. The provision of such a feature would be perceived as a signal of a benevolent online vendor; a vendor concerned for the environment and for the customers who are also eco-citizens and who, therefore, acts in their interest contributing to the protection of the eco-citizen customers and the environment. In this way, an online vendor can build trust, as it creates customers trusting belief in the online vendor benevolence.

At the same time, the actual implementation and availability of website functionality enabling reduction of energy consumption conveys the vendor's competence. When customers visit e-commerce websites with such ecological, energy saving functionality, they will perceive that the online vendor is not only benevolent and cares for the consumer, but it also has the ability and the means to actually manifest this interest in practice and do what the consumer needs. In this way, online vendors can further succeed in building trust, as consumers will form a trusting belief in the online vendor competence.

The potential value of energy saving features in e-commerce websites, such as the 'curtain' screen saver can be even higher in the Mediterranean region, where one need to take into account the sun and the difficulty to read on screens when the brightness is high. Nowadays, more and more people use their computer outside the house or the office, in order to take advantage of available Wi-Fi connections and enjoy being outside. The Mediterranean weather facilitates this kind of computer use. However, in the Mediterranean region, the sun shines strongly, making laptops screens hard to read when you work outside. The readability of content on a screen when the luminosity of the environment is very high can be problematic. Indeed, the low contrast occurred by the sun and the screen won't help the visitors of e-commerce websites at all. Previous research has shown that the contrast created between the dynamic colors (text) and the dominant one (background) could slow the reading of contents (Hall and Hanna, 2003) and damage the user's eyes that make efforts to read the content. This can lead to negative mood

feelings towards an online vendor and, eventually to a degradation of consumer trust (Pelet and Papadopoulou, 2010a; 2010b). A 'curtain' screen saver, which provides a dark appearance of an e-commerce website by increasing the contrast between screen colors and the physical light, could be a useful solution to this issue. Its potential can be viewed as two-fold. First, it will facilitate the readability of the content of the e-store and result in a positive mood of consumer which will ultimately increase trust in the online vendor, both in terms of benevolence and competence. Second, it will meet the requirements for energy saving, further enhancing consumer trust in the online vendor.

Thus it could be interesting to consider what the OLPC (One Laptop Per Child) project managed to do, with the "XO" project: "A small machine with a big mission" (OLPC, 2010). The XO is a potent learning tool designed and built especially for children in developing countries, living in some of the most remote environments. It's about the size of a small textbook. It has built-in wireless and a unique screen that is readable under direct sunlight for children who go to school outdoors. It's extremely durable, brilliantly functional, energy-efficient, and fun. The idea of a screen enabling readability under sunlight could possibly be adopted in the context of e-commerce, through the provision of a 'curtain' screen saver which offers a similar effect.

This approach towards energy saving and environment protection is not restricted to e-commerce but can also be extended to mobile commerce. In the mobile industry, m-commerce players could be even more interested in sustainable development since mobile constructors have been trying to build batteries for mobile devices that enhance their duration. By making 'curtain' screen savers appear after a short period of inactivity when users don't touch the screen or press any button, mobile devices preserve battery energy and thus reduce the greenhouse gas emissions. In this way, such energy saving features on m-commerce websites should potentially be more valuable and welcome in the mobile industry. Thus, it can be posited that the 'green' use of IT and online commerce is a topic where m-commerce could be in advance and more fruitful in comparison to e-commerce.

LIMITATIONS AND FUTURE RESEARCH

We are aware that this study is not without limits. An exploratory analysis is not sufficient at all to offer results on which to build a strategy. This study needs to be followed by a confirmatory analysis showing that people don't use or don't know how to use or don't know the existence of their screensavers. Some figures are not recent enough to be sure that they represent the actual reality of the screen market. In some developed countries, flat screen (LCD and Plasma) are becoming more and more used in households as well as in universities, schools and companies, but in others, CRT screens remain the most popular. Thus a study focused on a precise area might be more precise.

The responsible consumer online appears ready to use a system to rest the screen, if there is such a command that enables that. A system extension for the Firefox browser, displaying on the inactive screen a screen saver, like a curtain of sleep, resting the screen by consuming less energy while ensuring optimal readability, is being designed. It is the same with regard to the button for Websites, currently being finalized. Aiming to confirm the content analysis conducted during the exploratory phase in a forthcoming study on the Internet, this in vivo experiment was designed to verify the interest of the e-commerce websites to rethink the colors they display when the screen becomes inactive. The experiment allows visiting an e-commerce website, which is under construction, featuring two buttons triggering the screen saver. The experiment

will measure the use made of these buttons, and the perception of users about them. A button, designed with a programmer of extensions⁴ for Firefox, will serve to activate the screen saver, enabling customers to participate in sustainable development from that browser. Another button provides the same functions as the extension mentioned above, being adapted to an e-commerce website. Once activated, this button allows the emergence of a "curtain of sleep" that falls over the website and provides a dark version of its appearance. This will be offered as a Grüner Punkt type button, symbol of sustainable development on a website (Figure 5).



Figure 5: logo representing the "green dot" (die Grüne Punkt), symbol of sustainable development

As part of the Firefox browser, the button can exist provided that the proposed extension is accepted by the Mozilla community. As part of an e-commerce website, companies decided to opt for a policy of "sustainable electronic commerce" could offer this type of button on their interface.

The simple "grüne punkt" button provided on the website could thus be seen as a tool that affords to save the earth. The ability to test this button that makes the curtain screen saver falling after a short period of time when the mouse is not used could be interesting. This is part of our future research endeavours.

REFERENCES

- Anderson W. T., Jr & Cunningham W. L. (1972). The Socially Conscious Consumer, *Journal of Marketing*, 36, 3, 23.
- Antil J. (1984). Socially Responsible Consumers: Profile and Implications for Public Policy, *Journal of Macromarketing*, 4, 19-32.
- Autio M., Heiskanen E., & Heinonen V. (2009). Narratives of Green. Consumers – The Antihero, The Environmental Hero and The Anarchist, *Journal of Consumer Behaviour*, 8, 1, 40-53.
- Balderjahn I. (1988). " Personality Variables and Environmental Attitudes as Predictors of Ecologically Responsible Consumption Patterns ", *Journal of Business Research*, 17, 1, 51-56.
- Belch M. A. (1982). A Segmentation Strategy for the 1980's : Profiling the Socially-Concerned Market Through Life-Style Analysis, *Journal of the Academy of Marketing Science*, 10, 4, 345-358.
- Belch M.A. (1979). Identifying the Socially and Ecologically Concerned Segment Through Lifestyle Research: Initial Findings, *The Conserver Society*, eds. Chicago, American Marketing Association, 69-81.
- Bisaillon V. (2005). Le consumérisme politique comme nouveau mouvement social économique, in *Consumérisme politique I : du boycott au buycott*, Chaire de responsabilité sociale et de développement durable ESG-UQAM, Recueil de textes CEH/RT-30-2005, 8ème séminaire de la série annuelle 2004-2005 sur les nouveaux mouvements sociaux économiques, 6-17.
- Breuil H., Burette D., Flüry-Hérard B. (2008). TIC et Développement durable, (Rapport), Ministère de l'Écologie, de l'Énergie, du Développement Durable et de l'Aménagement du Territoire, Conseil général de l'environnement et du développement durable, N° 005815-01,

⁴ Extensions (or addons) of Firefox are programs designed to provide functionality to the browser.

Décembre. Disponible à cette adresse :

http://www.telecom.gouv.fr/fonds_documentaire/rapports/09/090311rapport-ticdd.pdf

Brooker G. (1976). The self-actualizing socially conscious consumer, *Journal of Consumer Research*, 3, 2, 107-112.

Dembkowsky S. & Hammer-Lloyd, S. (1994). The Environmental Value-Attitude System Model: A Framework to Guide the Understanding of Environmentally-Conscious Consumer Behaviour, *Journal of Marketing Management*, 10, 4, 593-603.

EnergyStar (2009). <http://www.eu-energystar.org/fr/index.html>

Engel J. F. & Blackwell R. D. (1982). *Consumer Behaviour*, New York, Oxford University Press.

FEVAD (2010). Fédération du e-commerce et de la vente à distance, Chiffres Clés disponibles sur le site web de cet organisme à l'adresse : <http://www.fevad.com>

Gartner (2007). Green IT : The New Industry Shockwave, ITXPO Conference, October 7-12, 2007, Orlando, Florida, gartner.com/symposium/us

Hall R.H. & 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.

Hollands J. G., Parker H. A., McFadden S. & Boothby R. (2002). LCD versus CRT Displays: A Comparison of Visual Search Performance for Colored Symbols, *Human Factors*, 44; 210

Infos-Industrielles (2007). Les TIC au service de l'efficacité énergétique, <http://www.infos-industrielles.com/dossiers/1156.asp>, 06/02/2007, sources extracted from "Sustainable Energy Europe" website, Directorate-General for Energy and Transport, <http://www.sustenergy.org/>

Jiun-Haw L., Liu D.N., Wu S.-T. (2008). *Introduction to Flat Panel Displays*, Wiley Series in Display Technology Edition.

Kawamoto K., Koomey J.G., Nordman B., Brown R.E., Piette M.A., Ting M. & Meier A.K. (2001). Electricity used by office equipment and network equipment in the US: detailed report and appendices, LBNL-45917, Lawrence Berkeley, National Laboratory, California.

Luder, E. (1997). Active matrix addressing of LCDs: Merits and shortcomings. In L. W. MacDonald & A. C. Lowe (Eds.), *Display systems*, pp. 157-172, London: Wiley.

Maloney M. P. & Ward M. P. (1973). Ecology, Let's Hear it From the People, *American Psychologist*, 28, 583-586.

McKnight, D.H., & Chervany, N.L. (2001-2002). "What Trust Means in E-Commerce Customer Relationships: An Interdisciplinary Conceptual Typology," *International Journal of Electronic Commerce*, Volume 6, Number 2, pp. 35-59.

McKnight, D. H., Choudhury, V. & Kacmar, C. (2002). "The Impact of Initial Consumer Trust on Intentions to Transact with a Web Site: A Trust Building Model", *Journal of Strategic Information Systems*, Vol. 11, pp. 297-323.

Melquiot, P. (2009). Technologies de l'information et de la communication (TIC), impacts sur l'environnement et le climat. *Actualité News Environnement*, available at: <http://www.actualites-news-environnement.com/19871-Technologies-information-communication-TIC-environnement-climat.html>

Menozi, M., Napflin, U., & Krueger, H. (1999). CRT versus LCD: A pilot study on visual performance and suitability of two display technologies for use in office work. *Displays*, 20, 3-10.

Mucchielli A. (1991). *Les Méthodes de Contenus, Que sais-je ?*, Paris, Presses Universitaires de France.

- Murugesan, S. (2008). *Harnessing Green IT: Principles and Practices*, IEEE IT Professional, January-February, pp 24-33.
- OLPC (2010). *One Laptop per Child*, project description available at <http://laptop.org/en/>
- Pelet, J.-E. & Papadopoulou, P. (2010a). *Consumer Responses to Colors of E-Commerce Websites: An Empirical Investigation*. E-Commerce, ISBN 978-953-7619-X-X, In-Tech, forthcoming.
- Pelet, J.-E. & Papadopoulou, P. (2010b). *The Effect of E-Commerce Websites Colors on Consumer Trust*. *International Journal of E-Business Research*, forthcoming.
- Pelet J.-É. & Papadopoulou P. (2009). "The Effects of Colors of E-Commerce Websites on Mood, Memorization and Buying Intention", 4th Mediterranean conference on information systems . MCIS 2009, "Information Society Research, Greece, 25-27 September 2009.
- Roberts J. A. (1995). *Profiling Levels of Socially Responsible Consumer Behaviour: A Cluster Analytic Approach and its Implications for Marketing*, *Journal of marketing Theory and practice*, 97-117
- Singhapakdi, A. & La Tour M.S., (1991). *The Link between Social Responsibility Orientation, Motive Appeals, and Voting Intention: a Case of an Anti-Littering Campaign*, *Journal of Public Policy and Marketing*, 10, 2, 118-129.
- Tucker L. R., Dolich I. J. & Wilson D. T. (1981). *Profiling Environmentally Responsible Consumer-Citizens*, *Journal of Academy of Marketing Science*, 9, 4, 454-478.
- Velasquez M.G. & Rostankowski C. (1985). *Ethics: Theory and Practice*, Prentice-Hall, Englewood Cliffs.
- Webb, D. J., Mohr, L. A. & Harris, K. E., (2008). "A Re-Examination of Socially Responsible Consumption and its Measurement", *Journal of Business Research*, Vol. 68, pp. 91-98.
- Webber C.A, Roberson J.A., McWhinney M.C., Brown R.E., Pinckard M.J. & Busch J.F. (2006), *After-hours Power Status of Office Equipment in the USA*, *Energy*, 31, pp.2823-2838.
- Webster F.E. (1975). *Determining the Characteristics of the Socially Conscious Consumer*, *Journal of Consumer Research*, 2, 3, 188-196
- Wright, S. L., Bailey, I. L., Tuan, K.-M., & Wacker, R. T. (1999). *Resolution and legibility: A comparison of TFT-LCDs and CRTs*. *Journal of the Society for Information Display*, 7, 253–256.
- Zaiem, I., (2005). *Le Comportement Ecologique du Consommateur : Modélisation des Relations et Déterminants*, *La Revue des Sciences de Gestion : Direction et Gestion*, 40, 75-88.

Appendices

Appendix 1: Presentation of the three technologies LCD, Plasma and CRT, used in computer monitors:

- LCD Technology (Liquid Crystal Display) is based on a screen composed of two transparent grooved parallel plates, oriented at 90°, between which there is a thin layer of liquid containing molecules (liquid crystals) which have the property to move when subjected to electric current. LCDs are composed of many tiny liquid crystals arranged in rows and columns. Liquid crystal molecules can be reoriented by an electric field. LCDs function by twisting the axis of polarization of the light as it passes through the liquid crystal such that when the light reaches the front polarizer, it is oriented correctly to pass through, allowing it to be seen by an observer (Hollands, 2002). When an electric field is applied, the structure is untwisted and no light is emitted (Jiun-Haw, Liu & Wu, 2008). The LCDs used for computer displays are most commonly active matrix, with an electronic switch at each pixel location (Luder, 1997);

- Plasma Technology (PDP Plasma Display Panel) is based on an emission of light through the excitation of a gas. We distinguish between screens called "matrix" passive technology TN (Twisted Nematic), the pixels of which are controlled by row and column, and screens called "active matrix" technology TFT (Thin Film Transistor), in which each pixel is controlled individually;

- The cathode ray tube (CRT Cathode Ray Tube) is composed of a heated filament, cathodes and anodes in the form of pierced lenses subjected to a potential difference which create an electric field accelerating electrons. They just hit the screen on which a fluorescent layer is put reacting to the shock of electrons by creating a spot of light. Conventional CRT displays rely on an evacuated glass tube with a display screen at one end and electron guns at the other. The guns emit electron beams that are deflected to various screen locations by use of magnetic fields generated by a deflection yoke. The beams strike phosphors near the screen, converting the electrons to observable light energy. A particular pixel is illuminated or not by coordinating the timing of the gun output and the magnetic fields controlling the deflection yoke.

Given the vastly different technologies underlying each display type, it is no wonder that the images rendered with LCD and CRT displays differ. Among other differences, the pixel definition with LCDs is much sharper than for CRTs (Wright, Bailey, Tuan, & Wacker, 1999). CRTs tend to produce a blurred Gaussian distribution of light at each pixel, whereas LCDs produce a sharp edge to each pixel (Menozzi, Napflin, & Krueger, 1999). This sharp edge has clear advantages, but the edge may be problematic when rendering curves (leading to aliasing problems) and may introduce a high spatial frequency noise component into the display.

Appendix 2: Interview guide used in the context of the exploratory analysis

Interview Guide

The interview can be conducted only if the respondent has a computer, or can modify the settings on the computer screen saver if it is for professional use. He/she should be aware of this information before starting.

Terms of Service

Respondent No:

- Date: / /
- Location (home, work or other please specify):
- Top of the interview: h Min
- End of interview: h Min
- Interview duration (in minutes): min
- The computer used by the respondent is:

Personal Computer: Computer located in the workplace: Computer loaned by the company:

- Screen Type: Flat Screen: CRT Monitor:

Start of interview

Thank you for accepting to devote to me a little of your time to help me achieve this study. The topic of the interview is computer screens. I invite you to speak spontaneously and freely, all information is likely to be interesting to me.

1. Introductory phase: Using your computer screen

1. Could you talk about the use you make of the screen saver on your computer?
2. If you have a screen saver configured on your screen, can you briefly describe it?
3. What is a screen protector of the environment for you?

2. Focusing on subject phase

Now I would like you to remember the last time you set the screen saver on your computer.

4. Can you remember your setting of the screen saver?

5. What do you think of the ease that you have to set the screen saver on your computer?

3. Phase of deepening

Theme 1: the constituent steps of setting the screen saver

6. What does the screen saver on your computer represent for you?

7. What is a useful computer screen saver for you?

8. What settings of the screen saver allow you to have a positive impression on the computer?

Theme 2: The emotions and feelings felt after setting the screen saver on your computer

9. Have you ever felt something deep in setting your screen saver?

10. Could you explain in detail?

Theme 3: The feelings and reactions vis-à-vis a computer screen saver

- Thank you for reading the following text:

"Xavier is sensitive to sustainable development. Since he knows that a screen saver configured to turn on after a few minutes of inactivity of the computer mouse can save the environment, he is interested in the question. When invited to dine with friends who appreciate good food and good wine, he spent a little time with Tonio on his computer, and found that the screen saver never appeared, after they had left the computer during dinner. A fine gourmet, Xavier can appreciate the quality of foods. The atmosphere is friendly. Suddenly, he is urged to get up to go set the screen saver, and he starts explaining why this action can save the planet ... "

Reread several times if necessary

1. Can you describe the first impressions of Tonio when he sees Xavier getting up hastily to go set the screen saver?

2. In your opinion, what does he feel?

3. And to you, what does this gesture inspire?

4. What do you think will be the reaction of Tonio?

5. And you, what would you do?

Data on respondent

- Sex
- Age: ()

Put a cross in the specified location:

- less than 18 years old, (...)
- between 18 and 30 years old (...)
- between 30 and 40 years old (...)
- more than 40 years old (...)
- Education:
- Occupation: Nationality:

Your actions and your statements were observed and recorded: and you have the option to hear the part of the recording in question and, if desired, to have its removal or destruction.

Appendix 3: Description of the sample used in the exploratory analysis

Sample Description

Nature Consumers who have French nationality and live in France

Sex - 65% women
- 35% men

Age - 88.5% ∈ [15-25]
- 11.5% ∈ [26-35]

Number 26
(semantic saturation point reached)

Study Type Exploratory Study

Selection Diverse population of respondents in terms of gender, ages and professions

Recruitment Respondents were recruited following the selection criteria

listed above