Ergonomics and interfaces of traditional information systems – Packaging

Ergonomia e as interfaces de sistemas informacionais tradicionais – Embalagens

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The contemporary world is characterized, among other factors, by the influence of the new computer information systems on the behavior of individuals. However, traditional information systems still have interaction problems with users. The aim of this study was to determine whether the interaction aspects between user versus traditional information systems (particularly the graphics) have been fully studied. To do so, the ergonomic aspects and usability of such systems were reviewed, with emphasis on the problems of visibility, legibility and readability. From that criteria, the evolution of ergonomic studies of information systems was reviewed (bibliometrics technique); and examples of ergonomic and usability problems in packaging were demonstrated (case study). The results confirm that traditional information systems still have problems of interaction between human X system, hindering the effective perception of information.

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A contemporaneidade se caracteriza, entre outros fatores, pela influência dos novos sistemas informacionais computacionais no comportamento dos indivíduos. Entretanto, os sistemas informacionais tradicionais ainda apresentam problemas de interação com os usuários. O objetivo deste estudo foi verificar se os aspectos de interação entre usuário versus sistemas informacionais tradicionais (particularmente, os gráficos) já foram plenamente estudados. Para tanto, foram revisados os aspectos ergonômicos e a usabilidade de tais sistemas, com destaque para os problemas de visibilidade, legibilidade e leiturabilidade. A partir desses critérios, foi revisada a evolução dos estudos ergonômicos de sistemas informacionais (técnica de bibliometria); bem com demonstrados exemplos de problemas ergonômicos e de usabilidade em embalagens (estudo de caso). Os resultados confirmam que os sistemas informacionais tradicionais ainda apresentam problemas de interação homem x sistema, o que impede uma efetiva percepção da informação.

1 Introdução

Along with other factors, the contemporary world is characterized by the "information age", where an exponential increase in the use

and application of new information systems (printed media, internet, digital interactivity, app's, etc.) have influenced human behavior in most activities of daily living.

Consequently, large investments have been made by companies, organizations and scientific and technological communities in the Research and Development (R&D) sector. Their purposes may involve the upgrading or innovation of the systems themselves to attract consumer markets or the improvement of the interfaces between such systems and their users.

In the latter case, ergonomic and usability studies stand out, since their conceptual goal involves facilitation, comprehension and satisfaction in the interface between user and system. Historically, such studies began in the second half of the 20th century due to the massive use of personal computers and their forms of interaction. Common user access to this kind of equipment was believed to be viable if adaptations and adjustments were made to its perceptive and cognitive capacities. Therefore, questions mainly involving the forms of interaction between humans and computers were investigated.

On the other hand, the interactions between man and other systems had already been part of ergonomic studies since the first half of the 20th Century, although the attraction of computer systems and the high market potential that they represented particularly directed usability investigations to this form of interaction.

Ergonomics studies with this focus were, are and will be continuously conducted since new information technologies are continuously being developed and presented. On the other hand, the following question remains: have the aspects of the interaction between users and traditional information systems (particularly graphics) been fully studied?

With this in mind, the objective of the present study is to discuss and demonstrate that studies on the ergonomic and usability of traditional information systems are still not completely clear or, at least, have not fully explored it, which has resulted in several usability problems in interfaces with traditional information systems, especially in the packaging of consumer products.

2 Ergonomic and Information Systems

The ergonomic of information systems can be understood based on its historical evolution. It cannot be denied that the first manifestations of cave art (e.g., representations of bison in the caves of Altamira, Spain) are, in fact, one of the first human systems of information exchange. However, only after the beginning of the 20th century did the first studies on information systems appear.

About mid-century, Shannon and Weaver formulated Information Theory (MORAES, 2002), in which a unidirectional scheme of information transmission was characterized. Based on this first

theoretical step, Wiener presented the concept of Cybernetics, which was characterized by a cyclical retroaction or regulation of information systems (i.e., that any transmission of information causes a reaction). Due to this and other new theories that began to appear at that time, there was a consensus that the information forwarded by a certain "source" is not always used by the human being as intended and that a reaction considered as "inappropriate" can generate constraint, frustration and dissatisfaction on the part of the user.

Thus, it seems reasonable to consider that the reception of any message involves human variables, which provides a basis for applying ergonomic criteria in this scientific field. Among the involved variables, Moraes (2002) highlights the importance of "attention", "perception", "comprehension" and "memorization". Therefore, according to this author, an information system can be understood by means of a cyclical multidimensional model that encompasses aspects such as comprehension, encoding, emission, reception, decoding, recoding, task involvement, meanings, exchanges, changes and the transformations of the involved parties.

In information theory the concepts of transmitter, channel and receiver have been previously established. However, Wogalter (1999) points out that, when the receiver is a human being, the information will be broken down into "Attention", "Comprehension and Memory", "Attitudes and Beliefs" and "Motivation and Behavior". Therefore, the ergonomic of information systems must include reliable feedback systems, making it possible to constantly reevaluate the processes in order to make them safer and more efficient.

The interaction between humans and information systems can occur via a number of different channels including visual, sound, olfactory, gustatory, tactile, kinesthetic and synesthetic. When a human being receives information, using his sensory-perceptual system he can detect, recognize and interpret this information, define strategies and make decisions (non-observable activities) and act on the technological system kinesthetically, visually, auditorially, etc. (observable activities).

This information and the action reciprocity process occur in a context that implies "noise" (constraints), which disturbs communication between man and technology. To Epstein (1986, cited in MORAES, 2002), noise is "... any phenomenon that is produced during communication that does not belong to the intentional message transmitted".

Moraes (2002) points out a number of problems related to noise: low rates of visibility, legibility and readability in the typographic and/or iconographic information; difficulties decoding and comprehending pictograms; lighting (deficiency associated with visual acuity or excess associated with reflection); topology of the information devices with regard to decision making; acoustics with regard to attention capacity; thermal comfort; disregard of the user's mental models, etc. These problems result in discomfort, fatigue, incidents, accidents and

psychological, cognitive and psychosocial overload, which hamper human development and communication, as well as the interaction between human and technology.

3 Ergonomic and Usability aspects of Information System

Among the ergonomic aspects involved in information systems, those related to the visibility, legibility and readability of visual elements stand out (NIEMEYER, 2006), particularly alpha-numeric characters and the iconographic symbols widely used in communication systems for signalization, orientation and safety (SANTOS and FIALHO, 1997).

The definition of each of these aspects is still controversial and demands further discussion, especially regarding user comprehension of the methodological criteria for ergonomic evaluation of information systems. Nevertheless, related studies present definitions that have been accepted in the academic community.

Visibility can be considered the quality of any graphic symbol that makes it visibly distinguishable from the background (or surrounding area). According to Luckiesh (1927), visibility can be defined as the state, quality or capacity of being seen. To Luckiesh e Moss (1935), the degree of visibility for the size of a given symbol depends on the configuration of this symbol. They also point out that visibility deficiencies due to configuration design are unjustifiable.

Among the studies on visibility in traditional information systems, the following stand out: Colombo and Kirsehbaum (1990), which is on the influence of luminance on the visual performance of observers; Collins et al. (1991), which is on the visibility of output signals; and Luckiesh and Moss (1935, 1937 e 1939) which is on visibility in different designs of typographic symbols.

On the other hand, some authors have discussed "visibility" together with aspects of "legibility". In this case, a study by Schooley and Reagan (1980) about environmental signage and Lozano (1980), which is about visibility, legibility, color and lighting in traffic signage, stand out.

Legibility, in turn, is characterized as an attribute that any graphic symbol demonstrates with its own characteristics that can be identified independently. According to Zuffi (2007), legibility refers to the properties of a character or a symbol that determine the ease with which it can be recognized. To Nilsson and Kaiserman (2004), it is the characteristics of a symbol due to its physical properties that describe how clearly it can be seen and, therefore, be potentially understood, regardless of its semantic characteristics. According to Jeng et al. (2005), legibility depends on the intensity of the lighting, and printed media provide better visual comfort than digital media, even though they perform the same function.

Studies on the legibility of traditional information systems have been published by: Smith (1979), who analyzed the ideal letter size;

Wendt (1979), who considered the typographic effect in didactic books; Ting et al. (2008), who studied the legibility of traffic signals, etc.

Finally, readability can be considered the quality of recognizing the information index of graphic symbols when grouped in a significant way. According to Zuffi (2007), readability is the property of easy reading of written structures based on material stimulus, regardless of their meaning.

Different studies have also dealt with readability in traditional information systems. Wright and Threlfall (1979) analyzed layouts in book indexes; Spencer et al. (1974) evaluated typographic coding systems related to topographic (spatial) questions, etc.

Nevertheless, it cannot be denied that these aspects, associated with other factors in the interface between users and information systems, are essential for avoiding noise and, consequently, avoiding ergonomic and usability problems.

4 The progress of ergonomic studies about Information Systems

Several specialized scientific studies have dealt with ergonomic aspects involving general information systems. With respect to the areas of ergonomic and usability, the progress of the specialized journal "Applied Ergonomics", whose impact factor (2011) is 1,428 (© Thomson Reuters Journal Citation Reports 2012), can be evaluated in an attempt to understand at which historical moments of the second half of the 20th century these subjects were studied.

This important journal (whose IF is the highest among all ergonomics-area journals) has existed for at least four decades and, from 1970 to 2011, 808 scientific articles include the term 'visibility', 524 include 'legibility' and 294 'readability' (Figure 1). However, the highest volume of articles reporting these themes were published between 1970 and 1994, which shows that this was the period when questions about the usability of computerized information systems were most explored.

When the three aspects were considered simultaneously, 46 articles were found, which can be distributed in 8 sub-topics (Figure 2): signage, electronic panels, letters and pictograms, parameters for occupational activities, transportation, others. Once more it was confirmed that articles associated with computer systems (display panels, etc.) stand out, representing more than one quarter of the total number of articles, whereas signage involved approximately 17.4% of the total and the sub-topic letters and pictograms only 8.7%.

These results allow the conclusion that ergonomic and usability studies on computer information systems were much more developed than those about traditional information systems, particularly in the period when they were necessary for the massive popularization of personal computers. In addition, the low rates of articles dealing specifically with traditional information systems do not indicate

that this subject is of lesser importance, since this type of question remains present in daily media.
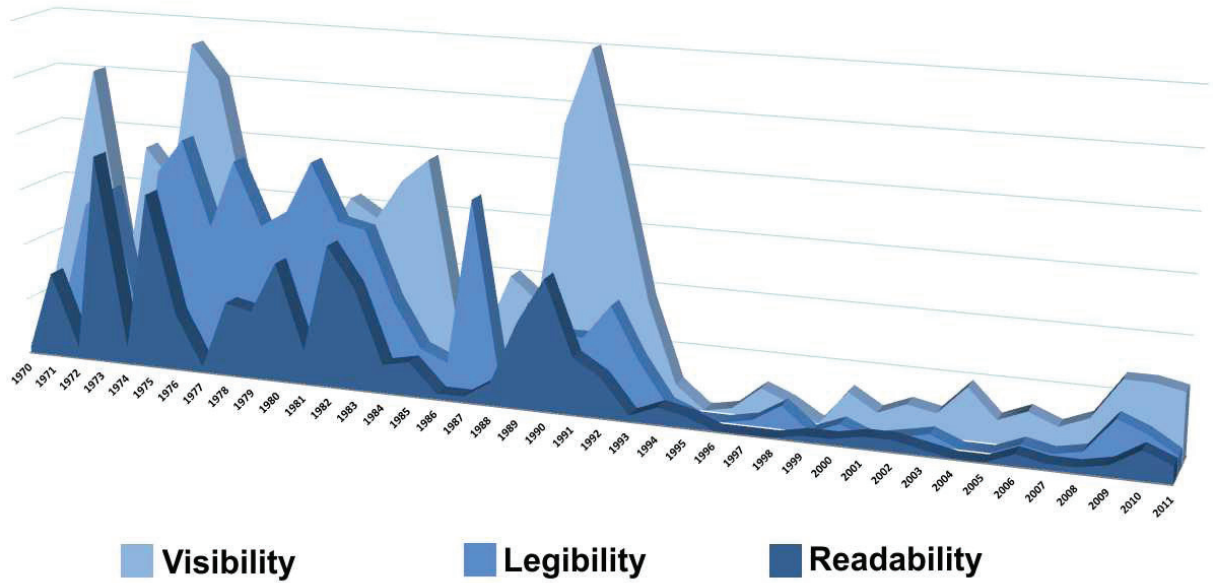

Figure 1 Report of the terms "Visibility," "Readability" and "Legibility", in the journal "Applied Ergonomics", from 1970 to 2011.
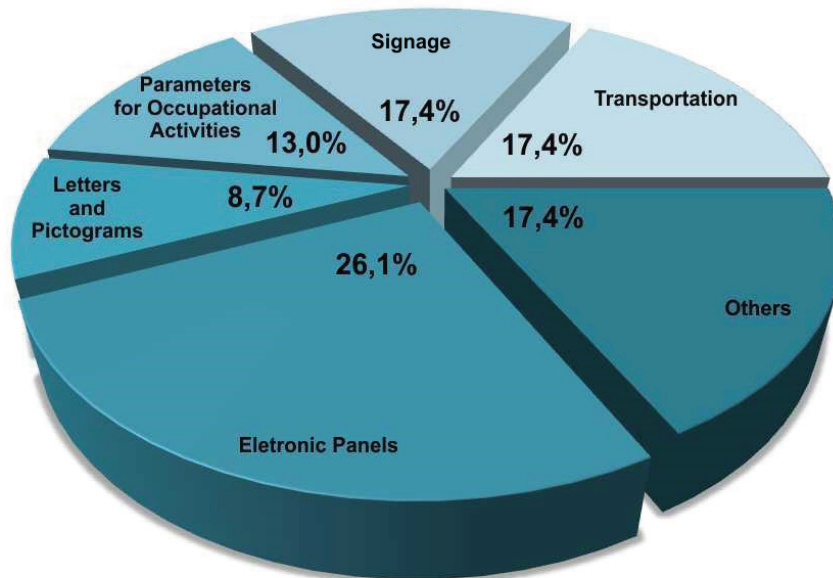

Figure 2 Distribution of sub-topics (signage, electronic panels, letters and pictograms, parameters for occupational activities, transportation, others) in the 46 scientific papers on "Visibility," "Legibility" and "Readability".

5 Examples of ergonomic problems in Information Systems Packaging

Several examples of ergonomic and usability problems with respect to traditional information systems have been observed in Brazil. If we focus on the interior of São Paulo state, responsible for a GNP (Gross National Product) of USD 287 billion, or 18,3% of the Brazilian GDP (IBGE, 2001 e SEADE, 2011), severe ergonomic and usability problems can be identified in various economics segments. But in sector of the packaging is that usability problems are more impactful and that may result in unsafe conditions for direct users.

According to Berman (2004) the most common problems are due to: small size and poor readability of presented information; similar appearing packages or labels on different products; poorly designed or disordered labels; poor use of color to differentiate products; inadequate warnings about drug use; poor legibility of presented information.

The main problems of visibility and readability in the case of packages, are related to information about the content, composition, prescription, dosage, etc. (Figure 3).

Figure 3 Examples of packaging in which visibility and readability problems are explicit.

Already the main problems of legibility and readability, in the case of packages, are related to the use of graphic elements (indicative symbols) unusual or that disregard the cultural conditions and the mental models of users, to display information about the packaged content.

Another example, where the visibility, legibility and readability problems occur, are certain Child Resistant Packaging which opening instructions are at the top of the cap. In such cases the figure and background are presented in the same color that complicates the comprehension and visibility (Figure 4).

Figure 4 Squeeze-and-turn caps in which visibility, legibility and readability problems are explicit.

Ergonomic problems are also widely observed in the interaction with drug packaging. Seeking for improvements, Lucio (2013) presents guidelines for the regulation and development of that type of packaging, with emphasis on the needs of the elderly.

6 Final Considerations

Information systems have been essential for human progress and are characterized by technological elements of interface with their users. Several aspects are involved in this interface, but it cannot be denied that the principles of ergonomic and usability are indispensable. The reception of information in its totality depends on these cognitive and perceptive conditions, which generates a demand for studies on this interface.

Ergonomic and usability principles, however, seem to have been widely explored, particularly during the commercialization of computer information systems. But the reality and context of certain

emerging regions confirms that traditional information systems still present problems of this nature, which hampers the effective reception (perception) of information.

Thus there is a need to develop new studies that not only analyze variables involving ergonomic and usability standards in traditional information systems, but also how they are applied and perceived, as well as the commercial and human advantages that they provide.

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