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The Effectiveness of Metaphoric Resources in Graphic Interface Design

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Abstract: This research is conducted in a moment when the emergence of new formats in Communication Technologies fills a gap in an unpublished stage on the social, cultural and artistic practices. The information access and its management are nowadays defined by a strong interconnection, which allows an information omni-directional dynamic flow, and as such, it contributes to re-define the social and cultural structure. The user interface, whose formal and functional bases are provided by the computer scientists, artists and designers' interdisciplinary labour, can be defined as a type of language on the basis that it allows a dialogue between the user and the machine. From the image massive deployment on the current spheres of communication, and the close relation between image and language, it is possible to establish a visual-nature study in the interface, where the graphical metaphor plays an essential role as a vehicle in the association of ideas, and it is directly implied on the interfaces' applications optimization. For this purpose, we consider the graphical metaphor to be a fertile area from which we can project usability solutions, considering this metaphorical use of the image the suitable attribute to communicate an idea in a more efficient way, or to project creative artistic applications, by establishing dynamic conceptual associations. In general terms, this paper seeks to explore the operative spectrum of the graphic interface based on a metaphorical structure navigation. For this purpose, some interfaces have been designed using metaphorical vehicles in its conceptual architecture and navigation paths. After analyzing the interaction with a sample of users, conclusions have been obtained that would help artists and designers to outline useful guidelines for their work, and to create new applications for the interactive interfaces.

Keywords: Graphic Interface, Interactive, Metaphor, Design, Communication, Cognitive, User, New Technologies, Information, Language

Introduction. Scope of Research

IN THE 21ST Century, information has become the main vehicle for social changing of human being, and its treatment, storage and access are now the main concern of the new designer. The information generation and access, the paradigm shift from matter to information[1], and the consequent transformation of the Industrial Society into Information Society, are the consequence of the technological revolution unleashed in recent decades. This revolution is responsible for the change from democracy to technocracy, revealing a scenario where the new dromologic man[2] is defined.

[1] Microelectronics stands as the main cause of the paradigm shift toward dematerialization of the world. A highlight reference is the J. F. Lyotard exhibition in 1985 at the Pompidou Center in Paris.

[2] The term is associated with the theoretical contributions of Paul Virilio on dromology and dromocracy, referring to the current implementation of the culture of speed and the consequent reduction in space distances throughout the world, a factor that undoubtedly transforms the contemporary persons through alteration of their status and *modus operandi* with the environment.

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Since the invention of the microprocessor, three trends have defined current evolution in an exponential rate of progress: the ICT[3] omnipresence, responsible for a qualitative change in social practices and culture; networking, a catalyst for the change in the leadership distribution; and convergence, which reveals paths for unpublished research between biology and microelectronics towards the development of AI.

Immersed in many emerging environments, the human being use the ICT as the driving force of its evolution in the 21st Century. From the introduction of Internet and network communication in all strata of human action derives the evidence that we are living in an omnipresent interactive environment. The formal and functional bases that define interaction patterns are in the hands of the interdisciplinary work of designers, engineers and computer scientists. Based on this premise, there are two inferences to be drawn:

- We need continuous review of methodologies for the cooperative work of these interdisciplinary groups.
- The use of interfaces defines the basis of human activity around communication.

Being aware of the importance of graphics in the electronic interface, and considering the widespread use of the images for the transmission of an idea or information, it is evident that graphic metaphors are a fertile ground to design usability solutions. This metaphorical use of the image may be appropriate to communicate an idea in a more efficient way, or to establish improved conceptual associations.

Communication technologies -transmitters of knowledge- make different cultures converge towards a global[4] and mediatic one. However, cultural differences pose the challenge of designing interfaces intuitive enough to get universally adapted to the particularities of each user, allowing a interference-free interaction with information. Ensuring the purity and usefulness of information, and the generation of interfaces consistent with both the characteristics of information as to the perceptual and cultural particularities of the user, are points to be checked by the interdisciplinary figure of the artist-designer, in the dual role of architect of media and knowledge programmer.

This study seeks to define the operational spectrum of the graphic interface interaction, emphasizing the strategies and resources oriented towards the establishment of a metaphorical structure of navigation. For this purpose, this document begins with a consideration of the language, image, metaphor and interface concepts, and the relationship between them. To determine the scope of the findings of this study, we proceeded to design interfaces that use metaphorical vehicles in their conceptual and navigational architecture, and were tested by regular users of these platforms. The results of the interaction were quantified, obtaining information that corroborated some previous findings, reformulated others, and outlined possible ways for action in the scope of interactive interface design.

[3] Information Communication Technology

[4] Through the establishment of the Internet, now is possible to understand the world as McLuhan's *global village* (McLuhan, 1962: 31).

Theoretical Approaches

Relationship between Language and Image

Considering the various studies of language over the ages, and the materials with which them have been related, three key points can be established:

- The language is primarily a communication system and a component in the construction of human thought, which evolved parallel with the process of socialization[5].
- Language is slowly mutable through the changes occurred in the cultural, geographical and social core, since its two manifestations, speech and writing, are involved in its evolution as key factors for the existence and future of society[6]. Therefore, the mutability of language is attributed to a social practice deriving from an individual practice, conditioned in turn by the sociocultural system and the need of the individual.
- The linguistic sign, as element of language, is mutable as a result from a changing society that continuously needs to define new concepts and re-develop existing ones. Through this approach, every language acts as a model to represent the world, and it changes accordingly to its technical, social and cultural limits.

Therefore, language can be considered as a complex mechanism, basis for communication, defined both at individual and social level, and therefore subject to diachronic changes in its working operativity.

If the image is considered as a sign that has high combining ability for semantic construction, can be defined as a phenomenon very similar to language, and therefore should be conditioned to the constraints of the society that generates them. Like language, the image has demonstrated the ability of building infinite worlds from a finite basis of references, provided under the rules of a grammar that is increasingly globalized.

Therefore, text and image can be identified as phenomena of similar nature, and subject to the same change factors. Consequently, like research on text metaphor, it is also possible to consider a study about the image and graphic metaphor.

The Relevance of Metaphor

In short, we can state that metaphor is a process that affects the semantic core of all language entities that are carriers of meaning. The metaphor replaces a missing term by another of equivalent meaning, and is developed from user's knowledge and his previous experiences.

According to cognitive studies, the metaphor has a function similar to the layout of the mental process. Patterns of thought that are built through experience allow fast responses to

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[5] "*Individuals belonging to a linguistic community have developed essentially the same language. This fact can be explained only by assuming that these individuals employ highly restrictive principles that guide the development of grammar"* (CHOMSKY, 1985: 11).

[6] *"If we include the sum of the verbal images stored on all individuals, then we would meet with the social bond that constitutes language. It is a treasure deposited by the practice of speaking in subjects belonging to the same community, a grammatical system existing virtually in every brain or, more precisely, in the brains of a group of individuals, for language is not complete in any, it exists completely in the mass. [...] By separating the speech language separates both: 1 st , what is social from what is individual; 2 nd , what is essential and what is accessory and more or less accidental"* (SAUSSURE, 1987: 29-30).

new situations, through association with others already lived. The metaphor, as cognitive transfer agent[7], facilitates the association with a previously known reality, and therefore makes possible the understanding of the new situation or the message it contains.

Similarly, the metaphor is directly involved in the conceptual understanding and the formation of abstract reasoning[8], relating a conceptual field that has no intelligible structure (an idea or unknown concept) with another that is known. Thereby the ideas are carried in the discourse through a conduit[9], thus the metaphor can be defined as a highly functional vehicle in the formation of ideas and knowledge transfer.

Interface Design: User, Information and Tasks

The interface is an essential agent for the information exchange between the user and the computer, establishing a communicational relationship[10]. However, the interaction actually happens between man and information[11]. So, speaking of Human-Computer Interface refers to a Human-Information Interface, considering the computer as a transporter agent and an information container, but not the main object of user interaction.

For the generation of interactive interfaces a multidisciplinary work is needed, integrating engineering, programming, art and psychology. We need the convergence of these disciplines to provide sufficient criteria to ensure appropriate and functional design solutions[12].

The user acceptance of an interface (cognitive compatibility[13]) depends on its ability to interact with it. The quality of an interface is determined by the suitability of the actions the user must do in order to achieve a task (number of steps and the intuition for application in the correct order). Understanding the user and the characteristics of the tasks to be performed are starting points to ensure a correct usability of the system, a feature that will determine the success or the failure in the interface design process.

The interface extends its expressive capacity through contributions from the arts (a clever use of metaphor as a high-expressive resource). However, the premise of *form follows function* made by Sullivan[14] remains a background factor to be considered during the creative processes of design. Thus, the interface design depends on the combination of user knowledge, the tasks to be developed and the tools necessary for that purpose.

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[7] Reference to metaphor in these terms in BARKER & others, 1994: 214.

[8] Ideas raised by Lakoff (LAKOFF, 1993: 244).

[9] Michael Reddy mentions the concept of conduit metaphor to describe the flow of ideas inherent in the act of communication (REDDY, 1979: 284-297).

[10] *"A human interface is the sum of communicative exchanges between the computer and the user. It presents information to the user and gets user information"* (BONSIEPE, 1999: 42).

[11] Church defines the interface as *"the limit or the intermediary between a human user and the information that seeks; a surface or boundary in which the user contacts, interacts or communicates with information sources."* (CHURCH, 1999: 19).

[12] As Bürdek states: *"The design of interface operates in a middle ground between the graphics and industrial design: the role of a product -and its software- should be designed visual, tactile and audible in a way that is easily understood by user."* (BÜRDEK, 1994: 316).

[13] A term referring to complex information processing, accepted as decisive part in human behavior since Cognitivism revolution in the 1960s, and cited by Nielsen (NIELSEN, 1993: 361).

[14] *"Form follows function"*. Phrase appeared in Lippincott's Magazine in March 1896, in an article by the architect Louis Henri Sullivan.

The Metaphor in the Interface

The graphic metaphor is an invisible network of terms and associations that underlie the way we talk and think about an idea, giving structure to abstract concepts. It is an important part of language, and therefore, of thinking[15]. So, the metaphor is a cognitive implement for users, and also a creative support for interface designers.

Using of metaphors in the interface clarifies the operating electronic process[16]. They are verbal, iconic and semantic tools that relate similarities between new and familiar situations for the user. An appropriate metaphor provides the user with a network of efficient associations, enhances the understanding and use of interface, and therefore reduces the response time to certain operations. It seeks to minimize any cognitive effort making the system invisible and easy to use.

Early Conclusions

Through the theoretical revision of topics related to this research some conclusions can be outlined:

Concerning the area of competence of language, metaphor and its relationship to the image:

- The language -text and graphic- acts as a complex communication system directly involved in the construction of human thought.
- The metaphor, like the language, lives and evolves in a social and cultural context.
- The use of metaphor improves both meaning of discourse as its effectiveness, while facilitating the understanding. The inclusion in the electronic interface allows the user to build cognitive bridges that enhance understanding of the functional structure of the system, and so improve usability.

Concerning the interface concept and implications with the user:

- The interface should be invisible to the user: a proper internal functioning of the system allows its understanding.
- The interface has to ensure efficient accessibility and navigability. This requires the appropriate syntactic and semantic construction.
- The use of both graphic environment and navigation criteria that are familiar to the user, improves interface usability through providing an intuitive use.

Although the findings presented here tend to outline a framework of actions for interface designers, the results of practical tests with real users are necessary to extract valuable information to corroborate these assertions, and clarify the final conclusions of this paper.

Practical Research

The purpose of the second part of the research is to examine the relationship between language, metaphor, image and the behavior of interface users, through practice on interactive

[15] As a constituent part of language, the metaphor activates the cognitive functioning of the mind, as it interacts with other information already assimilated by the receiver.
[16] The metaphor makes the information easier to access and manage, thus increases the usability of the interface.

interfaces designed for this study. Direct analysis of the *modus operandi* of the users in certain tasks allow us to understand their preferences, procedures and attitudes, establishing a general framework of knowledge for the designer of interactive spaces.

These test interfaces were related to various aspects of the interactive metaphor, such as standardization (the use of existing metaphorical resources, based on others previously known by the user) and the establishment of visual codes to identify the role of metaphorical objects, ensuring user's understanding of the interface functional structure.

General Objectives and Sample of Users

It is intended to explore the general behavior patterns of the interface regular users on common tasks, using interactive architectures with metaphorical vehicles. The users for the tests were selected amongst university students according to their affinity with the aim of the study. To this purpose, a checklist with three questions and three possible answers for each was used first in order to identify compliance with the requirements (regular user of interactive electronic interfaces), ensuring a final sample as homogeneous as possible: *" How long have you had access to a computer?" ("More than 3 years ago" / "Between 1 and 3 years" / "One year or less"), " H ow often do you use computers?" ("Almost every day" / "At least twice a week" / "Almost never"), "How often do you access the Internet?" ("Almost every day" / "At least twice a week" / "Almost never")*. Owning a computer, the frequent use and regular interaction with various interactive platforms are all features that helped to define the appropriate users for our study.

The final sample was formed by 100 people (40 men and 60 women), about 20-24 years old, familiar with multimedia design and interactive practices, habitual users of both PC and Mac platforms for over 3 years, and informed about multiple interactive interfaces through daily Internet navigation. Thus, the sampling error ($SE_{max} = 0.1$, $SE_{min} = 0.02$) ensured a representativeness index in the sample enough to initiate the study.

Description and Design of the Tests

Six tests were devised, five of which were related to interfaces built specifically for this study using Adobe Flash® software. The six tests were performed continuously with each user, using a PC (17-inch screen and optical mouse) in one of the university classrooms, with no interference of other students. The tests were intended to be brief, with a total run time in a range of 8 to 12 minutes per user. During the data collection process, a direct supervision of the users was conducted by one observer in order to explain them the tasks to be performed on the interface, observe and record their actions in a table.

First Test: Conceptual Associations

In this first test, users had to associate geometric shapes with concepts related to basic activities with computers. They could link each shape with a concept, with different concepts at once, or with none of them, if any association was significant enough.

Aims:

- Identify the correlation between simple geometric shapes, and basic concepts on the interface.

- Learning about iconic areas known by the users in order to build bridges between concepts.
- Establish a network of equivalences between shapes and concepts, to be considered for icon design in graphic interfaces.

Results:

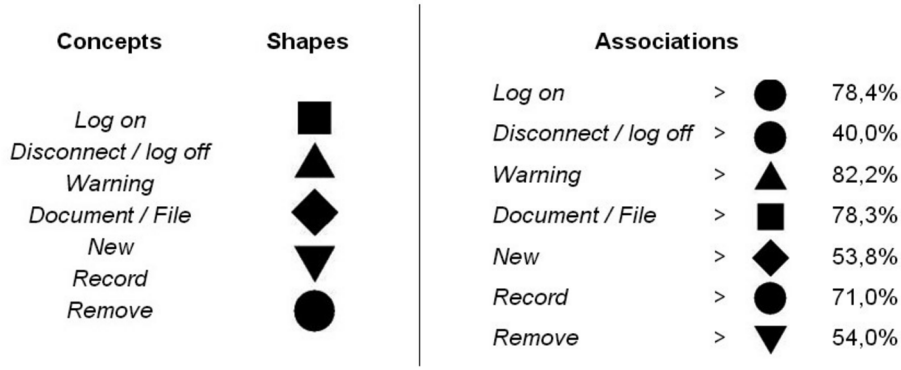

Figure 1: Conceptual Associations: Results

Conclusions:

- The associations that users establish between shapes and concepts are the result of his extensive experience in icon-based interfaces (Windows® and MacOS® operating systems) and the iconology of other areas, such as home electrical appliances.
- In order to establish a relationship between shapes and concepts, the user uses his knowledge about icons from different scopes, as the symbols of road signs (warning / triangle) and the shape of use objects (document, paper / rectangle or square).

Second Test: Blank Desktop Metaphor

Users had to perform four common tasks of the Windows® and MacOS® operating systems, by using the mouse only: open a program in order to create a new document, find and press the help button of the program, close one window, and turn off the computer. This interface was designed without text, with similar structure to those used by the two operating systems listed above. All interaction could be performed through graphic agents only. This test was evaluated according to the time used to run it, and according to the precision in performing each task.

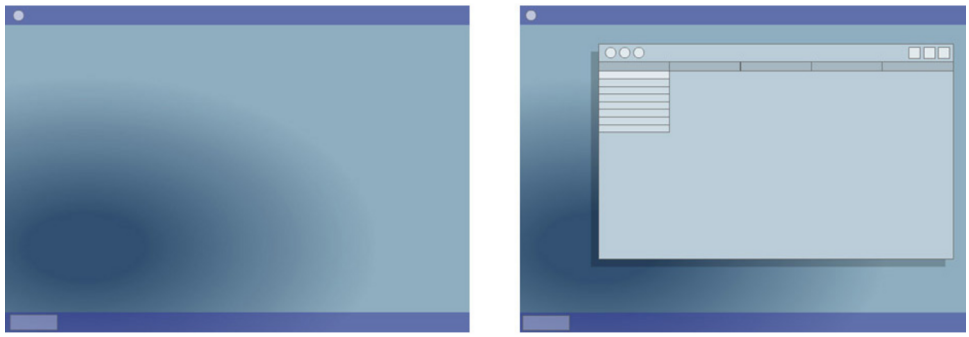

Figure 2: Sample Screens of Blank Desktop Interface

Aim:

To note that through normal activities in an image-based structure interface, user interaction is based on graphical and positional associations.

Results:

A good control of blank interface can be confirmed: about 82% of the tasks were resolved satisfactorily in a short interval of time (less than three seconds for each task) without textual support.

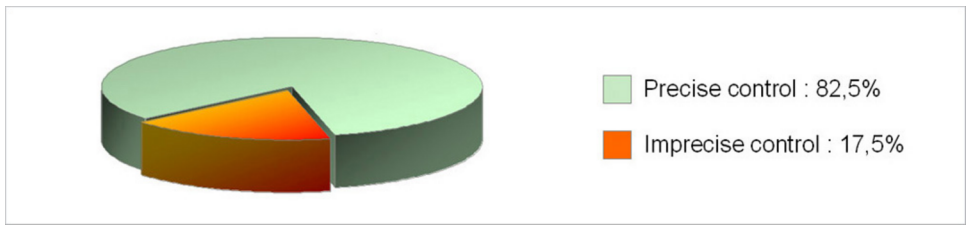

Figure 3: Control Precission of the Interface

Conclusions**:**

Once the operational structure of the interface has been understood by the user, and the location of the interaction buttons have been learned, a graphical interface architecture may become a space capable of conducting an agile dialogue between the user and the task.

Third Test: Iconology Based on Desktop Metaphor

The following interface presents a metaphorical workspace: the photographic representation of an office environment. Again, the interaction is done without text support. Each icon represents a graphical button, and is supposed to perform one specific function. Users were asked to click on the icon with optimal association with each of seven tasks proposed.

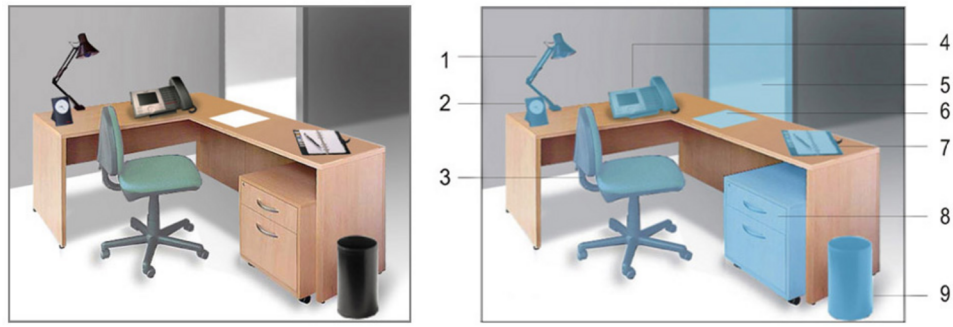

Figure 4: Graphic Interface (left) and hidden buttons (right)

Aims:

- To quantify the conceptual association between photographic icon and proposed tasks.
- To study the operational viability of the graphical interfaces without textual elements

Results:

		Interface icons								
		[6]	[7]	[9]	[2]	[4]	[8]	[5]	[1]	[3]
		paper	agenda	trash	clock	phone	drawers	door	flexo	chair
Suggested tasks	Create new document	**69**	13				18			
	See archived data		**93**			4	2	1		
	Delete a document			**99**			1			
	Check the time				**100**					
	Internet access		1			**98**			1	
	Find a document					8	**92**			
	Exit the application			1		1		**80**	6	12

Figure 5: User Associations between Icons and Tasks

Conclusions:

- The conceptual associations of the user between suggested tasks and icons seems based on the main function of the devices that are taken as reference for the construction of the icons.
- The iconology based on photography resources seems to provide a more direct relationship with each referent, favoring a faster response by the users.

Fourth Test: Conceptual Sphere

The three-dimensional representations can be used as reinforcement in the understanding of the structure of some contents. In this test, the contents of a ficticious company website are distributed according to the metaphor of a sphere with five concentric layers (figure 6). Each layer or level represents a different content. The users were asked to interact with the interface in order to understand it: five buttons centered at the bottom of the page trigger the animated opening of the sphere into five levels. Three different orders for the five contents were proposed (figure 7), and users were asked to select the order that seemed more akin to the structure of concentric layers. The lower numbers corresponded to the inner levels of the sphere.

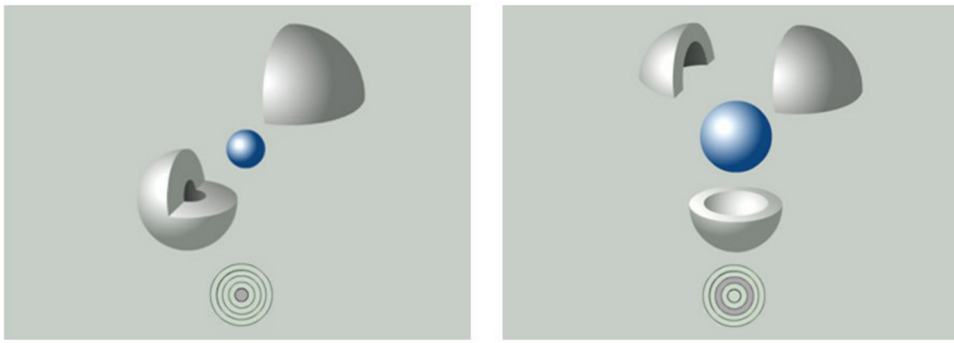

Figure 6: Two of the Five Layers of the Sphere

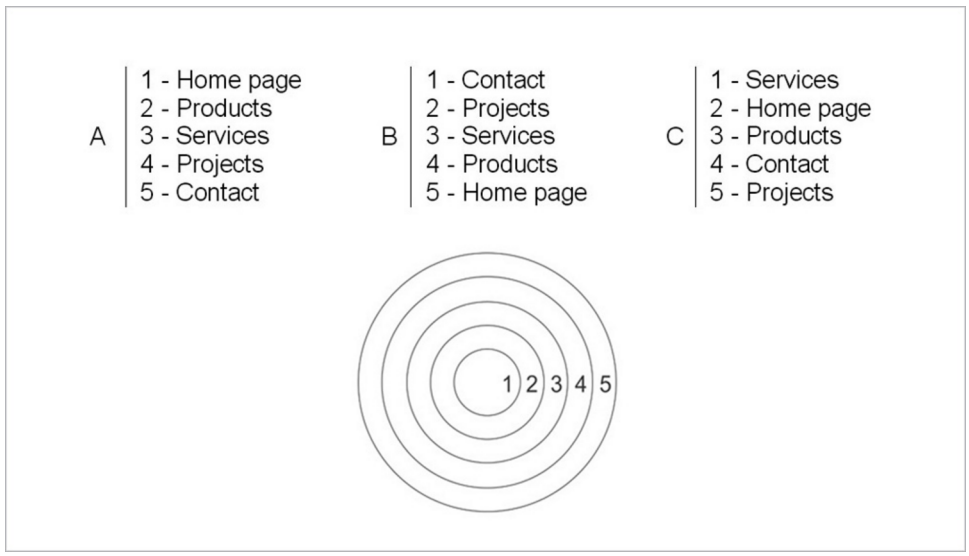

Figure 7: Three different Orders for Content Sequences, and Order of Sphere's Concentric Layers

Aims:

- Investigate the understanding of information architecture through metaphoric graphic agents, seeking equivalence between their structures.
- Consider how to manage the informational space.
- Identify user's preferences in interaction process: simple buttons or complex three dimensional representations.

Results:

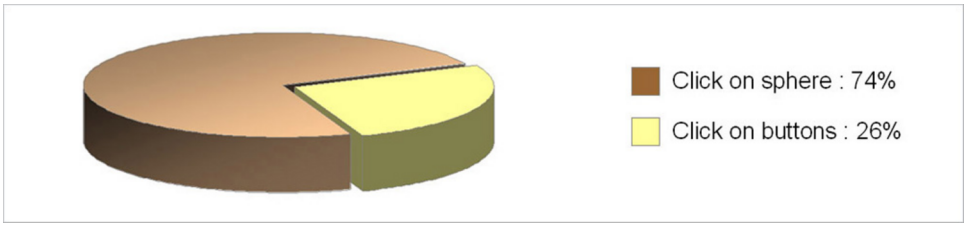

Figure 8: First User Interaction

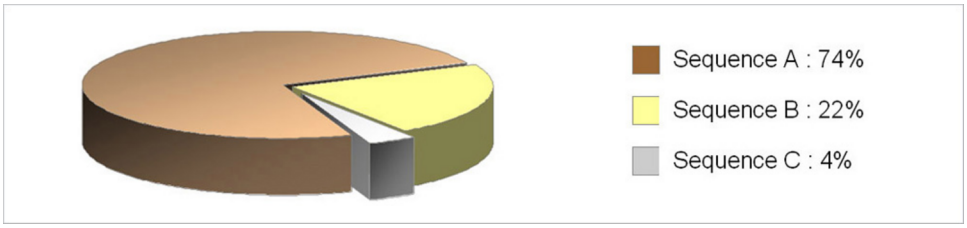

Figure 9: Association between Content Sequences and Sphere's Structure

Conclusions:

- The large size and movement of a graphic element (animated sphere) are attractive to users, and most of them instinctively move the mouse towards it in order to start the interaction process.
- For improve the understanding process about the website content distribution, seems appropriate to establish connections with graphical entities that are known by the user and have similar structures.
- Content distribution ordered from general to specific, is largely related to a graphical model of growth from center to periphery.

Fifth Test: Dynamic Cube

This interface consists of a single interactive agent: a cube that responds to cursor movement, spinning in all directions and pivoting on its center of mass. This time around users were asked to interact with it, rotating it in all directions to locate specific faces (yellow and red), while the observer was noting the control skill and learning process of each user.

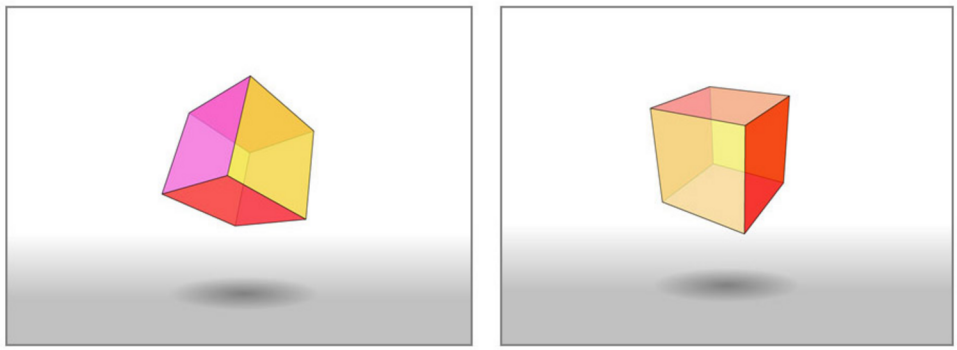

Figure 10: Two Positions of the Cube

Aims:

- Determine the user's ability to interact with the interface.
- Investigate the viability of using three-dimensional representations, in order to incorporate and organize some content structure on them.

Results:

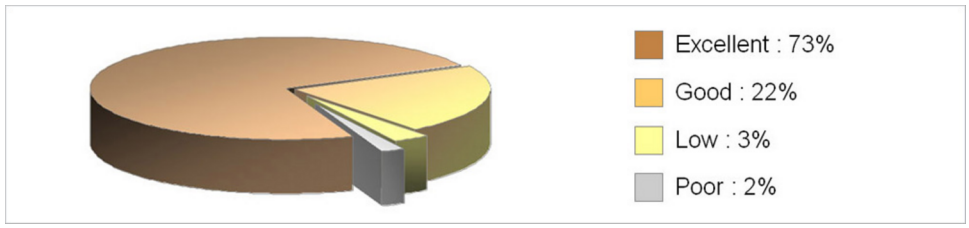

Figure 11: User's Ability to Control the Cube

Conclusions:

- The understanding of the structure of simple geometric volumes is almost instantaneous in most users. This makes the interaction movements highly accurate.
- The user's skill in handling three-dimensional virtual volumes is almost perfect. To achieve this goal, a direct correlation between mouse movement and spin of the virtual figure is required.

Sixth Test: Dynamic Sphere

The last test explores the relationship between mouse pointer movement and its effect on three-dimensional virtual agent. This time the structure investigated is the sphere, whose surface is represented by regular polygons placed on an orbit of constant height. The rotation of the virtual sphere is activated by the press and drag mouse movement, a direct equivalence of the movement of the human hand touching the surface of a real sphere and rotating it.

The interface offers the possibility to change the position, moving the user's point of view out from the sphere (figure 12a), on its surface (figure 12b) or inside it (figure 12c), with the purpose of studying the usability of the interface from several perspectives.

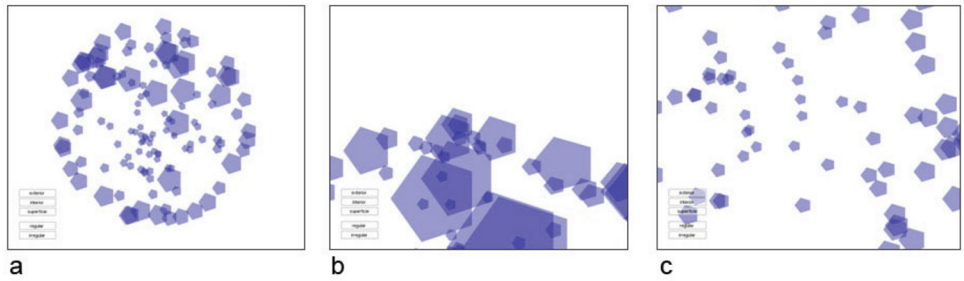

Figure 12

On these three-dimensional structures buttons could be placed, allowing a spherical space of interaction that could solve functional constraints related to conceptual deficiencies.
Aims:

The objectives of this test are identical to the previous one: to evaluate the interacting ability of the user with these environments.
Results:

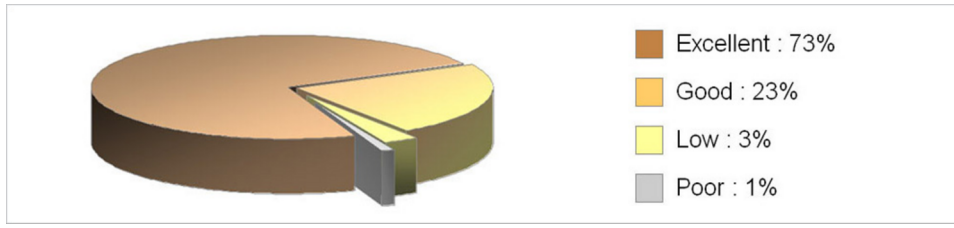

Figure 13: User's Ability to Control the Sphere

Conclusions:

- User just need a brief practice with the interactive process to understand the structure of the interface.
- In general terms, the user expects that a virtual representation of a volume responds to mouse movement in a similar way as a tangible volume would do.

Overall Conclusions from the Practical Tests

About the relevance of user's previous experiences:

- The interface is a language whose functional structure is associated with the establishment of conceptual or functional cause-and-effect relationships, and is built on prior knowledge of the user. Therefore, in the design process it is important to use graphic and semantic background known by the interactor.

About interactive practice using icons:

- Image is a perfect vehicle for communicating large amount of information in a brief time, by establishing cognitive links in a dynamic way.
- The graphic architecture of the interface provides the user with a mental scheme of its functional basis, facilitating a dialogue between the user and the task.

About the organization of the informational space:

- To initiate an interaction, the user tends to move the mouse towards the larger graphic elements and, preferably, those showing some movement activity.
- The distribution of information in a visual metaphorical environment makes it easy to find, and strengthens its structural and semantic basis.
- Similarly, the distribution of information on simple figures may provide the user with easy navigation through the interface.

About the understanding of virtual space by establishing conceptual relations with the phisical environment:

- The understanding of virtual space depends of the interface, whose agents are required to provide enough information about the functioning of the virtual environment and the interactive process for the user.
- A virtual interface based on user's real environment accelerates the understanding of system's functional architecture and the learning process for its management.

Conclusion

This study has tried to state that language, which evolves at the same level with society, is related to the construction process of human thought, and therefore is linked to the process of socialization of individuals. The interface can be defined as a language, since the user establishes a dialogue with the information, generates an artistic discourse, or is socially projected through the relationship with a ubiquitous and global community. As a sort of language, the interface also shows diachronic operative changes, caused by technological progress and the reconfiguration of cultural context.

The process of understanding the virtual space depends on the proper use of the images, organizing the information space and navigation patterns. We have assumed that metaphors can improve the effectiveness of discourses. Incorporated at the graphic interface, the metaphor provides cognitive bridges that allow the user to understand the system's functional structure, therefore improving usability. The functional process and the effectiveness of metaphor applied to the graphic interface, is based on prior knowledge and experience of the users in other languages and in their environment, the cultural conditioning of each individual user, the correct choice of metaphors, and implementing the conceptual solution that best adapts the nature of communication for each case.

Therefore, the interface is defined as a vehicle for communication between user and information, acting as a catalyst for an event of an operational or artistic nature. The metaphor, which occurs from the cultural context of the interactor, has a high creative and expressive potential in guiding ideas. Although the functions provided by interface agents are often

based on the response mechanisms present in the user's day living, we must not forget that the operability of the interface depends on the kind of discourse. So, the interface can be defined as an environment whose interactive features are established through metaphorical relationships, expanding the semantic resources and offering a wide spectrum of innovative solutions for discoursive line.

As a final thought, we can conclude this research by stating that the electronic communication space is emerging as a dynamic environment. Its functional architecture allows to establish a framework in which the flows occurred redefine the status of the society through knowledge generation and management. Its representation posibilities, from a still poorly explored use of metaphorical resources, should be continually reviewed for development of new creative practices in diverse areas.

References

Barker, P., Richards, S. and Benet, I. "Human-computer interface design for electronic books". In *Online Information 94*, eds. D. I. RAITT and B. JEAPES. Oxford: Learned Information, 1994.

Bonsiepe, Gui. *Del objeto a la interfase*. Buenos Aires: Infinito, 1999.

Bürdek, Bernhard E. *Diseño: Historia, teoría y práctica del diseño industrial*. Barcelona: Gustavo Gili, 1994.

Chomsky, N. *Reflexiones sobre el lenguaje*. Barcelona: Planeta, 1985.

Church, G. "The human-computer interface and information literacy: some basis and beyond", in *Information Technology & Libraries*, Vol 18, n 1, 1999.

Lakoff, G. "The contemporary theory of methaphor", in *Metaphor and thought* (2nd edition), ed. Andrew Ortony. Cambridge: University Press, 1993.

McLuhan, Marshall. *The Gutenberg Galaxy: the making of typographic man.* Toronto: University of Toronto Press, 1962.

Nielsen, Jackob. *Usability engineering.* Boston: AP Professional, cop., 1993.

Reddy, M.J. "The conduit metaphor". In *Metaphor and thought*, ed. Andrew Ortony. Cambridge: University Press, 1979.

Saussure, Ferdinand. *Curso de lingüística general*. Madrid: Alianza, 1987.

Virilio, Paul. (1995) "Speed and Information: Cyberspace Alarm!". Available URL: http://www.ctheory.net/articles.aspx?id=72 (10 october 2009).

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