ANL/ED/CP-95726

Impact of Mental Representational Systems on Design Interface*

by

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SEP 21 1999
OSTI

To be Presented at Conference on
Intelligent Tutoring System Fourth Annual International Conference
in
San Antonio, TX
August 16- 19, 1998

*Work supported by the U.S. Department of Energy, under Contract W-31-109-ENG-38.

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Impact of Mental Representational Systems on Design Interface

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Abstract: The purpose of the studies conducted at Argonne National Laboratory is to understand the impact mental representational systems have in identifying how user comfort parameters influence how information is to best be presented. By understanding how each individual perceives information based on the three representational systems (visual, auditory and kinesthetic modalities), it has been found that a different approach must be taken in the design of interfaces resulting in an outcome that is much more effective and representative of the users mental model. This paper will present current findings and future theories to be explored.

Available Topics: Design/Interfaces, Real-World Applications, Cognitive Modeling

Introduction

Typically thought of as a creative and interactive activity, interface design requires not only logical reasoning, but artistic imagination, aesthetic judgment, and an awareness of user mental representations of the system or information to be used. Though engineers and software developers have been creating user interfaces for several decades, their lack of training in the areas of human factors and cognition limits their understanding of effective choices that must be made in order for all users to interact proficiently with human designed interfaces. Even today, engineers and software developers generate functional interfaces based on what worked in the past, and the outcome still results in several redesigns and prolonged learning curves which require the user to adapt to the system instead of the system.to the user. To minimize such redesign delays, the designer must acquire an ability to meta-model (build a model of a model) the users to gain precise information regarding user requirements; thus matching the mental model of designer's perceived concept of the system or information to that of the user and workplace reality. Colors, fonts, character sizes, icons, context bound information, animation, advanced and/or ecological displays, etc., are all terms and concepts that are not new, but yet, widely misused or mismatched when designing software-user interfaces. This is due in part to the reluctance or naiveté of the designer to incorporate essential human factors principles and guidelines into their design, and their inability to initially gather precise information for effective assimilation.

Designers rely on their experience as the tool for creating functional and minimally user friendly interfaces. The concept is known as "hardware obsession," and is based on previous experiences of what works, regardless of the human aspect. Studies continue to show that any "human considerations" in creating the interface are based on what makes sense to the designer. If designers were asked to identify the standard used to implement human factors considerations and usability testing, 95% of the time the answer would probably be - NONE. This perspective of reality results in choices that limit the model design, exclude rather than include the user's perspective, and generates inherent (system) failures. How to align the mismatch between the designer's and the user's perspective models and comfort parameters has been the focus of some of the on-going studies that are presented in this paper.

Representational Systems

Though considered unattainable to some, mental models of user images can be observed via linguistic representations and recorded through a methodology known as Neuro-Linguistic Programming (NLP).

Background: A basic premise of NLP is that individual behaviors are indicative of their neurological representations. That by observing the two, the designer can establish the user's "primary representation system (PRS)" and cultivate a rapport with which to attain explicit information about an experience, system, or situation. This is extremely important in identifying what information is essential in designing software interface by "stepping into" the user's perspective and generating a model. By essentially "walking" through the user's perspective of the process, specific thoughts, needs and concerns can be identified; thus minimizing efforts in redesign and inherent failures.

Primary Representational System: The concept of a primary representational system (PRS) contends that many individuals tend to desire and employ one representational system modality: *visual, auditory or kinesthetic*, over the other two when performing decision testing and operations of tasks. Consequently, this kind of preference is often generalized to many different types of tasks, even to those for which the preferred representational system is inappropriate or inadequate. In other words, our behavioral characteristics, decision strategy patterns, and comfort parameters are based on the representational system we most tend to favor. Hence, providing the designer with an understanding of how a person constructs his or her model of a system or chunk of information (Miller's theory concerning seven, plus or minus two, bits of information storage/usage). Once the general patterns are assimilated, then more explicit distinctions can be generated which reveal strategies that are outside the normal, conscious awareness of the subject, and which can assist in identifying specific comfort parameters that are applicable to all three representational systems.

Other human factors studies conducted at Argonne have shown that by establishing the comfort parameters of each system, design features can be incorporated into interfaces that are more generally acceptable (read comfortable, too) to the overall population. The next section will briefly outline some of the findings to date.

Design Strategies

Designing effective and user friendly displays requires the designer, during each design and usability testing phase, to transition in all three states: *visual, auditory and kinesthetic.* Since this is not an easy (or understandable) task for most individuals, it can be accepted that most designers will create (unconsciously) interfaces based on their PRS and intuition (assumptions and other hallucinations) of the user's perspective model. This results in several redesigns, inappropriate formats, inherent errors, dissatisfied customers or operators, and a product that forces the user to adapt to the system, thus defeating the purpose of an advanced, self adapting, tool, i.e., intelligent tutoring system. This does not mean that the end product will be functionally unusable; on the contrary, software costs and lack of experience in designing systems will force most users to adapt. But the resulting stress costs are high.

Thus, the focus of the Argonne studies has been to discover and establish human comfort parameters that will best suit a general population for user interface acceptability. The studies and applications to date show that:

- the lead designers should be primarily auditory and kinesthetic (or a designer that has the capability to transition to all three states equally). Those individuals who are kinesthetic will provide the acceptable *colors and format,* while the auditories will display the relevant *amount of information.* Both will tend toward animations and icons that are reference based, minimize the amount of information to be seen, and incorporate pull down menus and pop-up windows for additional information that may be needed. Visuals have a tendency to design screens which are busy; placing information wherever there is space, and looks good.

• visuals should be used as evaluators. They are individuals that abhor making images deliberately. They view displays for clarity, resolution and pictorial reference (i.e., text = pictures). Visuals are poor to fair interface designers since their main focus is on how well the information is seen, and not how it feels or sounds. Busy screens can be processed by these individuals fairly quickly in contrast to the other two systems.

• light blue to mid-blue and light green should be used for background colors. Avoidance of black backgrounds is essential for those individuals who are kinesthetic and auditory. Black has a tendency to cause eye fatigue, and for some kinesthetics uncomfortable emotions. This prevents the kinesthetics from wanting to interface with the system for very long. In a learning situation, this would have an impact on final outcomes and results.

• earth-tone blends to primary colors should be used, i.e., blue-green, browns, rustic reds, greens, etc., and they should contrast well when appropriate. Kinesthestics prefer earth tone colors, blue-green, browns, yellow-greens, pastels, soft pinks, etc., whereas, auditories prefer the basic primary colors of browns, greens, reds, blues, and even purples, and fluorescent. Visuals prefer both the primary colors and earth-tones, whichever <u>looks</u> best to them. It was found that auditories prefer no more than 4-5 various colors on a display, where kinesthetics could handle 6-8, and the visuals from 9-10+ colors. (Per human factors principles, one should use no more than 10 variations of colors per display.) So color selection would be based on the worst case scenario of 4-6 color variations per user interface.

• interfaces should be dynamic, since this will assist both the kinesthetic and auditories to create internal (mental) images more quickly. The use of color changes or directional movement (i.e., moving arrows, moving objects), is extremely important in helping these individuals process information quickly and accurately. Blinking icons, particularly in certain shades of red, can be irritating (or in the case of epileptics - dangerous), and shouldn't be used in settings where machine to human interface could be physically harmful.

• there should be voice and sound interaction to assist the auditories. Relevant information associated with a tone or sound will have a strong impact on anchoring the learning process for these individuals. However, the level of sound and frequency used should be comparable to the age group. For example, male individuals over forty have hearing loss with specific high frequency ranges, and visuals have a tendency to ignore or literally turn off sounds that are bothersome or distracting. Also too much sound (i.e., "white noise:) will cause these individuals (visuals) to slow down their process when trying to create visual images.

- touch, an important element for the kinesthetic, is associated with colors, sounds or tones, feelings, and contact. For kinesthetics and visuals, touch screens are a faster way to respond to the system. Given the option of using a mouse or a touch screen, visuals would prefer touch screen. For kinesthetic, who do not make visual images, the drawback of touch screens is the information hidden by the hand. In selecting between a mouse and trackball device, the trackball is preferred since movement is limited to hand and fingers.

- triangles, boxes, rectangles, and so forth should be used as demarcations marked by different colors and/or texture (thin lines versus thick lines) for remembering like elements, issues, topics, etc., and is especially useful for kinesthetic individuals.

- monitors should (in general) be 17 inches in diagonal measure for young individuals (7-40 years of age) and 17 to 20 inches for those over 45 years of age.

These are but a few of the simple findings which can significantly impact the user when implemented in systems/graphical screen design.

Conclusion

Understanding how each of us processes information is an on-going study within the field of cognition, and the importance finding such understandings has been seen in the use of NLP techniques in the design process. In trying to establish general comfort parameters for user interface design, utilization of NLP is helping to identify what is common between the three states, *visual, auditory and kinesthetic*, and where the distinctions lie. The data has shown areas needing focus, how the information should be formed and who should design the delivery system. How we represent the world to ourselves in our models of reality is based on several constraints we place on ourselves and, in turn, has a direct bearing on our individual perception of how others, too, perceive. These considerations must be taken into account when designing graphical displays, systems, and so forth. These are *the human factor* in industry.