Visual Representations And The Web
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Abstract
Technological development, coupled with immense amount of information that needs to be processed on a daily basis, dictates a culture that is to ever larger extent using visuals to simplify information, to make it accessible and understandable. As a result, a visual culture is rapidly developing, demanding visual literacy that in turn implies use and profound understanding of visual languages. Despite this growing interest in visual representations, particularly in the field of representing knowledge and information, underlying theory and methodology to support the use of the visual are lacking. In an effort to make a first step in the direction of defining some characteristics of the visual language, we propose two terms – visual impetus and visual immediacy, and exemplify their usage in the context of web design and polyscopic modeling.

Introduction
Visual representations are nearly as old as human civilizations, and they are becoming more and more central in all aspects of human life – from traffic signs to the World Wide Web. While their use was mainly in rituals, arts and crafts etc in the past, they are today seeking their rightful place in science, in information representation and many other areas where cognitive processing is involved. Just some decades ago, visual representations were thought of as belonging to arts, and arts and sciences were considered as fields with little intersection. An insightful quotation from (Pang, 1997) where Kuhn is cited illustrates this view.

...Kuhn rejected the idea “that art can readily be distinguished from science by application of the classic dichotomies between, for example, the world of value and the world of fact,” for artists and scientists both work in or struggle against traditions, and confront a variety of technical problems in their everyday work. Still, he maintained that science and art are very different enterprises. Aesthetics is central in the arts, but in the sciences it is “seldom an end in itself and never the primary one,” and scientists’ “aesthetic responses and research styles... are to a considerable degree private and varied.”

The following quotation from (Barry, 1997) provides a different viewpoint:
The power to create and direct thought, Einstein felt, lay in the dynamic energy of images juxtaposed in dominant counterpoint in time, space, line, place, volume, and light. It was the perfect synthesis of Philosophy, art and science – the ultimate integration: “The projection of the dialectic system of things into the brain, into creating abstractly, into the process of thinking, yields: dialectic methods of thinking, dialectical materialism – Philosophy. The projection of the same system of things, while creating concretely, while giving form yields: Art.”

However, technological development has definitely and permanently changed the role of visual representations in science. Scientific imaging technologies and more generally all of the new media have generated images that have revolutionized our understanding of our minds, our culture and our universe. We have seen previously invisible information. Importance of visual information and visualization is no longer disputed in science (Giere, 1999). Furthermore, research in fields like marketing strategies and advertising has made it clear that visual representations have immense power and potential, still to be explored and exploited. A page on anti-smoking campaign of the Visual Culture and Public Health Posters site (see online exhibitions by date and choose anti-smoking) offers some good examples. The URL is: http://www.nlm.nih.gov/ (last updated 6th of January 2005, accessed on 6th of January 2005).

Immense amount of complex information that needs to be processed on a daily basis has contributed to giving visualization a central role in modern life. Both the amount of information and its complexity dictates a culture that is to an ever increasing extent using visuals to simplify information, and to make it faster and easier to comprehend. As a result, a visual culture is rapidly developing, demanding visual literacy that in turn implies educated use and profound understanding of visual languages.

Despite this central role of visual representations in representing knowledge and information, there is little underlying theory and methodology to support the use of the visual. The reason for this lack is difficulty in the formalization of reasoning with visual representations, requiring a synthesis of a myriad of professions and fields addressing the cognitive, representational, artistic, computational, logic, linguistic and psychological aspects of information.

In an effort to take a first step in the direction of defining some characteristics of the visual language, we
propose two terms – visual impetus and visual immediacy – in what follows, placed in the context of Web design and polyscopic modeling.

We have chosen to look at these two terms in relation to the Web design because the World Wide Web and the supporting technologies have made the problem of visual literacy clear and obvious. Anyone who has ever surfed the Web for some amount of time must have noticed the variety, the quantity and, unfortunately, the lack of clarity and quality in all too many visual expressions. This is not unexpected because, while we were trained at school to write, we learned the grammar and spelling, many of us were not taught anything about the impact of images on us, or how to use them to our advantage. Every single web page in itself can be viewed as a visual representation, composed of variety of other visual representations (including text, hypertext, links, animations, icons, navigation, pictures, illustrations, video clips etc.). Which representations are used in order to compose a page is important, but how to make them work together so that the right message is given to the end user is crucial. In likeness with writing, one needs both theory and practice in defining and applying visual literacy anywhere, and of course, on the Web in particular.

In order to remedy the lack of visual literacy, one may resort to learning about information design. Information design is defined in the Journal of Information Design as the art and the science of presenting information so that it is understandable and easy to use: i.e., it is effective, efficient and attractive. Information design integrates the contextual and the visual.

On Visual Impetus And Visual Immediacy
In (Willis, 1999), the following is stated:

Much research exists concerning the effects of mass media on viewers, and how the public uses mass media for their own purposes. Until recently mass media has existed as television and radio programs, film, video, and graphic art via hardcopy in the forms of magazines and newspapers. In this study they will be referred to as “traditional media” in order to distinguish them from the new medium of the Web. There is less research on the effectiveness of messages presented on the Web or on the effects of using enhancing visual elements (i.e. color, graphics, text, formatting, lines, icons) in a Web presentation.

The relation of visual information to information perception, retention, accuracy of understanding, memory enhancement, visual cuing, symbols, immediacy of understanding, and emotional reinforcement of message are briefly examined....

The concern of the current study is the broader framework of Web Presentation in general and whether the use of enhancing visual elements (i.e. color, graphics, textures, text formatting, icons) enable the Web message to be more effectively communicated to the Web user. Considerations in addition to memory are user interest; aesthetic attractiveness of the site; clarification of message; emotional reinforcement; and immediacy of understanding of message. The independent variable, enhancing visual elements, is defined in this study as: visual elements of line, graphics, pictures, color, text formatting, and icons that are carefully and sensitively chosen to be incorporated into the design of the Web presentation to complement and emphasize the textual message; to give greater embellishment to the textual message. The dependent variables of memory retention, interest, emotional bonding, aesthetic satisfaction, clarification of the message, and immediacy of understanding message are the intended effects of applying enhanced visual elements to the Web design.

The goals of Willis’ article are similar to ours. However, its emphasis is on choosing some visual elements, implementing them on Web pages and then studying empirically the effects of enhancements on the users. In a sense, the quotation points towards empirical work related to visual immediacy and impetus.

Our goal as compared to Willis’ work is to establish the concepts of visual immediacy and visual impetus through defining and exemplifying them for the purpose of embedding them into the context of a visual language. The ultimate goal is to contribute to foundational work in the development of visual literacy.

Visual immediacy and visual impetus are here proposed as the first steps in evaluating the design of a web page, also the first two rules by which the design should be carried out in order to produce the result with the desired effects (long term retention, understanding, aesthetic satisfaction, interest etc.).

Defining And Exemplifying Visual Immediacy

Originally, visual immediacy is defined in relation to Diagrammatic Modeling Languages (DMLs) and their design in articles (Akkok, 2003). Still, it is a visual rather than purely diagrammatic characteristic, and applies equally well to visual representations in general including Web representations.

In relation to DMLs, visual immediacy is defined as the DML characteristic that facilitates production of the kind of diagram that enables the diagram interpreter (user) to perceive/recognize and cognitively process information embedded in the diagram (or parts of it) at a glance.
Figure 1b demonstrates a diagram that is the consciously exaggerated result of using a simplified Flow Chart DML (Joiner Associates Staff, 1995), which does not enforce visual immediacy, characterized by the decision phrase (the rhombus) in Figure 1a that enforces rudimentary layouting and connection rules. Note that the decision phrase in Figure 1a is meant to exemplify the production rules of this specific version of a Flow Chart DML. Though not given explicitly, similar layouting and connection rules would be valid for the task box (the rectangle) used in Figure 1b.

**Figure 1**

Flow Chart DML Represented By

a) A Decision Phrase That Does Not Enforce Visual Immediacy And

b) A Diagram Representing One Possible Outcome Of Using The DML

![Diagram](image)

*(Partial) Production Rules:

Flow in on any corner.
True flow out on any other corner.
False flow out on any remaining corner.

Figure 2b is the result of using an alternative Flow Chart DML that does enforce visual immediacy through additional production rules (layouting rules, specifically) as exemplified by the decision phrase in Figure 2a.

Note that the decision rhombus accepts input only from the above, branches out only from below or the sides, and branches not on True/False as usual, but on outcomes re-evaluated to yield Normal and ¬Normal cases (¬ is negation and denotes not normal cases). It always branches out from the left when the outcome is abnormal (i.e., ¬Normal), and either from below or the right when the outcome is Normal. Note also that the general flow is always vertical, i.e., usually downwards except in case of a loop-back. If the abnormal case is further categorized into Exception and Termination, and similar layouting rules are introduced for the Flow Chart task-phrase (the rectangle), the result will be diagrams like the one in Figure 2b.

Visual immediacy is a cognitive quality that is often implied in references to a diagram’s intuitiveness and directness (see also Figure 4 in the next section). The term is chosen to reflect not only the visual nature of this diagrammatic quality but also to emphasize its faster (and sometimes apparently immediate) cognitive processing when compared with other visual representation forms like pure text in print. From the cognitive point of view, readers will most likely process the information presented in the two Figures at different speeds. Clearly, the information in Figure 2b will be recognized faster—almost immediately, or at a glance—as compared to the information in Figure 1b.

**Figure 2**

Modified Flow Chart DML With
a) Re-designed “Decision” And “Task” Phrases And
b) Resulting Diagram

![Diagram](image)

*(Partial) Production Rules:

Flow in always from the top.
Normal flow out from below or right.
Abnormal flow out on left.
General flow direction always downwards.

Visual immediacy demonstrated by the diagram in Figure 2b is similar to what is referred to as the result of “cognitively informed” diagramming by Gurr and Tourlas (Gurr, Tourlas, 2000). Though the diagrams in Figure 1b and 2b are logically identical, Figure 2b offers more ‘meaning’ related to which task and decision belongs to which category of operations, making the two figures semantically different. One can also say that the diagrams like the one in Figure 2b offer information beyond facts: The fact that decision D1 branches to task T2 or task T3 is information available also in Figure 1b, but in Figure 2b it is possible to see ‘at a glance’ that T2 is a normal operation, whereas T3 is an exception handling operation in addition. This additional information is said to be offered by “secondary notation” (Petre, 1995) or “implicature” (Oberlander, 1996).

As Gurr and Tourlas also note, text in print is as visual as diagrams in that they are presented to the readers’ visual senses. Thus, this very paragraph is as visual as the diagram in the figures above. However, it is noted that there is a major difference between text-based languages and diagrammatic languages in the following excerpt of the same paper: “One primary difference with diagrams is that they may capture semantic information in a very direct way. That is to say, intrinsic features in the diagram, such as spatial layout, directly capture aspects of the meaning of the diagram.”
Note that visual immediacy does not dictate which type of information is to be conveyed at a glance. That decision belongs to the problem domain and the DML designer. One may not be interested in seeing operations categorized with respect to their normalcy, but in operations categorized with respect to the actor responsible for the operation as in the case of UML’s Activity Diagrams (UML, 2003) instead. The language designer would then choose layout rules that will enforce that alternative layout instead. As a matter of fact, the language designer could choose categorizing with respect to both actors and operation types, and end up with the matrix like double-swim-line layout of Figure 3.

**Figure 3**

**Using Both Vertical And Horizontal Swim-lanes To Represent Categorized Information**

Because visual immediacy was defined in relation to DMLs, it takes into account a language that is more formal than the language of a visual presentation, where the structure of the language is also closer to the structure of natural language. Work on visual immediacy for DMLs has thus made use of linguistics and especially linguistic pragmatics implying mostly spatial arrangements, orders of symbols etc., which is somewhat limiting for the case of more generic visual representations. Visual immediacy is possible to achieve also through use of color coding, contextual or cultural coding and anything else that will contribute to faster cognition.

**Defining And Exemplifying Visual Impetus**

We define visual impetus as an impulse, incentive, stimulus through visual elements of web design whose aim is to increase activity and curiosity related to the contextual aspect of the design.

Visual impetus is thus related to the aesthetic aspect of the page under observation, and as such it could be considered to be subjective and thus useless as a design evaluation tool. However, one can evaluate visual impetus by asking questions such as: How does our first impression of the page "feel"? Is it likable? Does the ambience correspond to the context? Is it stimulating and exciting? Does the first impression of the page hinder or stimulate further interest?

One can definitely obtain a measure of aesthetic quality of the page. It will have a subjective flavor, but measured over certain number of users of the page, answering the same series of questions, would yield a more objective evaluation of the aesthetic quality of the first impression upon entering the site. Does it encourage and "draw" one to explore the site – or does it not?

The webpage [http://www.isn.net/~jypsy/](http://www.isn.net/~jypsy/), designed with best intentions, had its visual impetus rated by a sample of 8 computer science students as very, very low indeed. Their reaction was that there are too many visual elements to relate to, the colors gave the first impression as that of a new age web flee-market or a site with adult content – none of which actually correspond to the context of the page.

An example of the page for which the visual impetus was rated as high is [http://mosquito.paregos.com/](http://mosquito.paregos.com/). This site has won quite a bit of attention due to its innovative design. It may or may not be to someone’s liking in the long run, but it does increase the curiosity and activity: the reader is definitely set on an exploration journey. However, this site is aimed at entertainment and not at information retrieval. Some of the ideas though, can be carried to other realms.

To summarize, we could “visualize” visual impetus as the door into the cognitive world; i.e. the perceptive processing prior to cognitive processing in Figure 4. Then, visual immediacy may be viewed as the facilitator of cognitive processing (reasoning, conscious rendering) once the “door” opens and allows the impression to pass through. In a sense, this also says that visual immediacy is not related to first impression as visual impetus is, but rather to how much secondary processing (cognitive processing after the first impression or perceptive processing) is moved like a reflex to the level of the first impression (or how much of cognitive processing is moved in a reflex-like manner to perceptive
Notice that Figure 4 is a cognitive model as we mentioned we would be pursuing when we contrasted our goals to Willis’ work mentioned in the first section.

**Ideograms, visual immediacy and visual impetus**

Ideograms are one of the main tools in information design and polyscopic modeling. They can be viewed as visual metaphors that are designed to be simple, so that they are easily retained in the long term memory. However, they are not designed to possess visual immediacy. On the contrary, as defined in (Karabeg, 2000), each ideogram consists of four parts: the visual part, its explanation, its usage and its message. The idea with ideograms is that, like with didactic stories, one remembers the “punch-line”, but the punch line has visual reinforcement, which, after initial understanding of the ideogram, has a built-in visual recognition mechanism and therefore gains visual immediacy, through at least one repetition. Related to ideograms, visual impetus is usually very strong the first time the ideogram is seen, but looses its significance (and hence strength) through repetitions. We give one example of ideogram from (Karabeg, 2000) with some modifications. The ideogram is called the Polyscopic Information ideogram, and is sketched in Figure 5.

**Figure 5**  
The Polyscopic Information Ideogram

**Ideogram:** Triangle with an “i” for information (“i” is often used as an icon denoting information desks, information centers etc. but this is now a new and designed meaning).

**Explanation of the ideogram:** The triangle in the ideogram represents a hierarchy of viewpoints or scopes. In order to understand the idea of a hierarchy of scopes, it is useful to imagine that the triangle is a mountain and that its points are viewpoints. From the top of the mountain one sees the broad features of the terrain (a village, a forest, a lake) but not the details. From the foot of the mountain one sees the details (people, houses, trees) but not the whole terrain. Likewise, in polyscopic modeling the broad and general “high-level views” are distinguished from the precise and detailed “low-level views”. This corresponds to changing scopes “vertically”. Note that vertical scopes may be viewed semantically as levels of abstraction versus detail (i.e., as conceptual is-a relations as for example in semantic networks (Sowa, 2000)), and/or merologically as levels of decomposition (where merology is defined as the formal study of the logical properties of part-whole relations), and/or cognitively as levels of obscurity versus clarity in how information is perceived, comprehended or processed otherwise.

One can also look at the mountain in the above example from the other side, i.e. one can rotate the triangle in order to get a totally new view. This corresponds to changing scopes “horizontally” while keeping at the same “vertical” level if one wishes.

Note also the term “hierarchical” is iconic and designed in itself, since we know form knowledge representation (see (Sowa, 2000)) that information organization may be self-referential, may refer “backwards” in forming graphs (often called “networks”) instead of hierarchies, and may involve multiple relations also “upwards” and “backwards” as in multiple inheritance in the case of knowledge organizations akin to semantic networks. However, knowledge sections that are pure hierarchies may be defined and focused upon by choice and for the purpose of structural and conceptual simplification, and eventually related to each other such that they are re-integrable to form the original network. This is in accordance with polyscopic modeling (see below).

The circle of the “i” in Figure 5 represents the wholistic and rounded-off high-level views, and also art as the producer of such views. Note that the term “wholistic” is intentional, and that it is not the same as the term “holistic". To emphasize the distinction, let us start by remembering what the term “holistic” means according to the Merriam-Webster’s Dictionary (Encyclopedia Britannica, 2005, premium service):  
http://www.m-w.com/cgi-in/dictionary?book=Dictionary&va=holistic&x=0&y=0  
Main Entry: holistic.  
Function: adjective.
1. Of or relating to holism.
2. Relating to or concerned with wholes or with complete systems rather than with the analysis of, treatment of, or dissection into parts. Example: "Holistic medicine attempts to treat both the mind and the body" or "Holistic ecology views man and the environment as a single system."

In contrast, wholistic is meant to signify views from different viewpoints and/or at different abstraction levels that are re-integrable into a whole - i.e., pieces and abstractions that are designed to give the whole. A wholistic approach thus does not deny the existence of many levels of abstraction or detail, and does not deny that a whole or its components may be seen from many viewpoints (which we call scopes). Thus, a wholistic approach allows "analysis of, treatment of, or dissection into parts" of a system as long as the parts together serve to give the whole. A holistic approach, on the other hand, advocates an approach "relating to or concerned with wholes or with complete systems rather than with the analysis of, treatment of, or dissection into parts" by definition.

The square represents the analytic and precise low-level views and science as their producer. The circle and the square together compose an "i", the initial of "information". The square is the foundation of the circle. The ideogram suggests that polycsopic modeling produces information which consists of wholistic high-level views that are founded in analytic low-level ones.

Usage: The ideogram represents the polycsopic modeling methodology in a nutshell. By contemplating the ideogram with the help of the accompanying text some of the main characteristics of the polycsopic modeling approach to information design can be grasped.

Message: Polycsopic information - information given in terms of multiple simple, coherent and re-integrable views - is the natural way to provide both the perspective and the facts, both a clear and simple view of the whole and the voluminous details.

The information "i" suggests that combining the expressiveness of art with the rigor of science is the way to produce polycsopically structured information. It is also suggested how art and science are combined: Art expresses the high-level views, science justifies them. Art gives information a perspective; science gives it credibility and precision. Art (the circle) and science (the square) are not considered as separate kinds of activities, but as inseparable sides or aspects of all informing (the whole "i").

Now, one can use the same ideogram interpreted as a methodology for successful Web-site design as follows:

Triangle (one scope): Initial impression upon entering a Web-site:
  - Circle: Visual impetus - aesthetic base - the first impression.
  - Square: Visual immediacy - cognition at the "first glance".
  - Change of scope - view of the information at a "second glance", "third glance" etc.

The designer should naturally be interested in scoring as high as he can within a scope, but also in keeping consistency and making successful trade-offs while changing scopes.

Conclusions And Further Work

In conclusion, we hope that visual immediacy and visual impetus get to be used as part of terminology of the visual literacy. We hope that we have successfully argued in their favor.

As further work we could also mention a need to look closer at "functionality" of aesthetic qualities in terms of Web-design. This is because we can observe the net effects of visual impetus but we cannot really explain what it is that brings about this quality. A candidate solution is that it is related to the aesthetic qualities of the presentation. If this is the case, then we would have a better understanding of not only why visual impetus is as it is, but also a guide to designing the characteristic in to a presentation like a Website.

Also as further work on visual immediacy, we may mention that studies on layout and its effects are being conducted. Layout is assumed to be more spatial then temporal, but time has practically always been expressed in spatial terms also in natural language. Thus, layout related studies are addressing both spatial organizations and visualization of temporal expressions as well. What is not addressed and needs to be addressed at this point is audio, because results indicate that temporal layout arranging both appearance (often in the form of animations) and audio in time seems to facilitate and speed up comprehension and improve retention. Thus, not only visual characteristics like visual immediacy but also audio-visual characteristics deserve serious attention.

References


