Effective Communication Through Infographics

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Abstract

Writing about the historical roles of visual and verbal methods of communication, Lester (1995) notes that "words and pictures have been locked in a struggle for dominance, with words being the clear-cut leader" (p. IX). Indeed few would contest the written or spoken word's communicative power, flexibility, or historical relevance. Despite this however, there are certain types of information for which exclusively textual communication is not the most optimal solution. Certain information needs call for a combined presentation of visual and verbal communication. This paper covers the strengths and weaknesses of both textual and graphical communication, as well as the manner in which the two can be combined to produce more effective artifacts. Additionally, a case study highlighting the design of a sample information graphic will be used to present different strategies for combining text and graphics.

Background

The act of reading, though a common and frequently performed task for most humans, is a rather complex cognitive process (Atkinson et al., 1988). Carr (1988) suggests that while humans' information processing system contains certain characteristics that facilitate auditory language processing, it has no intrinsic strengths at interpreting written language. Written alphabets are essentially symbol systems whose basic characters are abstract representations of phonemes that can be combined in myriad ways to produce an infinite range of meaning (Ware, 2004). While this arbitrary abstraction gives written language its scalability and strength, it also contributes to the cognitive load involved in its comprehension (Carr, 1986). Visual text perceived by the biological processing system is converted to linguistic information in the working memory system; meaning emerges after repeated transfer of the information between the working and long-term memory systems (Atkinson et al., 1988). Thus, the reading process may require significant effort, attention, and motivation on the part of the reader. In certain contexts this effort can be rather rewarding for the reader; research has shown that the cognitive processes involved in reading can allow for deeper and more developed learning (Chin and Brown, 2000). Many use contexts however, don't allow for such effort to be exerted. Tasks involving other additional simultaneous subtasks (e.g., reading instructions while attempting to operate a device) or a quick time to act (e.g., reading diagnostic information in an emergency situation), may not allow readers' the resources required to read through large amounts of text (Wickens et al., 2004). Many times readers will not even bother reading the text if it is not predicted to provide great benefits (Schriver, 1997). Some steps can be taken to simplify the reading process, such as applying visual formatting to help readers detect document structure more easily, but little can be done to limit the verbiage required for communicating complex information (Schriver, 1997). Thus, one can utilize graphical representations of information to create relatively concise messages that would otherwise require large amounts of words.

Graphical representations

One could infer that given written languages' more representational origins (e.g., cave drawings, hieroglyphics, etc.) visual imagery embodies naturally communicative qualities. Unlike modern written languages that rely almost entirely on intensive cognitive workload, representational graphics have the potential to split the workload more evenly between the cognitive, preattentive, and perceptual systems (Ware, 2004). Humans' ability to interpret visual imagery is dependent on the brain's natural ability to detect objects through processing of shapes, contours, and space (Boff, 1986-a). The perceptual system interprets such image elements and transfers them to the working memory system where long-term information is utilized to make sense of the incoming visual stimulus (Boff et al., 1986-b). While the long-term memory system is particularly strong at storing visual information, it contains more than just distinct "snapshots" of real-world objects and scenes; instead it holds complex sets of visuo-spatial schemas that allow the brain to successfully interpret visual representations that bear minimal resemblance to their real-world equivalents, or even representations whose real-world counterparts haven't even been seen firsthand (Ware, 2004).

Early cave drawings are a good example of such low-fidelity, near-abstract representations that allow for effective visual communication. Rather than representing precise spatial details, such drawings present only the most critical shape elements required for communication. While technological advances such as the discovery of perspective and the invention of photography have facilitated the creation of more realistically representational imagery, there remains great benefit in the abstraction of visual representations (Mishra, 1999). Essentially, abstraction allows visual imagery to be simplified to a level appropriate for the overall task at hand (Pettersson, 1989). By extension, different levels of abstraction accommodate different viewing strategies (Massironi, 2002). Photographs, perhaps the least abstract mode of visual representation, have the potential to present a relatively large amount of visual detail. This detail, which requires additional cognitive workload to be processed, can be beneficial when fine distinctions are relevant to the viewing task, but can be distracting when it isn't (DeCarlo and Santella, 2002). Line drawings include enough detail to communicate the shapes of the real-world objects they represent, but may exclude finer details such as color and texture. Ideally, the inclusion and exclusion of detail should match the needs of the task to be performed with the visualization (Wickens et al., 2004). Occasionally, distortion of shape or space can be used as part of the abstraction, in an attempt to convey structures and organizations that may not be easily perceived in a more realistic representation (Mishra, 2002; Petterrson, 1989). Research has shown that in instructional materials as well, somewhat abstract line drawings can produce more effective performance than more realistic representations (Schmidt and Kysor, 1987).

The greatest amount of abstraction can perhaps be found in icons, such as seen in Figure 1. Icons are effective in tasks requiring the communication of broader concepts rather than specific real-world instances (Dewar, 1999). A downside of this level of abstraction is that, compared to photographs and line drawings, they are more dependent on viewers' familiarity with culturally learned symbols (Olmstead, 1999). As such, they have been shown to produce misinterpretations across culturally diverse viewing populations (Brugger, 1999).

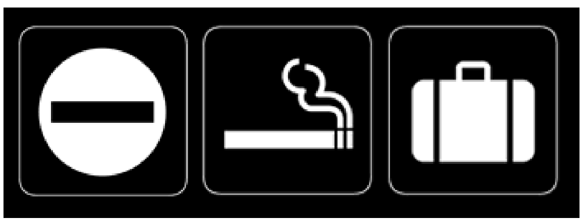

Figure 1 - A sampling of several standard icons

In addition to icons, graphical communications tend to utilize a wide range of learned symbols and visualization techniques to communicate concepts that are not directly perceivable in the real world (Tufte, 2001). Visualization techniques such as cutaways and phantom views present views that are not possible in real life, conveying external and internal structures simultaneously (Brasseur, 2003). Similarly, motion can be conveyed through the use of directional arrows and lines, which can be combined with the use of multiple frames of information to represent causality over time (Tufte, 2001). The power of such techniques however, is also dependent on the viewers' familiarity with encoding methods such as the use of dashed leader lines to denote transparent areas or the presentation of motion through arrows (Massironi, 2002). Use of such techniques is rather common within technical communities, and is frequently used to create effective visual communication (Brasseur, 2003).

The combined use of text and graphics

On their own, text and graphics are both useful yet imperfect methods for communication. In general, written language can be used to describe an infinite number of concepts, but some concepts demand use of dense and inefficient linguistic structure that can be rather difficult to process cognitively (Wickens et al., 2004). Graphics are very capable at communicating specific spatial, physical, and structural properties in a concise and clear manner, but are inefficient and inconsistent at communicating abstract concepts without the use of specialized encoding systems (Ware, 2004). As such, combining text and graphics in a meaningful and calculated way allows communicators to take advantage of each medium's strengths and diminish its weaknesses. Research has shown such combinations to be particularly effective in a variety of learning, instructional, and persuasive tasks (Zacks et al., 2001)

Through the work of various researchers, a taxonomy of different text and graphic combination options has emerged (Schriver, 1997). The following are four of the most common combination types:

Redundant

Redundant combinations involve the presentation of the same exact content through both textual and graphic means. Research suggests that such a combination is beneficial in some contexts, in that the "dual coding" of information helps create multiple connections to the same concepts in long-term memory; this is commonly referred to as "redundancy gain" (Paivio, 1990; Wickens, 2004). Redundant combinations aren't always optimal however, because they don't necessarily cater to the unique communicative strengths of the two communication options and can inhibit performance when the redundancy causes viewers to lose interest (Schriver, 1997).

Complementary and Supplementary

Complementary and supplementary interactions are text and graphic combinations in which each medium communicates unique aspects of the overall content. This allows the strength of each medium to be better utilized, and allows for a potentially more efficient communication (Schriver, 1997). Such combinations are useful in technical instructions in which the graphics present the physical context in a specific and precise manner, while the textual content complements it with procedural information that would have been less successfully communicated through visual presentation (Schriver, 1997).

Stage Setting

Stage setting combinations are ones in which either text or graphics are used to prime readers to the content included in the infographic or document. Such combinations can set the readers' expectations for the type of content to be read, its overall importance, or ways in which it should be read.

To better illustrate the advantages of different text and graphic integration strategies, a case study of a sample infographic design is presented below.

Case Study

Figure 2 presents a sample infographic of a Theremin, an obscure musical instrument that creates sounds by utilizing electromagnetic frequencies.

The infographic's overall structure is meant to accommodate one's introduction to the Theremin. An introductory paragraph in the upper left corner of the graphic provides a narrative detailing the instrument's invention. The text also functions in a stage setting capacity, introducing the basics of the infographic topic and describing the contents and use of the rest of the document. The text is accompanied by a photograph of the Theremin's inventor playing his instrument, which complements the narrative and gives viewers a highly representational and specific real-world reference to the instrument and its inventor.

The Theremin's obscure history may cause it to be perceived as a dull and uninteresting topic. Thus, a large and bold graphic fills the center of the page, in an effort to generate emotional interest in the reader and provoke them to examine the additional levels of detail. The simple graphic also provides a significant level of physical information, communicating the device's shape, size, and usage. This information is also complemented by embedded text that clarifies usage details that are not readily apparent, or easily presentable, in the graphic. A cutaway view provides information regarding the instrument's internal structure, but stops short of providing a full explanation of its inner workings. Such technical details are provided in the explanatory frames located to the bottom of the central graphic, where abstract graphical representations are used to show the involved scientific processes with greater fidelity. This separation of broad and detailed information is a form of scaffolding that allows multiple levels of reading; a quick glance at the page will allow one to notice the central drawing learn about the instrument's basic features, while secondary sections requiring additional reading effort provide more specialized and detailed content to match some readers' cognitive interests. A similar design strategy is employed to the left and right of the central graphic, where information regarding the instrument's acoustic and musical technique is provided.

Arguably, one could communicate all of this content using either text or graphics alone. Their combination however, produces an infographic that communicates a wide range of information in a cohesive and efficient manner.

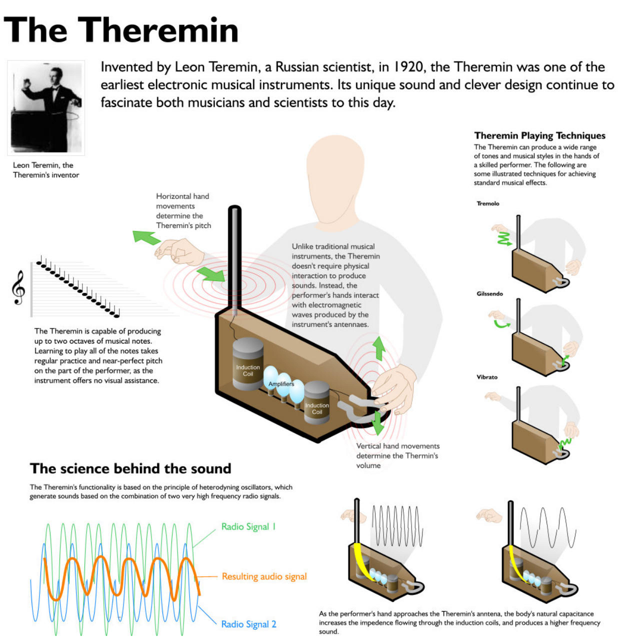

Figure 2 - Sample infographic

Conclusion

As the amount of information in our lives continues to increase, information designers must continue to design solutions that optimally match users' requirements. Thoughtful combinations of text and graphics are one way to optimize communication, but doing so requires designers to be cognizant of the particular ways in which the two interact.

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