

Why History Matters: Visual Innovation and the Role of Image Theory in HCI

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Abstract. Creating and experiencing visual innovation in HCI is based on the historical property of images, and builds on users' visual experiences with certain prior imagery. Historicity of digital visibility seems to be crucial but ignored by most approaches in designing visual experience. This paper suggests to take into account not only aspects from image theory but also art history and science studies that suggest ways of dealing with the historicity of images for successfully creating "new" visual form. Furthermore HCI's own history bears opportunities to connect to the epistemics of visibility derived from the past.

Keywords: History of HCI, Image Theory, Art History, History of Science, Science Studies, Visual Studies, Epistemology, Visual Thinking.

1 How Images Work: A(n) (Art) Historical Approach to HCI

Seeing and understanding certain visual forms, structures, or images intuitively when interacting with technology are key aspects of usability and of successfully creating user experience. The epistemics of visual thinking – perceiving as understanding – is closely connected to image theory and a field of lively debate in various historically grounded disciplines. Although working visually and producing images and iconic visual structures when creating user experiences, HCI is not referring to recent image theory that deals with functions of images in science and technology.

Research within the last two decades from the History of Science, Science Studies, Visual Studies and especially from Art History in the German-speaking countries, has produced deep insights into the ways images work and the role they play in visual strategies in science and technology [3, 16, 4, 8, 7] – especially when the extremely constructive character of any visual form has been emphasized [5]. Images in both art and science have been investigated not only in terms of their aesthetics, but mainly regarding their epistemic functions [6]. As a result the notion of images as purely illustrative elements has been dismissed. In this discourse the understanding of the term 'representation' has been questioned; furthermore it has been concluded that images and visibility play a generative role in the production of knowledge in science and technology [23, 24]. In particular, visual thinking and concepts of implicit knowledge seem to influence both the production of images by artists, designers, and scientists and the reception of images by observers or users [11].

Another closely connected result of the research on images concerns their historicity, as images always seem to refer to other (preceding) images. The specific momentum and power of images, that may even be contrary to any precise purpose or instrumental use, are historically informed – by the very own image history. Any interpretation, as well as any further “visual innovation” of technical images or visual experiences – as in HCI – have to consider the historicity of the “visual” in general: the form, use and function of images depend on a continuous historical process in which visual traditions and new imaging techniques intersect [7, 15].

2 History of Interacting with Images in Art and Technology

Perceptual traditions shape today’s user experience. Such traditions can be traced by comparing recent solutions to historical ones, or by comparing displays to handle visual information made by artists throughout the 20th century to technological solutions [18, 19, 21]. Examples from the modern era in art, i.e. exhibition installations or architectural collages, could serve not only as sources of inspiration for the design of interfaces but rather as fundamental theoretical studies of displaying multiple workspaces interacting with users in a spatial setting.

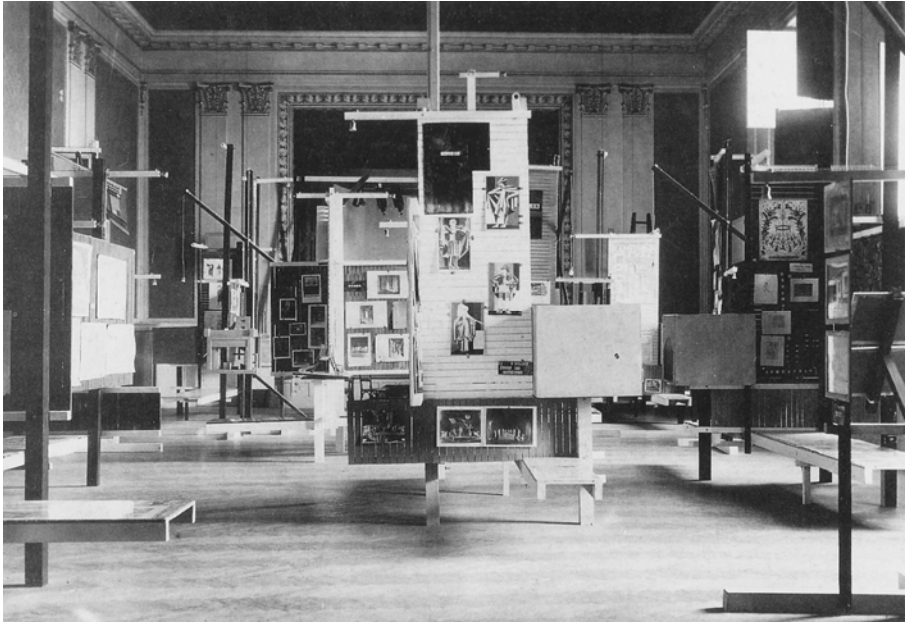


Fig. 1. Frederick Kiesler, Internationale Ausstellung neuer Theatertechnik, Vienna, 1924. Interactive display installation for exhibitions with overlapping structures.

The way in which people interact with multiple, spatially arranged images and objects – in analogy to multiple workspaces on screens or in spatial interaction (‘arranging windows’) – was vastly theoretically discussed and practically explored in

avant-garde architecture and design. The problem of dimensionality, movement and interactivity of viewer/user and objects or images were the main goals tackled by several artists: for instance in the architecture of Mies van der Rohe in the 1930s, or the exhibition design and architecture of Frederick Kiesler in the 1920s (Fig. 1), the films and spatial experiments of Hans Richter and Theo van Doesburg in the 1920s, or Herbert Bayer's display-installations for pictures. But also designers like Ray and Charles Eames who were working in the avant-garde tradition in the 1960s and 70s investigated into the ways of communication and interaction technology – within the art-sphere, but, as in the case of the Eames, were collaborating with and working for corporations like IBM. All of these examples of experimental methods of arranging images in time and space through collage-like interfaces, play with the viewer's sense of disorientation, thus challenging him to interact all the more strongly.

As artistic expressions of user-centered design, such examples could serve not only as sources of inspiration for the design of interfaces but also as fundamental theoretical studies of displaying multiple panels or workspaces interacting with users in a spatial setting. Comparing historical examples of interacting with art or architecture to current ways of interaction experiences in contemporary HCI, does not aim at transforming these images into art [7]; the issue is rather how the interplay of visible forms is intimately connected with the viewers'/users' visual experiences in a diachronic way – and is informed by the history of images in the context of communication, technology, science and art.

“Visuality” has a specific rhetoric, with significant communicative and mnemological laws, not only effective in the sphere of so-called “high art” but in the production, design and interpretation of scientific representations and records as well. Thus images in art and technology likewise build on their own historicity. Based on this historical argument, perceptual traditions and historically imparted visual forms have impact on the design and reception of visual innovation in HCI. By tracing visual conventions resulting from the history of images in both art and technology new starting points for visual innovations might be created.

3 Tracing Traditions: Image Theory and Epistemology in HCI

Computer Science and HCI rarely refer actively to their own history when developing future scenarios, though at crucial historical moments of visual innovation in interaction design, the protagonists were not only practically developing new images, but were dealing with image theory derived from art history or were even referring to contemporary contexts of art and design. One aspect of the efficiency of these approaches is characterized by the reference to concepts of visual thinking and the preference of visibility and visibility by their creators.

The historical impact of visual thinking in terms of gestalt theory as well as concepts of implicit pictorial knowledge within computer science, offer another way of tracing the successful creation of conventions that shape today's visual forms in HCI from a theoretical point of view.

3.1 Visual Thinking: Xerox PARC, the GUI, and Rudolf Arnheim

Although several scholars in the history of science have pointed to contacts and productive exchanges of gestalt psychologists Kurt Lewin and Wolfgang Köhler with protagonists of cybernetics [12], as well as to Michael Polanyi’s exchange with Alan Turing [25], the influence of Rudolf Arnheim, Ernst Gombrich and gestalt theory on human-computer interaction, artificial intelligence, on the research of Xerox PARC, and on scientists such as Douglas T. Ross, J. C. R. Licklider, Alan Kay, Marvin Minsky, Herbert A. Simon, and Allen Newell has remained unnoticed until recently [20, 21]. What all of them had in common was a belief in the virtue of images and explanations of perception as intuitive cognition.

Rudolf Arnheim had developed a theory of “visual thinking” based on gestalt psychology [2]; in his theory he attacked the assumption that thinking is only possible in words, and that language precedes perception. Quite the contrary he argued that “all perceiving is also thinking, all reasoning is also intuition, all observation is also invention” [1]. In this sense “gestalt” was not conceived of as just a way of defining visual form or shape, but rather – as did experimental gestalt psychologists – as a way of understanding human cognition that is based on visual knowledge. In this notion the concept of gestalt offered an epistemic theory of perception and visuality as a creative process that comprised instantaneous and direct ways of problem solving contrary to cybernetic explanations based on procedural processes in temporal sequences. In fact the theory of gestalt formed a basis for early interaction design, visual interfaces and the shaping of pictorial interface elements like windows, icons, and menus that were developed at Xerox PARC.



Fig. 2. Smalltalk-72 Interface, Xerox PARC, Alan Kay and Learning Research Group, [14] Fig. 11.51

Xerox PARC’s work during the 1970s led to one of the most successful products in the history of HCI, the graphical user interface (fig. 2). Based on the work for the programming language Smalltalk, Alan Kay and the Learning Research Group at

Xerox PARC referred to pedagogical theories as well as art historical image theories by art historian Ernst Gombrich, along with art psychologist and gestalt theorist Rudolf Arnheim [21, 15, 26, 2, 10]. In particular, David C. Smith's thesis [26] demonstrates not only an example of visual programming and of Kay's concept of iconic programming, but an extraordinary discussion and reference to Gombrich and Arnheim in tradition of the gestalt reception in computer science from the 1960s.

Thus Gombrich's theory of stylistic historical evolution of art, that refuted the notion of an "innocent eye", became an arthistorical groundwork of a technological process leading to pictorial human-computer interaction [10]. Furthermore Arnheim's concept of "visual thinking" served as an argument to reject any interaction with computers that was word- or number-based [2].

As a result many elements of the graphical user interface seem to reflect experiments conducted by gestalt theorists and offer historical examples and opportunities for further productive investigation into the trans disciplinary correlations and the diachronic character of visual form (fig. 3, 4).

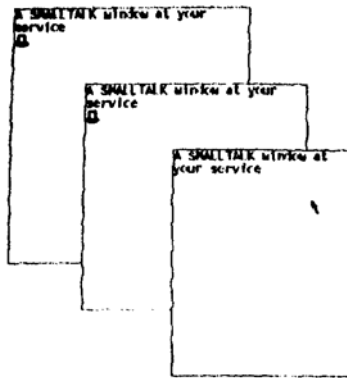


Fig. 3. Early Smalltalk Windows on Interim Dynabook (Alto), Xerox PARC, Alan Kay and Learning Research Group, Smalltalk-72, [14] Fig. 11.32

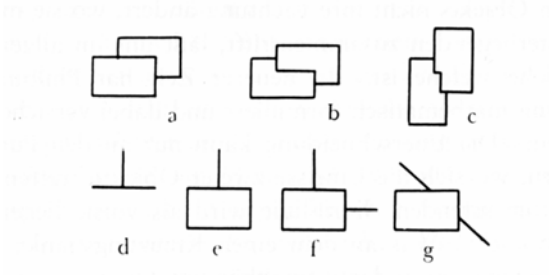


Fig. 4. Gestalt experiments on creation of visual space, 'Depth by Overlapping', Rudolf Arnheim, Art and Visual Perception, [1] fig. 180

3.2 Tacit Knowledge: Douglas Engelbart, the Display, and Herman Miller

While Xerox PARC's experimental work on iconic programming and visual interaction almost lead to a dogmatization of "visibility" when constructing the first commercial graphical user interface for the Xerox Star, a similar outcome resulted from another historical collaboration that crossed the borders of computer science and art/design. Working on his Augmenting Human Intellect workspace at Stanford Research Institute (SRI) in the 1960s, Douglas Engelbart collaborated with Herman Miller Research, headed by Robert Propst, who was doing research that led to an innovative office system, the "Action Office". Both researchers developed human-centered strategies for "displays" from the respective point of view of art and technology [21, 9, 22].

Engelbart's concept of Augmenting Human Intellect [9] came up with a workstation, interface, and connecting devices for man-machine interaction of the NLS computer system. It was informed by ergonomic considerations resembling those of the designers and artists working at Herman Miller – and bears resemblances to Michael Polanyi's theory of bodily implicit knowledge [17]. Although not explicitly referring to Polanyi, Engelbart's contemporaneous concept of bodily connections of man and machine via mouse, chorded keys or other devices, seem to be concrete deductions of Polanyi's theoretical concept of tacit or implicit knowledge.



Fig. 5. Robert Propst, The Office. A Facility Based On Change, 1968, Herman Miller Research, Action Office System, [22] p. 51

Prior to Engelbart's 1968 live demonstration of the NLS computer system his team collaborated with Herman Miller Research and was even testing a mock up of Herman Miller's Action Office furniture set up at the Augmenting Research Center at SRI. The Action Office was designed by George Nelson and had been the result of experimental efforts by Herman Miller's Research Lab guided by Robert Propst (fig. 5).

Robert Propst had devised a new understanding of the office as a flexible display system, based on "visual image triggers", experimentally tested for the „human performer“ who had a „spectacular ...tool: the human eye as a receptor for the mind.“ [22]. With its concepts of "multi-work stations" and vertically oriented displays one can compare Propst's efforts not only to exhibition installations from the avant-garde in art but also to the preference of visuality in the history of computing that led to early versions of graphical interaction between humans and computers, or: resulted in interactive "displays".

4 History Matters: The Challenge of Intersecting Past and Future

In the light of image theoretical arguments stressing that visuality always refers to its own historicity it seems quite clear that history matters when designing visual innovation. Certain visual conventions, image traditions and the uses of images build on earlier experiences of any user or viewer. It may be concluded that the historicity of images – in art and design history as well as in HCI's own history – lays the groundwork for further understanding of how images work in designing interaction. Any future visual innovation is based on history.

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