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Introduction: Visual Communication in Life Sciences

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INTRODUCTION: VISUAL COMMUNICATION IN LIFE SCIENCES

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Ten to twenty-thousand year old cave paintings by the Cro-Magnon depict hunting scenes and anatomy of prey [1, 2]. While the origins and purposes of such illustrations are difficult to know with certainty, the existence of such paintings is neither accidental nor merely decorative [3]. We can easily identify the forensic *telos* of such inscriptions; beyond that, the illustrations may serve ritualistic purposes through epideictic rhetoric in celebration of a successful hunt, or perhaps a didactic purpose, constituting deliberative rhetoric intended to train young members of the group how to achieve success in the hunt. As scientist and scholar Brian J. Ford points out, "Scientific illustration has its roots in the earliest endeavors of *Homo Sapiens*" [2, p. 7], which helps us place the historical roots of visual communication in science at an early mark indeed.

Understanding historical and contemporary scientific images requires visual literacy. For comprehension, the same codes must be available to the audience as the creator. Visual communication, as an area of study that falls within technical communication but overlaps with many other fields, considers a veritable constellation of cognitive, creative, and contextual objects and events that contribute to meaning-making. Toward greater understanding of visual communication, scholars are being drawn to various specific sites to tease out patterns that expand our understanding of the roles of the visual in scientific communication. The sites of inquiry represented in this issue—molecular and cell biology classes, medical journals, Web sites on medical topics, and medical clinical protocols—fall squarely within the realm of the life sciences.

Within the field of technical communication, visual communication theories are increasingly being articulated and tested through various types of research across institutional, technical, and public settings, a wide cross section of which are

demonstrated through the articles in this issue. The production of visual rhetoric remains a pedagogical challenge. In the first selection of this issue, Neal Lerner describes the legacy of Louis Agassiz, and explains how he (Lerner) continues that legacy by encouraging students at MIT to learn through visual means. John Dinolfo, Barbara Heifferon, and Lesly Temesvari conducted a research study into cell biology courses at Clemson University, examining the methods through which university science teachers help students comprehend structures seen through a microscope.

Our interest in visual communication extends beyond university classroom settings. Examining the literature of medical professionals, Alan Gross articulates visual semiotics and the psychology of visual perception as they apply to the images in major medical journals. Bernadette Longo, Craig Weinert, and Kenny Fountain analyze documents that medical practitioners use to treat diabetic patients. Still other theories are relevant to how audiences interpret visual rhetoric, and Carmen Maier, Constance Kampf, and Peter Kastberg apply multimodal analysis to a Web site designed to teach adolescents about neuroscience.

Technical communicators will recognize the conventions of visual rhetoric identified by the contributors. From all the articles in this issue, technical communication instructors can extract information on teaching visual rhetoric and design, conducting research into visual communication, and expanding our thinking about how people work and learn.

The articles build on an ever-growing body of related literature about rhetoric of the life sciences. For the broadest possible understanding of where their contributions fit, a historical overview of visual communication in such fields may be useful.

In Classical times, teachers such as Hippocrates, Plato, and Aristotle focused much attention on the human condition, mostly speculating about the interior processes of the body. Their works, especially Hippocrates', were synthesized by Galen, who visually theorized the human body, and whose notions of human morphology persisted for the next millennium [2]. The influence of Galen, who utilized animal rather than human cadaver dissection, is apparent in the work of the great Persian scientist Avicenna, who worked at the turn of the first millennium, and was prohibited by the Qur'an from dissecting humans [2]. Half a millennium later, Leonardo da Vinci's 16th century scholarship "established a lone pathway toward representational scientific illustration which remained without peer" [2, p. 37]. Leonardo did rely on data from human dissection, and thus it is often through Leonardo that we recognize the appropriate measure of direct observation and reliance on empirical data in illustration to render it "scientific." Leonardo also incorporated the work of his predecessors, including Galen, practicing the intricately intertextual endeavor we see in today's scientific visuals.

It is in the 18th century that scientists began employing professional illustrators, and by the 19th century, the practice was fully professionalized. *Gray's*

Anatomy, in its 1858 first edition, contains 363 engraved figures illustrated by H. Vandyke Carter [2, p. 44]. Those images are representational in a literal sense: they mean to depict the natural world in a way that transforms that world for observation by a remote audience. Concurrently with the move toward drawing from physical, corporeal evidence, new theories of life evolved: physiology, emerging in the 19th and 20th centuries, focuses on life as a dynamic force, replacing the organism orientation of anatomy [4]. Life became a cultural concept. Further complicated by Darwinian theories of natural selection and cumulative species change over time, cinematic technology allowed the movements of individual live beings to be studied [4]. Also at the turn of the 20th century, x-rays offered a look inside living beings that was previously almost unimaginable. Medical science had evolved from a snapshot guess at forms, diseases, and conditions, and an imperfect chronicling of practice, to a study of change within organisms and differences among them. As new technologies have offered fresh views of—and on—life, medical science, illustration, and cultural attitudes about life, disease, and treatment have changed rapidly.

Across all the stages in the development of medical science, illustrations have been used in various ways for different purposes. Representation has come to mean a spectrum of realism, and the notion that an illustration can ever be "accurate" or "true" is more likely to be challenged than accepted today. If representations of scientific and medical materials are not purely truthful, however, what are they? Theorists offer rubrics for visual representation that help technical communicators enter the seemingly impenetrable world of the non-verbal by mapping language theories onto images.

Semiotics in its various guises is often applied to images, with references to the signified, the signifier, and the sign. W. J. T. Mitchell articulates three semiotic concepts: icon, symbol, index, to help us understand the visual nature of verbal structures like language, along with nonverbal visual artifacts like photographs [5]. An icon is an imitation of an object, or some natural aspect of it, to allow the proper inference, and thus association with the real object, to be made. A symbol is part of an arbitrary, artificial code, requiring experience and practice to develop literacy in decoding the intended message. The symbols contain fewer, if any, clues to the material nature of the thing being depicted, and thus abstractions are communicable. Indexes involve connectedness or traces to the object, in the way that footprints indicate the ground having been trod upon; photographs tend to be indexical because the photograph is an effect of the objects being where they were, and having been photographed.

Often, representations are some combination of icon, symbol, and index, and indeed most medical representations, including graphs, charts, photographs, and drawings, combine relationships. Partly as a result of the complex relationships between verbal linguistic structures and pictorial representations, our delineation of "visual communication" continues to evolve: Do we strictly mean non-verbal symbols? Any visible communicative artifact? Only those

identifiable genres (photograph, diagram, bar graph, line drawing) that we expect to see accompanying written texts? Such questions are addressed broadly within this issue.

In the articles that follow, researchers and theorists employ tools and techniques to illuminate the story that emerges when we set our sights on the spaces where science, visual representations, and rhetoric overlap. Ideally, the research presented here will eventually promote the most important role of technical communication, which is empowering all citizens to participate more fully in the public forums where science is central.

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