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Communication and the scientific use of the internet

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In *Computer-Mediated Communication* (2003, pp. 1-2), Susan Barnes reminds us that since the "Internet has changed the way people work, learn, play, and communicate," it is difficult to imagine living in today's world without it. Computer–mediated communication has developed electronic mail, discussion groups, Internet relay chat (IRC), multi-user dungeon (MUD) games, instant messenger (IM), and the World Wide Web (Web). The uses of computer-mediated communication is increasing for general and scientific purposes. Communication through computer networks can provide the scientific community with a medium for carrying on a scientific dialectic; that is, we can hear diverse scientific opinion from all and from the best in the scientific community. Scholars can challenge foolish research practices and suggest improved research practices. A scientific dialectic can help the scientific community embody a form of meliorism as well as listen and respond to issues involving scientific findings and research methods. The threat of a type of oppression in modern times resembling what Galileo faced can be reduced through a comparatively open dialog that strives toward the rigorous and reasonable establishment of fact through methods that can be challenged and improved. Scientific communication

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entails communication about matters and methods of science. Science is seen broadly as the procedures and accomplishments of a systematic, cumulative, progressive, measurable, verifiable, and self-correcting way of knowing.

Overview of Scientific Communication

With respect to scientific communication, what the philosopher Jose Ferrater Mora (1962) argues about philosophy and philosophers may apply with similar value to science and scientists. He maintains that the common person cannot be criticized too harshly for a lack of interest in philosophy. Rather than blame the average person facing an increasingly demanding life, Mora prefers to blame the philosophers for a lack of understandable philosophic communication (p. 133). Along with Mora, I maintain that philosophers and scientists should "find the best possible ways to make their thinking communicable" (p. 134). Furthermore, Mora recommends an ideal of ferreting out "truths that are accessible, in varying degrees," to everyone (p. 135). Knowledge must be "sought for its own sake." To attain knowledge, rigor should never be shunned, no matter how unpopular one's research may become as a consequence. In addition, the knowledge gained from the problems investigated should be communicated generally and effectively (p. 133). Scientific communication might then develop the existential component Nicola Abbagnano advanced: namely, "a philosophy of existence *as* a philosophy of possibility" (p. 44). Scientific communication might then grow from a philosophy of possibility. In other words, communicating scientific information might entail the possibility of creating understanding and sharing meaning broadly on verifiable phenomena (Griffin, 2003).

To communicate efficiently about science, whether through the Internet or other channels, presupposes a reasonable degree of scientific literacy. According to Hazen and Trefil (1990), one scientific premise is that human beings "can grasp the regularities of the universe and can even uncover the basic, simple laws that produce them." While science is "one way of knowing about the world" (p. 1), it is not the "only way, nor always the best way, to gain an understanding of the world" (p. 2). Scientists seek to know what the facts are as well as to explain the facts (Copi, 1989, p. 189). Explanations in science are "set forth tentatively and provisionally." Proposed explanations are seen as mere hypotheses, "more or less probable on the basis of the available facts or relevant evidence." When a *hypothesis* becomes well confirmed, scientists elevate the hypothesis to a *theory.* When a theory accumulates a mass of evidence and achieves virtually universal acceptance, scientists promote the theory to a *law*. While these scientific terms have their virtues, they can be clumsy as well. These terms can obscure the fact that "*all* of the general propositions of science are regarded as hypotheses, never as dogmas" (p. 191). In short, hypotheses vary from some support to extensive support, and this truth must be kept in mind to avoid semantic confusion and to communicate carefully. As Wolpert (1992) asserts, there is "no easy road to understanding science" (p. 177).As for scientific communication generally, Wolpert (1992) claims that misunderstandings will likely remain. As our understanding of science improves, we will be in a "better position to understand its role in current life and will be better able to make informed decisions on issues relating to the environment…and other concerns." As we understand science better, we will have a more sympathetic attitude towards it. Our understanding will improve when we recognize "what science cannot do, the problems that cannot be solved by science, and, of course, its unnatural nature" (pp. 172-173).

Wolpert urges us to "resist being seduced by science into thinking that all problems will yield to its approach." He also informs us that science is "wrongly perceived to be homogeneous." In fact, science is "quite difficult even for scientists." For example, physicists may "have little understanding of even the basic ideas of cell biology." Yet, scientists have confidence that, "given the effort and time, they could understand most other areas of science, if not in detail then at least in general principles." Those who are not scientists may lack the confidence that scientists have and may also lack "any familiarity with scientific thinking" (p. 176). Nonetheless, "science is a part of our culture." Most of us have views that scientific ideas influence, even if we have a "very poor understanding of the validity or basis of the ideas" (p. 177). Although understanding the "processes of science and scientific ideas is hard," science is "bound to play a central role in our lives." A commitment to "free and critical discussion [is] essential for science to flourish." Wolpert admonishes us to be aware of how easily science can wither. He argues that once we reject understanding and choose dogma and ignorance, democracy and science are threatened. As one of humanity's marvelous achievements, science must maintain a free and critical environment for discussion without political interference for its continued progress (p. 178).

One threat to scientific understanding comes from the mass media's tendency to provide reductionistic and erroneous reports of scientific findings and methods. Although packaged well via mass media, too many so-called scientific reports and specials are merely popularized distortions of science promulgated through television broadcasts or newspaper stories. The care and precision of scientific methods loses ground to popularized exaggerations and simplifications. Cautiously qualified scientific validity and reliability become subordinated to unjustifiably bold and sweeping generalizations (Violato, 2003). The clumsy broadsword of mass mediated science may threaten to triumph over the refined scalpel of science. Without a mindful and critical dialectic in scientific communication, imprecision may rule over precision and folly over wisdom.

The joyful burden of those with high scientific insight might be to guide scientific neophytes and those generally confused to higher levels of scientific understanding. All those in the role of Galileo should lead the ignorant and the erroneous by the light of scientific wisdom, truth, accuracy, and verifiability. Meliorism has to be present in both scientific methods and results. To illustrate the potentially steady improvement of science, if statistical data can be gathered more efficiently with method alpha than with method omicron, then the scientist who understands method alpha should step forward and demonstrate the superiority of method alpha over method omicron for the benefit of the scientific community. If a scientist sees that a

Pearson product-moment correlation is being interpreted incorrectly in an empirical study, the scientist should announce and elucidate the weakness. If scientific studies demonstrate that medical practitioners may dispense a low viscosity flu serum beneficially to elderly people and children through a less intrusive .5mm needle than a more intrusive .16mm needle, the scientist should communicate this technology to those most affected by it. And, if researchers conclude from several studies on children and advertising that the overall attitudes toward advertising become more negative with age but that parental yielding increases with age (Frith & Mueller, 2003, p. 140), the burden on the critical scientist might be to uncover where the findings are in error and communicate this to the general scientific community.

A more specific example might be drawn from chaos theory. Science shows us that while many daily systems are predictable, there are systems in nature that do not demonstrate a pleasing regularity and predictability. When a system is extremely sensitive to certain conditions, it is chaotic. In chaotic systems, we cannot "measure the initial conditions of a system accurately enough to allow [us] to predict its behavior for all future time" (p. 19). The weather exemplifies a chaotic system. Regardless of how fancy our measuring devices and computer simulations are, we cannot predict the weather a year from now. The "butterfly effect" illustrates the chaotic nature of weather forecasting: the butterfly effect meaning that in a chaotic system, an "effect as small as a butterfly flapping its wings in Singapore may eventually make it rain in Texas" (ibid.). Some systems are extremely "sensitive to the smallest of perturbations" (Wolpert, 1992, p. 174). Relative to the sensitivity of a system, what has low scientific predictability might have to be calculated along with what has high scientific predictability. The insightful scientist has the responsibility of sharing critical perspectives with the scientific community on whatever surfaces as being problematic. If weaknesses in chaos theory or the mass mediated presentation of chaos theory surface, the insightful scientist is encouraged to advance arguments and evidence to correct the mistaken perception or understanding of the concept. The end result is a strengthening of scientific information.

Perspective on the Internet for Scientific Communication

The perspective presented here on the use of the Internet for scientific communication stresses the communicative powers and limits of relying on the Internet to advance science: (1) in a global environment that is not equal in its use of this technology; and (2) among professionals who are not equal in their utilization of this technology (Barnes, 2003; Rubin, Rubin, & Piele, 2000). In another sense, we must ask about the “digital divide” (namely, the gap between those with and without adequate information technologies) confronting those communicating scientifically via the Internet. We must also seek to establish a “telepresence” created via virtual realities and communication. When computer technologies are not available to diverse scientists and scholars, sending information can range from limited success to no success. When computer technologies are robust, if the users are skilled and interested, they can rely on the information being sent and downloaded properly. Successful expectations must be modified, however, when dealing with users having limited technologies, limited skills, and limited motivation. If a message is sent to many people using a technology that needs special computer equipment or programs to download it, the message will not attain adequate exposure since it may not reach some destinations at all and other destinations only with distortion. When the real limits of computer-mediated communication is ignored, communication goals may fail along with the transmission of signals.

Although computers used in a communication network may have comparable hardware and software, the successful use of the Internet for communicating science is still not guaranteed. Conditions contributing to success in the Internet communication of science may include Internet users: (1) agreeing that its use is a requirement for the scientific task before them; (2) knowing how to use the Internet for the purposes of the scientific task (or, having access to a professional support network for computer-mediated communication); (3) being willing to check Internet information sources routinely; (4) designing web pages to be as friendly (namely, lucid and plain) as possible (that is, friendly enough to have no need for code breakers); (5) defining an acceptable mortality rate on Internet use based on the consequences of nonuse and misuse (perhaps a percentage from zero tolerance to some reasonable failure percentage, such as 15 percent) since some users will not participate efficiently despite their expressed intentions or capacities to do so; (6) accommodating divergent cultures and different languages when predicting the successful use of the Internet; (7) developing a criterion-referenced list of computer-mediated communication behaviors with minimum performance levels (MPLs) that take into account the stylistic sophistication of users (that is, what we can reasonably expect of other users); (8) knowing the format, system, or frame of reference of the message sender; (9) embracing Internet technology with commitment; and, (10) being clear on the constructively critical nature of the scientific dialog (Barnes, 2001; Barnes, 2003; Davenport, 1997; Ellul, 1964; Gattiker, 2001; Mandel & Van der Luen, 1996; Sproull & Kiesler, 1991; Wresch, 1996). Research determining who might best use the Internet productively as a medium of communication would benefit those using the Internet for science in the future.

Public Relations, Scientific Communication, and the Internet

To illustrate how computer-mediated communication principles apply to scientific communication, an example of risk management in public relations with adolescents will follow. Risk management entails a rigorous public relations effort to control hazards in a positive manner (Jurin, Danter, & Roush, 2000, pp. 129-131). This risk formula, applied to public relations, might help clarify the relations between pertinent factors. Risk equals hazard plus outrage, or risk = hazard + outrage: where hazard refers to its probability of happening times its consequences, and outrage refers to the cultural reaction to risk. “Hazard “ is defined as the scientific determination of how harmful a particular risk has been measured to be; “probability” is the statistical likelihood that a problem may arise;

"consequence" indicates the predicted outcome should the problem become real; and, "outrage" is the perception (real or imagined) of a problem by the communicators in general involved with the problem (pp. 124-127). Outrage is the social psychological factor that public communicators have to consider.

For example, if recent scientific findings on teenagers using lethal drugs becomes available, scientists and communicators in general might consider reporting these findings via the Internet to other scientists and to the public. Risk associated with this communication should be assessed before advancing the new information. Risk may be judged as having catastrophic, critical, moderate, or negligible consequences. The probability of the hazard may be judged as being frequent, likely, occasional, seldom, or unlikely. If the probability is determined to be frequent and the consequences catastrophic, the hazard may be seen as too high to take. If the cultural outrage is estimated to be extremely high also, then the risk may not be worth taking. Public outrage or panic may not be worth the risk of communicating immediately the newly found scientific information. However, the probability may be seen as unlikely and the consequences negligible. If this condition prevails, the hazard may be seen as low enough. If there is not likely to be any significant cultural outrage, then the risk of communicating the scientific information immediately may be seen as insignificant and reasonable (US Army, 2003).

Scientific information publicized on the Internet may reach a number of publics. The risk of negative effects should be assessed before revealing the findings. Once the risk has been judged to be relatively safe, the ethicality and reasonableness of announcing the findings on the Internet would be in order. In other words, scientific information published in scientific sources might be a first step in announcing the discovery. Before going public with the findings, a risk assessment would be wise and should be considered. For proactive public relations strategies to flourish, scientific communicators that plan to go public on the Internet with their findings should try to develop and nurture worthwhile media, governmental, and community relations as well as plan and develop crisis and internal communications (Jurin, Kanter, & Roush, 2000, pp. 130-131). With such precautions taken, an outraged public is not likely to surface. A proactive dialogue between relevant communication groups will assist in marshalling against public relations difficulties and disasters. Scientific information will then be shared in multiple sources in a reasonable, timely, and beneficial manner. While our focus here has been based on treating a public concern that grows out of conditions that warrant a conservative strategy. However, a communicator's role may not always be to reduce public outrage; rather, the role may sometimes be to increase public outrage. Each situation has to be assessed in light of its unique factors and its own merit (pp. 125-126). This topic might be considered in another paper.

Concluding Remarks

Although he lived prior to the use of computer-mediated communication, Giuseppe Peano (1858-1932) provides us with a general mission for using the Internet for scientific communication. Peano was a mathematical logician known for being modest, simple, kind-hearted, benevolent, and affable in his personal behavior; yet, he was also known for being strictly precise in his thinking and devoted to the idea of the perfection of human relations, international communication, spiritual growth, technological advancement, and rapprochement. Driven by scientific and humanitarian interests, Peano aimed to solve international communication problems (Runes, 1955, pp. 904-905). His noble aim should be resurrected and applied in today's international scientific community. As Brera (2001, p. 5) points out, we might be celebrating the mystery of the kairological moment with respect to scientific communication via the Internet. Since *kairos* refers to a time when conditions are right for the accomplishment of a crucial action (or, simply, the opportune and decisive moment to realize an end), humanity has created the possibility of an opportune space-time for sharing scientific information through computer-mediated communication. The time may be ripe for a least some of Peano's humane dreams of scientific communication to become realities.

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