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D A Stewart

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FORUM

Words and Things: Paradigms Lost or Never Found

Attribution of meaning to words is both a natural process and a social custom which, like many processes and customs, can vary over time and in different situations; words rarely have "inflexible" meanings, although we are often, and rightly, vexed when usage becomes so loose that important concepts are muddled. All of us use a word such as *terrific* in many ways, shading its meaning to suit our needs with scant thought of consequences; to play fast and loose with *sensitivity* and *specificity* in scientific discourse, however, shouldn't be done with impunity, although we continue to encounter lapses in the radiologic literature.

The belief that the way to determine a word's "true" meaning is to learn what it previously or originally meant is usually wrongheaded, because words often wander from their etymologies and undergo what students of language call specialization (restriction of scope), generalization (widening of scope), pejoration (go downhill), or amelioration (go uphill), or simply change because of social-class dynamics or the vagaries of vogue (1). A study of words that have dropped in or out of the medical lexicon or that have undergone radical change in meaning might top the list of things to do in one's golden years, but the "now" is plenty demanding.

Paradigm (not a medical word) currently enjoys a new vogue and is being used in novel ways, although its earliest meaning remains solid. For grammarians, the set of all inflected forms of a single root or stem comprise its paradigm (eg, *patient*, *patient's*, *patients'*, and *patients* for the noun *patient*). But over a long span of time (the Oxford English Dictionary traces its English usage from Caxton in 1483 ["We no longer have interpreters of the parables or paradigms"] to Zweig in 1976 ["The television set is the paradigm of consumer culture, with its disarming passivity prone to desires divorced from action"]), the word has been used in an array of situations, never quite entering the modern word stock of scientific discourse, at least until the appearance of Thomas Kuhn's *The Structure of Scientific Revolutions* (2), in which the word appears on almost every one of its 172 pages, often in ways as different as "concrete scientific achievement" or "a characteristic set of beliefs and preconceptions." In response to critics who pointed out the many senses in which he used the word, Kuhn decided to explicate and supply a corrective in a 1974 essay, suggesting that a "paradigm is what the members of a scientific community, and they alone, share." What, in his view, constitutes a scientific community? It consists of the "practitioners of a scientific specialty. Bound together by common elements in their education and apprenticeship, they see themselves and are seen by others as the men responsible for the pursuit of a set of shared goals, including the training of their successors" (3). Adapting some of Kuhn's ideas, one might try to construct a radiologic-specific definition of *paradigm* to highlight its current application: "a paradigm is that set of beliefs that members of a radiologic subspecialty share, beliefs that shape their approach to education, research, technology, and diagnosis/patient care, and that validate the uniqueness and assure continued existence of their disciplinary matrix" (most readers should be able to improve on this).

What does "paradigm" have to do with neuroradiology and neuroradiologists? The radiologic centennial fast approaches, as do drastic changes in this nation's health care system. It is inevitable that radiologists in all subspecialties will be taking stock, looking ahead, and trying to envision what their futures might hold, perhaps recognizing that they can and should play proactive roles in the process. Neuroradiologists will be called on to take part in dialogues and will doubtless initiate some of their own. Those who do might find "paradigm" woven through the fabric of such discourse along with a spate of buzz words and phrases that have entered the futuristic lexicon—"breakthrough thinking," "dislocators," "self-fulfilling prophecies," "Delphi technique." What seems important is that neuroradiologists can offer an adequate definition of what their discrete radiologic paradigm comprises. How might one respond to someone who simply says that neuroradiologists look at the central nervous system (CNS) using pretty much the same imaging tools as everyone else, and basically have the same mindsets as other radiologists? Twenty years ago, Wolpert observed that "the emergence of neuroradiology as a subdiscipline simply gives concrete expression to the requirement to limit one's focus when a domain of knowledge becomes intellectually complex" (4). Has a neuroradiologic paradigm emerged as well?

What's in a name (or a word)? Again, much depends on social customs, a user's and listener's perceptions, or information currently available to the public. It is interesting that the American Medical Association (AMA) *Encyclopedia of Medicine* (touted as a "medical information powerhouse" by its publisher) does not define *neuroradiology* but is fairly expansive on *neurology* and *neurosurgery* (160 and 130 words, respectively) (5). Though it does define *radiology* and *radiologist*, there is no hint in these definitions that specialization within radiology even exists. This reference book (medical dictionaries as well) is not unique in such deficiency.

It may well be that neuroradiology has no paradigm, that it simply shares the paradigms embedded in all of diagnostic radiology, or—Promethean discipline that it is—seeks to create new paradigms. Definitions emanate from paradigms. Information seekers, critics, and motley onlookers are assessing the verbal messages of all medical specialists; future lexicographers and compilers of medical encyclopedias could use the help.

Donald A. Stewart
Biomedical Communications
Elmhurst, Ill

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Reply

Don Stewart made a play on words, musing about whether neuroradiology has yet developed its own paradigm. It hurts to know that the 1989 AMA medical information encyclopedia did not define our vocation at all. However, that predated the official recognition of neuroradiology training by the appropriate agencies in the United States and Canada. Since neuroradiology can now be officially studied, surely the AMA must now know it exists. The converse is also telling: previously one could not officially have studied neuroradiology; therefore, how could a neuroradiology paradigm have been expected to have been understood and acknowledged by medical officialdom like the AMA.

Interestingly, the dialogues that many of us engage in for health care planning include important buzz words in addition to those mentioned by Stewart. "Downsizing" and "streamlining" are part of our lives, as industries, institutions, and government agencies have worked to meet the challenges of our "lean and keen" or "do or die" world of the 1990s. An industry management-training video used by our hospital administration deals with the need to change paradigms to adjust to these pressures and concludes that those who cannot change their paradigms will not have secure situations in the future.

Two questions arise. Does neuroradiology have to develop and declare its own paradigm, or must everyone who might deal with neuroradiologists change his or her own "neuro-" or "radio-" paradigm to include neuroradiology? Just as the AMA encyclopedia didn't need to acknowledge neuroradiology in 1989, those who don't know neuroradiology don't believe they need to, even now. How to get them to recognize their need? Maybe by sitting down with "breakthrough thinkers" and such, who are trying to plan changes to their paradigms. The old adage declares, "If it ain't broke, don't fix it." Our health care systems are not broken but are desperately broke.

For more than 20 years the governments in Canada have had responsibility for equality of quality health care for all citizens and are struggling with the escalating costs with downsized revenues. In the United States, government has committed itself to take over some degree of similar responsibility, as a response to escalating costs and human health care needs. Are there still too many expensive hospital beds, staffed by expensive nurses and other employees? Are there too many hospitals and clinics? Are there too many magnetic resonance and computed tomography machines, doing too many examinations for insufficient reasons, costing too much? Does much of the "too many" imaging examinations fall into the neuroradiologist's paradigm of neuroradiology? Does or will the "powers to be" recognize that those magnetic resonance and computed tomographic exams of the brain and spine are more than a noticeable blip in the current morass?

It should be important to neuroradiologists that good neuroradiology be noticed in this context. If there are too many expensive neuroimaging exams being done out there, then there needs to be documentation of their value (or lack thereof) to the real therapeutic decision making and patient outcome in various categories. Many of these exams became popular because the anatomic clarity of the head and spine is so pleasing, that it became important not just to show disease, but to show no disease in people not likely to have disease. *Neuroradiologists can contribute positively in this discussion by carrying out significant research into the value of use of imaging procedures, and into the value of subspecialized training in neuroradiology. Neuroradiologists also must take an active part in all pertinent discussions and lobbying. Neuroradiology and its own paradigm may evolve and change further. Most important, however, is to enable a change in the paradigm concerning neuroradiology, or even to develop one that has never before existed, in the minds of the "powers to be."*

Allan J. Fox
Neuroradiology
Departments of Diagnostic Radiology
and Clinical Neurological Sciences
University Hospital
London, Ontario, Canada

Reply

Paradigm, like *hegemony* and *hubris,* is one of those words encountered on the printed page but rarely said aloud. Webster's dictionary defines *paradigm* as "an out-

standingly clear or typical example or archetype," and our task here is to offer a paradigm for neuroradiology.

It is natural that we should choose this time to reexamine and redefine our specialty. Major changes are being planned for medicine (use of the passive voice here is intentional), and during times of major change it is comforting to establish an unyielding standard. Unfortunately, neuroradiologists and our practice fall into the "specialist" class as defined by health care policy planners, and we nongeneralists have been cast as the Bad Guys, partly responsible for the "dismal" state of medicine today. But these same planners must recall that neuroradiology was not created, but *evolved* from a need. *Imaging technology became more sophisticated during the last decade; advances in neurosurgery, such as the operating microscope, developed; and it became clear that a radiologist could master the vast fund of knowledge only by concentrating almost exclusively on the study of the CNS.* Thus, neuroradiology evolved gradually from general radiology, but was not created de novo.

What is a paradigm for neuroradiology? Neuroradiologists must first and foremost be trained as general radiologists. Only a radiologist has broad experience in the full range of modalities available today, including the physics of radiography, ultrasound, computed tomography, magnetic resonance, and nuclear medicine, as well as a firm knowledge base of both normal anatomy and the appearance of pathologic processes in virtually every organ system. Without that broad fund of knowledge, diseases can be appreciated only as they relate to a single organ system.

Second, the neuroradiologist is one who has devoted some time to the intense study of imaging of the CNS. That includes close interaction with neurologists, neurosurgeons, neuropathologists, neurootologists, otorhinolaryngologists, skull-base surgeons, craniofacial surgeons, oral surgeons, dentists, and ophthalmologists (other truly Bad Guys!). Not only can neuroradiologists describe the findings and precise extent of disease and offer a sophisticated differential, but they can anticipate those questions the clinicians must have answered to treat patients appropriately. How can a general radiologist with no subspecialty training possibly fulfill such a tall order?

Thus, the paradigm of neuroradiology is "a radiologist who has special training in the brain, spine, orbits, and head and neck, with an emphasis on imaging the CNS, as well as a broad understanding of normal neuroanatomy, neurophysiology, function, and disease processes of the CNS. The neuroradiologist is familiar with the clinical presentation, natural history, imaging findings, treatment, and complications of CNS disease."

Of interest is the recent development of subspecialization within the specialty of neuroradiology, such as pediatric, interventional, and spine neuroradiology. Is this subsubspecialization to be encouraged? Now, with the threat of external regulation, is not the time to splinter our specialty. There is power in numbers. Although we each may have special expertise, we all should fit within the paradigm for neuroradiology.

Patricia A. Hudgins
Division of Neuroradiology
Department of Radiology
Emory University Hospital
Atlanta, Ga

Reply

Mr Donald Stewart, the former managing editor of *AJNR*, has written an interesting editorial in which, as a semanticist, he examines the word *paradigm*. He borrows from Kuhn the definition of paradigm as a shared set of beliefs that shape behavior. He urges us to define *neuroradiology* in relation to the other neurosciences and to other imaging disciplines.

I would like to offer this paradigm of neuroradiology: *It is the study of neuroscience and the treatment of neurologic disorders using a variety of imaging tools.* I also would like to stress that a set of beliefs encompass what is, what could be, and what should be. Let us examine the implications of these concepts.

This definition (paradigm) stresses the study of neuroscience, not just the study of the tools themselves. Neuroradiology was originally developed as a discipline to facilitate the study and understanding of the normal and pathologic neurologic substrate, using rapidly evolving biotechnology. Unfortunately, the glamor and the financial aspects of that technology have acted as a golden calf for many. In large part, we have forgotten that the goal is to understand the complex anatomy, physiology, and biochemistry using any modality possible rather than to become enamored of one form of biotechnology to the exclusion of others. Too often we have become entranced with the "stereo equipment" and have forgotten that our goal is to listen to and understand the "music."

If we are truly interested in understanding the complex interrelationships between anatomy, physiology, and biochemistry, we must use all of the tools available to us, from x-rays to sound waves to magnetic resonance spectroscopy. We neuroradiologists must broaden our knowledge base and become competent in all aspects of the neurosciences. With so many tools available, the neuroradiologist probably has the greatest potential of all neuroscientists to become a "renaissance man."

Today, neuroradiology not only provides more understanding of pathologic processes and better ways to make diagnoses than in the past, but it also enables us to provide better treatment than could be previously offered. Whether the treatment is provided by us or our neuroscience colleagues, our development of higher-resolution systems allows us to see more soft-tissue detail than ever before. The better we can see, the better we can treat. We have developed smaller, better, and more flexible catheters, guide wires, and occlusion devices, and a whole host of interventional materials that allow neuroradiologists to perform procedures with less bodily invasion and less mor-

bidity than traditional surgery. We are rapidly developing three-dimensional techniques and merged data sets acquired from multiple modalities, including both anatomic and physiologic data, to aid us in that treatment. We do not need to think in terms of "virtual reality"; we have a rapidly evolving "real reality" made up of a myriad of anatomic, functional, physiologic, and biochemical data too complex for our minds to absorb adequately with our current methods of collation and presentation. There is no doubt, however, that we will solve these problems, and their solution will lead to even better patient treatments.

What are the implications of these evolutionary and revolutionary changes for our specialty of neuroradiology? First, we need to realize that our strength is in our expertise. We are a small group—we do not all see patients directly, but our neuroscience colleagues need us desperately. The best of "them" realize that the best of "us" represent a real asset, not a competitive force. We need to remember the reasons that neuroradiology developed and remember that we will all advance further by complementing rather than competing.

Second, we need to increase the quality of our science, not just the quality of our images. Let us remember why we developed the biotechnology in the first place. The more we know, the more we are needed. Turf issues will subside by our being better. Being better requires us to be open and responsive to all aspects of the neurosciences. The real student never stops studying; the professor is a student forever.

Richard E. Latchaw
Neuroradiology Section
Departments of Radiology and Neurosurgery
University of Minnesota Hospital
Minneapolis

Reply

Donald Stewart asks thought-provoking questions. Who and what are neuroradiologists? We need to address these questions not only because the radiology centennial is fast approaching, but because an alteration in the thrust of medicine toward primary care will certainly affect us as neuroradiologists. Possibly nothing we can do will diminish the impact that the new health care system will have on our future. Nevertheless, not defining and publicizing our role will certainly place us in the shadow of organized medicine, diminishing our role as health providers.

Mr Stewart quotes from my commentary of 1983: "The emergence of neuroradiology as a subdiscipline simply gives concrete expression to the requirement to limit one's focus when a domain becomes intellectually complex." What in neuroradiology is meant by "intellectually complex"? To quote that commentary again, "Neuroradiology involves diagnostic skills based on experience and a basic knowledge of neurologic disease that goes beyond the radiologic image." And again, "Neuroradiologists are impelled . . . to acquire a measure of competence in the several areas of expertise staked out as the preserves of their colleagues (neurologists, neurosurgeons, and neuropathologists)," and finally, "their responsibility to their patients is carried out as a member of an interdisciplinary team of neuroprofessionals."

Neuroradiology is an organ-based discipline in which radiologists bring to the diagnostic (and therapeutic) process skills based on the integration of technical knowledge, a solid basis in the basic neurosciences, diagnostic acumen, and a knowledge of practical clinical neurology. *It is this integration, borne of experience and continuous interaction with our neuroscientific colleagues, that sets us apart and establishes us as the essential consultants and collaborators in the team, clinical neuroscientist-diagnostician-therapist. Neuroradiologists do much more than simply look at the CNS with the same imaging tools as everyone else.* Although firmly embedded in the discipline of diagnostic radiology, we have progressed and created a separate entity—a new paradigm, if you will.

Unfortunately, promotion of our perceived image may be thought by some to be self-serving, arrogant, and even patronizing. Furthermore, we are in the unfortunate position of often preaching our collective role to ourselves. Could it be that we are too pretentious? I don't think so. We must in the new medical lexicon continue to promote and publicize our mission. We have a long, hard road to travel, but if we do not vigorously and affirmatively define ourselves, others less sympathetic to our cause will do it for us.

Samuel M. Wolpert
Section of Neuroradiology
Departments of Radiology and Neurology
New England Medical Center Hospitals
Boston, Mass