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Dualism: From Descartes and Bacon to *AJNR*

The *Oxford English Dictionary* defines duality as "an opposition or contrast between two concepts or aspects."[1] In the *American Journal of Neuroradiology* (*AJNR*), I see these aspects reflected in the nature of our articles, which are either basic research or clinically oriented. Basic research articles tend to be multiauthored, hypothesis-driven, and thus prospective, blinded, and controlled, and often extramurally funded. Clinical ones are often retrospective and descriptive. Opposing concepts are found in most of our activities, and though many times these result in anxiety and difficulties, I believe that a balance between them is needed for any activity to succeed.

Reality itself is defined by its duality, subjective and objective, so it is no surprise that all other human activities contain some twofold elements. From ancient times, duality has guided Western thinking according to 2 major activities: theologic and scientific. Theologic thinking, at least as it relates to Christianity, has been, in turn, dominated by another duality, the struggle between good and evil. Generally speaking, in our Western environment, being both religious and scientific is at odds and often incompatible. This is not the case with Eastern religions, where the duality of beliefs and science may coexist within individuals. Unlike the Old and New Testaments, other religious texts tend to be descriptive rather than analytic, a fact that allows these to be incorporated into everyday life without competition from other strong beliefs. Muslims can be scientists, but most Western neuroradiologists I know do not profess a Christian religion.

The true separation between Western religions and science occurred as a result of Galileo's observations about the earth's orbit (and his conflicts with the Church) and later with Darwin's theory of evolution. Until the 18th century, the 2 dominant disciplines of science were astronomy and mathematics. Although intimately related, the first fell into the category of observation through motivation and the second was (and still is) driven by interpretation of facts. Mathematicians themselves have their own duo of ideas: pure and applied.

The modern scientific revolution began in the early 1600s with René Descartes. Often called the "father of analytical geometry," Descartes was mainly responsible for rationalism and a significant school of philosophy. The other great scientific figure of that epoch was Sir Francis Bacon. A true man for all seasons, Bacon was responsible for the creation of the inductive methodology now simply called the scientific method. These ideas were expounded in his 1620 book, *Novum Organum*. Science was thus split in Cartesian and Baconian influences, and it is fair to say that much of its advances during the 17th century were due to the competition that existed between these 2 thought currents. In a very simple-minded explanation, Baconians sought to discover while Cartesians attempted to unify all that had been discovered. That is, Baconians were free to experiment and discover while Cartesians used pure reasoning to come up with explanations (interpretation of facts). The West was then basically divided according the countries of origin of these 2 great thinkers: the British side (Bacon) and the French one (Descartes). Of course there were exceptions such as Newton, who was British but followed a mostly Cartesian school of thought. Newton's Cartesian thoughts (as related to physics) brought him greater recognition than his, perhaps Baconian, practical experiments with alchemy.

I think even today, we can see evidence this dualism still exists. In the United States, because of our pioneer/explorer past and our British heritage, we initially tended toward a more Baconian school of thought rather than a Cartesian one. We like to be "free thinkers" and go out and collect our data. As our science matures and we accumulate experience, we incorporate many Cartesian strategies. In reality, all scientific disciplines are deeply influenced by the culture in which they are developed.

Now, let us go forward 250 years to another duo of individuals who defined modern science. Henri Poincaré was a great French mathematician of the late 19th and early 20th centuries. Despite all of his accomplishments, laying the foundations for popular topics such as chaos and relativity, today he is not considered a great popular figure (by this I mean, commonly encountered in mainstream culture). During his lifetime, there was another figure who is now immensely more popular: Albert Einstein. While Poincaré was a great theoretician, respectful of past ideas and attempting to incorporate these into his thoughts (obviously influenced by Cartesian thinking), Einstein was more experimental and adventurous and sought explanations that were radically different from those of the past (Baconian).

Nonconformists and rebels are Baconian and have been responsible for many great leaps of science in the past century. As our world becomes smaller, both schools of thought merge, therefore making us better scientists. Science, as we know it now, would not exist if it were not for the complementary roles that Cartesians and Baconians share. Extrapolating these thoughts to our modern times and, more pertinently, to neuroradiology, one can think of our basic scientists as Baconians and our translational and clinical colleagues as Cartesian. Going further, science is the union of tools (Baconian) and ideas (Cartesian). Modern science (as is neuroradiology) is both tool- and idea-driven. Without more and more complex equipment that permits exact quantitative measurements, science cannot progress.

Quantification is of essence as it allows the application of mathematics to our observations and later their reproducibility. Quantification is so important that, for example, at the annual meeting of the Radiological Society of North America, all abstracts presented that contain quantitative elements are clearly labeled as such. Recording of images is, by definition, already a quantitative method. To me, nowhere is this more evident than in our specialty of radiology. The ability to take these basic observations and apply them to our clinical activities creates a stronger subspecialty. A discipline that develops ideas but never implements them acquires no practical importance and disappears; conversely, one that only applies ideas of others without developing its own loses importance and may be absorbed by stronger ones. Thus, to survive, our research needs to be translated to practical clinical applications just as most pure mathematics eventually become applied mathe-

matics. All sciences are human constructions, and as such, their discoveries need to be incorporated into our daily lives to endure.[2] Dualism leads to wholeness in individuals and their endeavors. *AJNR* thus strives to publish a fair balance of research and clinical articles, and we are particularly interested in receiving more "translational" articles.

It is fair to say I consider myself more a Cartesian-type individual. I have had few original ideas, but I am not afraid of taking those of others and building upon them. As such, for this *Perspectives,* I have borrowed freely from the essays of Freeman Dyson.[3] Mr Dyson himself always leaves the door open for commentaries and/or corrections of his writings. I invite our readers to use www.ajnrblog.org for the same purpose.

PS: This essay was sent to Mr Dyson, who told me that he had no objections to its contents and no comments on it.

References

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