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## Scientific Multiples, Neuroradiology, and the *American Journal of Neuroradiology*

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## Scientific Multiples, Neuroradiology, and the *American Journal of Neuroradiology*

It often happens that I open the newest issues of 2 related scientific journals only to find articles from different groups of researchers reporting identical topics and results. How is this possible? Throughout the late 1950s and the 1960s, Robert Merton, a sociologist, wrote several articles in which he attempted to explain this phenomenon, which he called “scientific multiples.”<sup>1,2</sup> In science, credit is given to the individuals being the first to communicate important advances in knowledge. Merton pointed out that this behavior has characterized science for more than 300 years.

The idea of originality probably arose in the plastic arts community and was thereafter adopted by science. In art, an individual is mostly responsible for creating a work, thus receiving the credit. Conversely in science, although commonly 1 individual becomes identified with a discovery (or in radiology, a description, eg, Modic changes), most works are actually a collective effort. Therefore, the principle of scientific multiples implies that discoveries are not so much the product of individuals as the result of currents of thought among the scientific communities. This is the reason why several individuals and/or groups of investigators may arrive at the same conclusions simultaneously and publish similar results at the same time. More important, nowadays the wide availability of knowledge implies an inevitability of scientific discovery. Because background knowledge is readily available, the same discovery will eventually be made by someone who studies that area of science.

Interestingly, Merton also proposed that when scientific publications enter society as a whole and become widely available, they will be used and quoted extensively, legitimizing the name of the author(s).<sup>3</sup> Publications that are freely available achieve this sooner by being extensively quoted (this thought supports the concept of “open access” in the scientific literature). The quickest way for a scientist to establish a position of prestige and recognition is by placing his or her articles (a sort of private property constrained by copyright agreements) in the public domain and sharing them through open access initiatives. Bibliography becomes the instrument of transmission of knowledge, and the value of this knowledge expands with its usage (the more we quote articles from a certain journal, the higher its impact factor will be, subsequently increasing the importance of that journal). The irrational exploitation of knowledge that includes duplicate publication and plagiarism helps to erode our confidence in science and to diminish its importance.

There is no evidence that mental capacity in humans (as a group, not individuals) has changed in millennia.<sup>4,5</sup> Despite that, scientific (particularly medical) advances occur today at a greater pace than any other time in human history. Consequently, the exploding quantity of knowledge must be cultural and not individual. Discoveries will be made independent of the talents of an individual.<sup>5,6</sup> If scientific multiples are inevi-

table, how can we account for the brilliant work done by geniuses (these advances take the form of the so-called “singletons”)? Most discoveries by geniuses are not independent from the work of lesser talented individuals, so, in a way, they are also multiples.<sup>6</sup> Specific innovations (CT and MR imaging, for example) are the result of the efforts of many individuals and not just of Hounsfield and Brock and Purcell. Genius is better characterized as the ability to be involved in multiples rather than by a single contribution. Common problems may be solved by more than 2 individuals (or groups) at a time (producing triplets and quadruplets). None of these observations negate the importance of geniuses in man’s history.

Scientific discoveries are of 2 types: normal and anomalous. Normal discoveries embody a solution to a well-defined problem (ie, the scientific method). Most full-length articles published in the *American Journal of Neuroradiology* (AJNR) and other scientific journals are of this type. An anomalous discovery is not expected and generally is preceded by a long line of subsequent normal discoveries associated with it. Creation may be a type of anomaly. The act of creation in science occurs when an individual (or a group of them) has the ability to modify traditional and conventional ways of thinking.<sup>7</sup> In AJNR, I see “creation” mostly in our interventional-related articles. The individuals writing them are generally forced to think outside the matrix of fixed rules to provide the best treatment for their patients (often in desperate situations). Creation continues to be tied to Merton’s original ideas—that is, creation is the product of the size of a field of knowledge and of its richness. The larger and richer that field of knowledge is, the higher its output is too (in interventional neuroradiology, this becomes quite obvious when we see the large number of such articles published by AJNR and the fact we have 2 Senior Editors for that field and just 1 each for the other disciplines).

The behavior of scientists is governed by universalism, communism, disinterestedness, and skepticism.<sup>5</sup> In my opinion, AJNR also abides by these values in the following manners:

1) **Universalism:** refers to the acceptance or rejection of knowledge entering science and is not dependent on 1 person or his or her social attributes. AJNR uses a multinational peer-review system and publishes articles from all over the world.

2) **Communism:** states that important findings are products of collaborations. Today, most scientific articles are multiauthored, and AJNR encourages submission of federally funded studies that involve large groups of scientists.

3) **Disinterestedness:** pertains to a passion for knowledge and a concern for humanity. Most researchers are not highly paid, and this group of individuals seems to be the most interested in widely sharing their discoveries through the literature and open access initiatives.

4) **Skepticism:** refers to a suspension of judgment and a scrutiny of publications. I invite our readers to participate in this activity via our Letters to the Editor forum. We, the Editors, already do this in the form of commentaries and editorials.

If we follow these 4 principles, neuroradiology will advance and grow. After reading this editorial, you may think that once a discovery is made and published, it enters the public domain and is established in our beliefs. Nevertheless, only observations published in journals with wide circulation or through

open access achieve this status today. *AJNR* has the widest “circulation” of any clinical neuroimaging journal (nearly 3.5 million articles electronically viewed last year) and thus offers its authors the best vehicle to establish their reputations.

To finish these few thoughts, I would like to briefly address the term “elitism” because I have heard it used with regard to academics and scientific publications (the commonly used term “ivory tower” when referring to academics implies [poorly] a sort of elitism). The famous Spanish philosopher Jose Ortega y Gasset wrote about the relationship between the “elite” (active-creative minds) and the masses who passively consume this knowledge.<sup>8</sup> Ortega looked at the elite as being in charge of scientific results (a view known as the “Ortega Hypothesis”). He further admired others who said that in the field of physics “if 10 or 12 individuals were to die suddenly, it is almost certain that the marvels of physics today would be lost forever to humanity.”<sup>9</sup> I hope that Merton is right (and Ortega wrong), because wide dissemination of neuroradiology-related literature implies that our field (and *AJNR*) will continue to thrive for many years to come. I do not consider

*AJNR* an elitist publication. We publish high-quality articles and clinically pertinent reviews, expecting that all our readers will find something of interest in it.

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