OPINION ARTICLE

How Did Probability Come to Medicine?

¿Cómo llegó la probabilidad a la medicina?

JORGE TRAININI[1, MTSAC]

1. HOBBES'S SOCIAL MATHEMATICS

The mechanics established by Newton (1643-1727) enjoyed great application during the 18th and 19th centuries, to the point that it was quickly transferred to political, economic and social theories. In this way the community was analyzed through arithmetic analysis. It was assumed that politics should be converted into science through measurements, given that with quantitative measures, the irrational of human nature could be controlled.

Thomas Hobbes (1588-1679) and simultaneously his disciple William Petty (1623-1687) tried to introduce this mathematics into the human sciences. Hobbes, with his book, *Leviathan* (1651), (1) tried to develop the political theory with this mechanism. This text is written with a mechanistic vision of man's behavior and also of society. He introduced laws to rule. He tried to ensure that power was not a partial or capricious conviction but rather a logic support for political theory.

Hobbes's thought of incorporating Newtonian physics into society would produce, even long after *Leviathan* was published, a certain optimism when, for example, Kenneth Waltz (1924-2013) expressed, "[politics] *is closely related to character and training.*" (2) The historical time of science would show that mechanistic politics would succumb to the randomness of systems, such as that of human society. On the other hand, this concept of political arithmetic would enhance the sciences. In fact, physics with the development of quantum mechanics and the randomness and uncertainty of systems would permeate all science. It should also be noted that this mathematical game could be used, not only in medicine, but in all human fields; the latter being an attempt by Petty in his writing *Political Arithmetick* published shortly after "Leviathan".

It was not unintentionally that Hobbes had traveled to Florence to meet Galileo (1564-1642) and his theory about the constant motion of bodies. He understood that this notion could be extrapolated to people and organisms as a machine concept. Then he went so far as to declare: "... *reason is nothing more than calculation... Every man flees from death and does so, driven by an impulse of nature*." (1) We would later see this perception with Arthur Schopenhauer (1788-1860) in his book *The world as Will and Representation* (1819). (3) Impulse is evolutionary, with more force at each step of the living forms complexity, until it joins with human consciousness as the last force acquired by the existential entity towards its natural development.

Hobbes tried to understand the behavior of societies through postulates. Medicine later learned to fall into this concept that the disease and its therapeutic responses are not so complex that they cannot be solved from those minimum postulates. The plural man was brought to physics, but where was the singular man? The question about free will also inevitably arises here: what space is left for it?

This concept of *Leviathan* did not cease to horrify since it referred to human beings. Descartes had already anticipated this mechanism with an even more hopeless paragraph: "… *I wish you to consider that all these functions take place in this machine only by virtue of the arrangement of its organs, in a manner no less natural than the movements of a clock.*" (4)

Thus, the universe was considered as an immense clockwork mechanism. Therefore, it had to be dismantled to study it under a reductionist strategy that has seduced science ever since. This criterion of the infinite fragmentation of man in clinical study and interpretation is still more enhanced in medicine. We have gone beyond the horizon where the concept of psycho-organic-social integrity is lost with the logical consequences of falling into the coldness of a positivism in which the "human factor" is nullified.

But let's go back to Hobbes and his proposal. Was it possible to perform a social arithmetic that would help us understand social behavior? John Locke

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Correspondence: jorge.trainini@fundacionpracticum.edu.es

[1] Hospital Presidente Perón, Avellaneda, Provincia de Buenos Aires

(1632-1704) and Jeremy Bentham (1748-1832) believed that reason was enough to achieve that alchemy of joining the benefits of society with those of each individual. Karl Marx (1818-1883) benefited from these theories for his later formulation. Hobbes had thus become a political scientist.

Physics is quantitative, mathematical. Hobbes did not really intend for the social to be a similar discipline. However, his disciple Petty introduced social arithmetic. Being an empiricist, he was not concerned with individual psychology. This development was inevitable. This is how mortality data appeared with John Grant (1624-1674) in 1662. Of course, we must realize that the conscience of the deceased no longer weighed in the observations made; therefore, sometimes an imponderable heart attack was noted as the cause of death instead of syphilis in order to avoid social scandal among the bereaved and close relations. The purpose of the exchange was achieved with a few coins requested by the tabulators. It was no longer the reality of the missing person that influenced the statistics but the honor of those who remained alive. This material did not fail to seduce those who speculated on the behavior of society. Birth and death rates were the first concerns of social mathematics. This new task sought to know the behavior of the masses that is beyond the knowledge of power. The figures of society from the Prussian Gottfried Achenwall (1719-1772), considered the father of statistics, were called "*statiskit*" since he legislated on natural states. Starting in 1769, those who manipulate data are called statisticians.

Here we must stop at some concepts about statistics and medicine. Establishing medical conduct without knowing the complexity of the patient quantitatively and qualitatively distances medicine from an individual decision regarding the patient. Physics has had influences through its mathematics on science in general. The risk in the human sciences is to extrapolate quantification to the individual man. There is no possible certainty in transferring the physics of probability to a clinical act, because the first measures the average behavior of people with numbers and the second interacts with a singular consciousness.

Statistics not only implied at that time the possibility of knowing what was happening but also what could happen. Neither more nor less than knowing about destiny. Marie Jean de Condorcet (1743-1794) foresaw the importance of this mathematical tool. He then attempted to relate social, political and economic issues to laws analogous to Newton's mechanics. His optimism led him to express: "*Everything indicates that one of the great revolutions in human history is near... the present state assures us happiness.*" (5) He believed in the human evolution from instinct to altruism and when being persecuted by the French Revolution, he decided to poison himself in his cell rather than fall under the revolutionary guillotine.

Although he did not totally share Condorcet's optimism, Thomas Malthus (1766-1834) agreed that society had the same relationship as mechanics with the movements of bodies. The Newtonian system was the dream that led him to believe that society could be governed by science and its calculations. David Hume (1711-1776) with his empiricism argued that human nature could be reduced to fundamental laws.

All this led to the prediction that human beings were doomed to happiness just as bodies and the laws of gravity were. Thomas Jefferson (1743-1826) thought so while Edmund Burke (1729-1797), for whom the complexity of people did not allow for a scientific analysis since their trajectories were random, denied it. Here emerges Auguste Comte (1798-1857) who with his *Cours de philosophie positive* maintained that natural laws would be known through the science that came from Newton. His words take Enlightenment to the highest point: "*Now that the human mind has understood terrestrial and celestial physics, mechanics and chemistry, organic, vegetable and animal physics, there still remains a science that must complete the series of observational sciences: social physics.*" (6) However, atoms would lead physics and the rest of the sciences to the freedom of the individual. Let's see.

2. IN SEARCH OF THE LAWS OF SOCIETY

The existence of atoms had been envisioned around 500 BC. by Leucippus, Democritus, Epicurus and later by Lucretius (99-55 BC). Daniel Bernoulli (1700-1782) around 1738 in his work *Hydrodynamics* took up the idea with the concept that small particles that collide are the constituents of gases. Taking advantage of this theoretical development, the Jesuit Ruder Boskovic (1711-1787) formulated the hypothesis that "*an omnipotent mind might foresee all subsequent states and movements and the phenomena that necessarily derive from them*." (7)

This concept would be revealed some time later by Pierre-Simon Laplace (1749-1827) and James Clerk Maxwell (1831-1879). The first stated: "*An intelligent being who at a given moment knew all the forces that animate Nature and the positions of the beings that form it, and that was vast enough to be able to analyze that data, could condense into a single formula the movement of the largest objects in the universe and that of the lightest atoms: nothing would be uncertain for such a being; and both the future and the past would be present before his eyes.*"(8) William Thomson (1824-1907) baptized this being with the name "demon." That is to say; the future of history could be deduced from a moment in time. The logical question arises again: what about free will? Under these concepts of being able to predict each of the

events, freedom was buried by the determinism that classical physics had achieved, transferred to political science.

Laplace, astronomer and mathematician, warned about errors in Newton's mathematical regularity. Together with his student, Dennis Poisson (1781-1840), they estimated that these errors were random and that they decreased with a greater number of observations. In this way, from astronomy, it was determined that probability had to do with the error of measurements. This distribution of data formed a figure that was called the "error curve." Later Carl Friedrich Gauss (1777-1855) gave his name to the probability distribution curve, also known as a *stochastic* curve, since each observation acts independently.

Knowledge of the works of Laplace and Poisson gave Adolphe Quetelet (1796-1874) the impression that they determined the natural order. He went to the limit. He saw the variations not as a natural process, but as deviations from an ideal. He transferred this concept to behavior, since he considered that everything about man is a physical fact. The *average behavior* of an individual was correct. This placed uniformity above singularity.

Quetelet set out to legislate scientific understanding in society. He used Hobbes's mechanical concept upon which he added statistics and the conviction that natural laws were found in the internal structure of society. Every scientific and human discipline was brought into the fold of positivism without any difference between mathematical sciences and strictly human sciences, such as medicine, psychology or politics. There were no differences between cosmic movements and that of individuals. Let us add that Quetelet was an astronomer by profession. The statistics that he used from his physical training gave him the necessary drive to tackle social studies. Astronomy positioned itself in this position and its practitioners realized that they could describe the natural laws of human behavior. They had active participation in searching for the laws that governed society.

There was controversy over these concepts. Henry Thomas Bucke (1821-1862) argued that statistics would allow history to be a science that would avoid falling into the arbitrariness of singularity. Nassau William Senior (1790-1864), English economist, went much further in this prediction: "*human will obey laws as precise as those that govern matter.*" Maxwell's judgment of Senior was to consider him an extremist of positivism. This statistical prediction obviously led to strong opposition. In relation to these mechanistic laws, even within the concept of probability, Friedrich Nietzsche (1844-1900) was sardonic: "*if history has laws, neither these laws are worth anything nor is history worth anything.*" (9) Similarly, it was later explained by Hilaire Belloc (1870-1953) in the following way: "*Statistics are the triumph of the quantitative method, and the quantitative method is the victory of sterility and death.*" (10)

Regarding this point of social arithmetic, it was believed that knowledge of a society could determine people's behavior. Here we must incorporate another postulate of quantum physics, "non-objective reality." It is substantially doubtful to continue considering the postulate of objectivity in science. It is almost impossible for observation not to be affected by the "reality" of the observer. Quantum physics has demonstrated with its development that we should not exclude the concept of "non-objective reality." In medicine, for example, the objectivity that was imposed in science faded consciousness as an essential fact in the health/disease process.

3. PROBABILITY OR INDIVIDUAL CONSCIOUSNESS

Consciousness, the fundamental and unique fact of the universe, causes all physical and human analogies to be abolished as incongruous. Consciousness cannot be reduced to a mere physical structure. And even more so when this is unique and exclusive to each individual. (11, 12) The probability used in human organic systems obeys an arithmetic tool, ignoring the role of consciousness, the true attractor of the new physics of dissipative structures, which makes each individual a unique being. To ignore consciousness in organic processes is to ignore the true mind-body integration possessed by the exclusive being that can describe the entire universe through the interpretation given to it by the conscious faculty. Each response, whether physical or spiritual, passes through the sieve of consciousness. Given this situation, how to confront it with arithmetic? Obviously, the only method for the singular analysis of a consciousness is through the singularity of another consciousness.

The application of statistics to individuals is a risky topic. This is what has happened with statistics in medicine. Evidently, the concept that gave rise to social arithmetic with Hobbes and Petty has changed, where classical physics had lorded over the behavior of individuals. Beyond the step taken from the strictly mechanical to probability, even in the sciences that have to do with the singular man, there are risks in the global interpretation through statistics. What would the behavior of a clinical trial be in an individual case? We could ask ourselves, imitating Charles Pierce (1839-1914) (13), when in relation to chance on natural diversity he asked "*what will be the natural selection in each individual case?*".

Conflicts of interest

None declared.

(See authors' conflict of interests forms on the web/Additional material.)

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