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Scientific knowledge I: scientific realism vs. pessimistic metainduction

El conocimiento científico I: realismo científico vs. metainducción pesimista

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What has distinguished scientific knowledge from other forms of knowledge in the world (such as those created by religion or culture) is the belief that scientific methods offer an irrefutable view of how the world *truly* is, rather than a subjective or biased interpretation of it. Researchers "discover" the reality of the world through a methodical and impartial process based on the objective observation of events. We can say that science provides us with knowledge that is universally true and applicable to the universe. Described this way, it seems simple and easy to understand. However, this view is not entirely accurate, and science thinkers and philosophers have shown us that this is not how scientific knowledge has been constructed throughout history.

Scientific knowledge and truth are not the same, much as we might wish they were, although they tend to be related. Scientific knowledge is based on observations, experiments, and evidence; it is constantly undergoing improvement, change, new discoveries, etc. This is why scientific conclusions are always provisional. They change with new evidence or better explanations that refute, modify, or improve them over time. Truth, on the other hand, can be understood as an objective reality that exists independently of whether we are capable of discovering or understanding it. Philosophers have debated for years the nature of truth and how we can come to know it. Science and scientific knowledge attempt to reach the truth through objective and rigorous methods of observation and analysis. However, they may never fully achieve it.

Can this really be the case? The question of whether it is reasonable to interpret scientific theories based on observation and reasoning as real and faithful explanations of the world as it is remains a matter of discussion in the philosophy of science. On one hand, "scientific realism" holds that scientific theories can effectively describe reality and should be interpreted as true descriptions of it. In our particular case, this would imply that the theories and practices in the field of podiatry that are based on scientific research and evidence truthfully reflect the pathophysiological processes occurring in the foot. However, the 1981[1] article by Larry Laudan[1] precisely exemplifies the opposing view, known as "pessimistic metainduction." Laudan explains—through historical events in the history of science, which are objective facts—that most past theories have proven to be replaced by others that *seem* true, and so on over the years, implying that today's theories will likewise be proven false in the future. A classic example of this concept is the Ptolemaic geocentric theory, which placed Earth at the center of the universe with celestial bodies, including the Sun, orbiting it. This theory was the dominant view of the cosmos in many civilizations and was upheld as the only true model until the Renaissance in the 16th century, when it was replaced by Copernicus' heliocentric theory, which placed the Sun at the center. Despite its flawed conception, the geocentric model of Ptolemy accurately represented and predicted the apparent movements of the Sun, Moon, and the five known planets with great precision.

In the field of podiatry, we have witnessed this problem several times. One example is the mechanical conception of the midtarsal joint. Initially, Manter in 1941[2] and Hicks in 1953[3] described the kinematic behavior of this joint around two independent axes: the oblique transverse tarsal axis producing combined motion in the sagittal and transverse planes, and the longitudinal transverse tarsal axis producing motion in the frontal plane. This concept of midtarsal joint mechanics became the dominant view for decades. The dual-axis idea was embraced and disseminated by Root et al.[4,5] to describe foot function, with enormous impact on the professional development of podiatry—especially in the field of biomechanics and orthotic treatment—that remains present even today. However, more recent research using improved technological methods to study the joint's kinematics has shown that this model was incorrect and not a true interpretation of how the joint behaves in the foot. Van Lange-

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Figure 1. Discovery of a statue as an example of the scientific knowledge-building process.
Image obtained from OpenAI (2025).

laan first, and later the group led by Nester et al.[6-8], found that both the talonavicular and calcaneocuboid joints have articular axes that move continuously in space, independently of one another, during pronation and supination movements. These authors "bury" the notion that two simultaneous axes exist in the midtarsal joint, since the same bones could not move in two different directions at the same time—ideas that are clearly explained and developed by Kevin Kirby[9].

Proponents of scientific realism have offered several arguments in defense of their position, especially the so-called "no-miracle" argument. This concept refers to the impossibility of explaining science's success unless we accept the postulate that scientific theories are, to some degree, true. The success of science would then serve as a reasonable indicator that scientific theories more or less accurately describe reality. This is the only way to conceptualize scientific discoveries as *not* miraculous, but rather as preexisting realities that have been discovered through science[10,11]. However, the truly compelling argument of pessimistic metainduction has led scientific realists to take a more cautious stance, approaching scientific knowledge as "to some degree" true, "approximately" true, "partially" true, "plausible," etc.

Both approaches may converge at some point. On one hand, we can accept that there is a reality we attempt to reach through scientific knowledge using observation and the scientific method (in our case, a biological and mechanical reality explaining the pathophysiological processes of the foot and ankle); but it is also true that all theories based on scientific knowledge will be refuted or modified over time, leading to a progressively closer approach to the truth. One image that exemplifies this process is that of a giant statue covered by sand, stones, and other debris, which scientists progressively uncover. Some areas of the statue are exposed or nearly uncovered, while others remain hidden. The workers don't know what the statue looks like or where to dig, but theories and their empirical testing progressively lead to further uncovering of the statue (Figure 1). This analogy helps us understand how scientific knowledge is "approximately" true, yet incomplete and subject to change or modification over time.

Ultimately, given the historical record of scientific theories that have been refuted over time, we must at the very least be cautious in accepting current theories in our field as definitive or "absolutely true." This perspective does *not* mean we shouldn't base our treatments on currently validated evidence-based theories, as these have replaced earlier theories that less effectively explained biological and mechanical behavior of the foot. However, it *does* invite us as professionals to adopt a more critical and reflective approach toward the theories and treatments we use today, as they will likely be replaced in the future by more advanced ones. Although this view might seem discouraging, it actually fosters ongoing research and the development of new techniques that better align with the reality we are progressively uncovering.

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