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Introduction to "Newton's Legacy for Psychology"

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This first article (of the group that follows) is intended as a brief introduction to the general philosophical assumptions of Newton: namely, his mathematicism, empiricism, positivism, reductionism, and dualism. These five "isms" provide an important background to the main articles that are also briefly described.

As many historians have noted, knowledge grows at a tremendous rate when a great person and a great opportunity appear simultaneously. A case in point is the "coincidence" of seventeenth century physics and Isaac Newton. Certainly, seventeenth century physics was fertile soil for scientific progress and discovery. Newton's forerunners — individuals like Galileo, Descartes, and Boyle — had not only prepared the soil well, they had planted many of the seeds Newton was later to harvest (cf. Burtt, 1954, chapter VII). It was not mere modesty that led Newton to remark, "If I have seen further [than other persons], it is by standing upon the shoulders of giants" (Newton, 1675/1992, p. 281). Newton knew full well that few of his immense accomplishments would have been possible without the numerous contributions of his predecessors.

Nevertheless, Newton's own genius for capitalizing upon these contributions should not be underestimated. Indeed, this genius and its subsequent effect upon science have often been compared to another great intellect — Aristotle. Any student of scientific history knows that this is particularly impressive company. Almost every discipline of science has been traced, at one time or another, to Aristotle's philosophy, including the "softer" sciences such as psychology (cf. Slife, 1990). Many observers have contended, however, that Newton has had a similar influence upon the modern scientific community.

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Edwin Burtt (1954), for instance, notes that "Newton enjoys the remarkable distinction of having become an authority paralleled only by Aristotle . . . . Newton's supremacy in modern science, the most successful movement of thought that history so far records, stands unquestioned" (p. 207).

An amazing testament to this supremacy is the extent to which it was acknowledged by Newton's contemporaries. For example, one of the greatest intellectuals of this period, John Locke (1690/1990), considered himself a mere "underlaborer" of the "incomparable Mr. Newton" (p. 89). Contemporary literature also seemed to venerate the man, as Pope's famous couplet shows:

> Nature and Nature's laws lay hid in night;
> God said, "Let Newton be," and all was light.[1]

Even the common person had heard of Newton's exploits. As George Horne (1753) observed:

> It is a notion every child imbibes almost with his mother's milk, that Sir Isaac Newton has carried philosophy to the highest pitch it is capable of being carried, and established a system of physics upon the solid basis of mathematical demonstration (p. 72).

Newton's supremacy in science continued into the nineteenth century — the crucible of modern psychology. Newtonian physics had become the envy of all sciences. It seemed only reasonable for fledgling sciences such as psychology to model itself after "the queen of sciences," physics. How did this modeling affect the science of psychology? Although psychology obviously occurs in the same physical world as that studied by Newton, it was not his *physics* that most influenced psychology. It was rather his *metaphysics* that influenced psychology so profoundly. That is, Newton's physical laws did not affect the direction of psychological science so much as the philosophy he assumed in establishing those physical laws. In this sense, psychologists took not only their method from Newton, but also their style of explanation and general scientific philosophy. The following seven papers concern primarily these aspects of Newton's legacy for psychology.

This first article is intended as a brief introduction to the general philosophical assumptions of Newton: namely, his mathematicism, empiricism, positivism, reductionism, and dualism. These five "isms" provide an important background to the main articles that follow. The main articles take up the more specific aspects of Newton's philosophy and apply them to the issues of contemporary psychology. All the articles suppose, of course, that

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[1]This was intended as an epitaph for Newton's tomb in Westminster Abbey, *Poetical Works*, Glasgow, 1785, Volume II, p. 342.

Newton *had* a philosophy. This supposition may be an obvious one to some, but it bears noting because Newton himself specifically denied the importance of metaphysical philosophy. He clearly favored "exact knowledge" as the basis of his understanding. The problem is, as Jaspers has observed, "there is no escape from philosophy" (Valentine, 1992, p. vi). Even though Newton rarely acknowledged his own philosophy explicitly, he nonetheless endorsed a very specific one. Indeed, this is part of the reason that his philosophy has been so influential — it was adopted without later scientists knowing it *was* a philosophy.

General Philosophical Assumptions

*Mathematicism.*The title of Newton's magnum opus, *Mathematical Principles of Natural Philosophy*, aptly expresses his foremost philosophical assumption: that all natural phenomena can be explained in terms of mathematical principles. As Newton described, "By the propositions mathematically demonstrated in the first book, we then derive from the celestial phenomena the forces of gravity with which bodies tend to the sun and the several planets" (1687/1990, pp. 1–2). This and other passages reveal that his scientific procedure was twofold: discover the mathematical principles underlying certain basic motions (e.g., the three laws of motion), and then apply this discovery to the other motions of the universe (e.g., planetary orbits). Newton even felt he could apply this procedure to those aspects of his discipline considered more "qualitative" in nature. In his book *Optics*, for example, he attempted to put the phenomena of color in quantitative terms. "The science of colors," he declared, "becomes a speculation as truly mathematical as any other part of optics" (1704/1990, p. 478).

Empiricism. Newton's empiricism is second only to his mathematicism and pervades all aspects of his scientific work. Of course, Newton came by this British empiricism rightly, having been British himself, and his close friendship with John Locke — one of the foremost empiricists of his time — probably made empiricistic philosophy unavoidable. Newton (1687/1990) noted repeatedly that ". . . we learn from experience . . . we gather [knowledge] not from reason, but from sensation" (p. 270). Indeed, he often seems to equate this epistemology *with* science. As he recorded in *System of the World*, "we no other way know the extension of bodies than by our senses" (Newton, 1687/1990, p. 270). It is the observed (sensible) phenomena of nature that scientists should attempt to explain. Although many of his predecessors — Kepler, Galileo, and Descartes — believed in a priori certainties, Newton would have none of this. He passionately contended that the mathematical principles of the world had to be derived from empirical observations of the world itself. If the world does not submit to the mathematics at hand, then we must expand our mathematics until it does. In this sense, even Newton's coveted mathematics sometimes took a back seat to the dictates of experience.

Positivism. The third in our philosophical assumptions — positivism — is readily apparent from Newton's constant attack on hypotheses. Early in his career, Newton questioned the use of hypotheses and urged at least their postponement until accurate experimental laws were firmly established through positivistic observations. One should first "investigate the properties of things and establish them by experiments, and then later seek hypotheses to explain them" (Newton, 1779, p. 314). If hypotheses exist that do not conform to empirical laws, then these hypotheses should be abandoned. Newton made a consistent distinction between empirically derived laws and theoretically dependent hypotheses. Nothing irritated him more than to have one of his laws called an hypothesis. On one occasion, when the refrangibility of light was alluded to as an hypothesis, Newton affirmed that this doctrine "seemed to contain nothing else than certain properties of light, which I have discovered and regard it not difficult to prove" (Newton, 1779, p. 310). After several irritations of this nature, Newton concluded that the only safe method was to ban hypotheses entirely and rely upon positivistic verification exclusively.[2]

Reductionism. Newton's reductionism was probably developed by his illustrious predecessors, though Newton seems to have adopted this assumption without criticism (Burtt, 1954, p. 231). He readily admitted that the "foundation of [his] philosophy" requires that the main qualities of the "whole, result from . . . [the main qualities] of the parts" (Newton, 1687/1990, p. 270). Moreover, the world is ultimately composed of absolutely hard and indestructible particles — "atoms." All changes in nature are to be regarded as the association, separation, or motion of these permanent atoms of reality (Newton, 1704/1990, p. 541). As he put it, "primitive [atomic] particles, being solids, are incomparably harder than any porous bodies . . . no ordinary power being able to divide what God himself made one in the first creation" p. 541). But is this a statement of theological belief or empirically derived law? Newton acknowledged that such indivisible particles had not been empirically observed, so he qualified his endorsement of atoms. He did not budge, however, from his general endorsement of reductionism. Any proper scientific procedure, according to Newton, focused on the smaller elements of sensibly experienced objects, whatever they may be ultimately.

Dualism. Newton's final philosophical assumption reflects a pervasive epistemological dualism. Once again, Newton seems to have accepted the pre-

[2]Newton also said, ". . . whatever is not deduced from the phenomena is to be called a hypothesis, and hypotheses, whether metaphysical or physical, whether of occult qualities or mechanical, have no place in experimental philosophy" (Thayer and Randall, 1953, p. 1).

vailing philosophy of his time, notably that of Descartes (Burtt, 1954, chapter VII). This includes not only mind/body dualism but also subject/object dualism. In Newton's *Optics*, for instance, the human soul (which approximates the modern notion of mind) is locked within the body, having no immediate contact with the "outside" world. Newton's object of study — the motions of the world — is first transmitted from the object to the senses and then carried through nerve fibers to the brain, wherein the soul rests. The proper realm of science, in this sense, is the "primary" qualities of the "objective" world, rather than the "secondary" qualities of our "subjective" world. Newton's study of color is especially instructive in this regard. He argued that the phenomena of color, as perceived, is a "phantasm" of the mind, and only partly the product of the mode of light received (Newton, 1779, p. 304). Color as experienced is not a primary quality and thus has no real existence outside our mind. Only the rays of light related to the perception of color are pertinent to scientific inquiry.

Newton's Legacy for Psychology

Most psychologists should find the aforementioned assumptions quite familiar. Despite the obvious dissimilarity in subject matter, many psychologists have attempted to practice a science very similar to the science practiced by Isaac Newton (cf. Bateson, 1978; Leahey, 1987; Polkinghorne, 1983; Rakover, 1990; Rychlak, 1981, 1988; Slife, 1981, 1989, 1993). In fact, some psychologists would consider variants of these assumptions to be *the* assumptions of science.[3] That is, the very notion of science is somehow equated with the Newtonian perspective. This should not be surprising when the movement of modern science itself arose in large measure from Newton's scientific accomplishments. Modern philosophers and physicists have since challenged Newton's view of the scientific enterprise (see summary in Slife, 1993, chapter 1). Still, Newton, in a very important sense, defined the science of a significant period of scientific history, and psychology's formative years as a discipline occurred during that period.

Thomas Leahey begins these papers by chronicling how Newton's definition of science came to affect psychology, both in its "foreground" and its "background." Newton's foreground influences include those thinkers who wished to be "Newton's of the mind" (e.g., David Hartley), while Newton's background influences include the spatio-temporal universe and the dichotomy of subject and object. Next, Brian Vandenberg notes the broad

[3]For example, most psychologists do not go to the extreme of attacking hypotheses (as Newton did). However, many psychologists practice (or attempt to practice) versions of positivism and logical positivism.

impact of Newton upon modern developmental theory and research. Although typically traced to Darwin, developmental psychology owes much to Newton's metaphysical assumptions as well as his (and others) theological assumptions. Piers Rawling, then, emphasizes another portion of psychological research — signal detection. In his article, Rawling demonstrates how Newton's scientific method has been the implicit guide to some of psychology's most rigorous research, with some interesting exceptions.

The articles by Slife, Williams, and Faulconer focus less upon specific topics of psychology and more upon certain "styles" of explanation that Newton bequeathed to psychology. My article, for example, discusses Newton's assumption of "absolute time." I attempt to demonstrate the wide influence of this assumption upon psychological explanation, despite its disputation and abandonment by subsequent philosophers and physicists. Similarly, Richard Williams describes Newton's difficulty in accounting for "action at a distance" with his mechanistic philosophy. Williams parallels this to many of psychology's theoretical difficulties and notes that in each case the difficulty stems from the commitment to a mechanistic metaphysic of "things." James Faulconer, in turn, concentrates on Newton's conception of causation. Contrary to mainstream psychology's use of Newtonian physics, Faulconer claims that psychological researchers can explain their data, without resorting to mechanism, materialism, and mathematicism.

The philosopher Paul Roth closes this group of papers on Isaac Newton. Roth provides a commentary and criticism of each of the articles. He notes that all the papers discuss different aspects of the Newtonian-type of paradigm found in psychology. He applauds the aforementioned authors' recognition of this paradigm and agrees with many of their criticisms. However, he also draws attention to a vital and relatively overlooked question: If not Newton, then who? What alternatives do psychologists have for their scientific philosophy?

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