Chapter 1

Newtonian Time and Psychological Explanation

Linear time pervades psychological explanation. As outlined in the Introduction, linear assumptions are foundational to both the basic and applied aspects of psychology. How intriguing it is to note that this issue has virtually never been discussed. With rare exceptions, time has not only managed to avoid systematic examination, it has scarcely been acknowledged anywhere in the field. What is the reason for this lack of acknowledgment? Psychology is a scholarly discipline with many highly educated people examining its ideas and explanations on a continual basis. How could a metaphysical assumption of this importance escape some sort of scrutiny?

As this chapter shows, two factors appear to be the most responsible for this lack of scrutiny: psychology's past and psychology's future. Regarding its history, psychology is a relatively new discipline. Although many ancient thinkers have certainly influenced psychology, psychology's identity and style of explanation are distinctly modern (and "modernist") in outlook.[1] Many metaphysical assumptions are implicit to our modern culture, and contemporary psychologists have adopted some of these assumptions without full awareness. As this chapter describes, one of these cultural assumptions is linear time itself.

Regarding psychology's future, there is no mistaking the early goal of psychologists—being "scientific." Wilhelm Wundt, for example, titled perhaps the first psychology course in 1862, *Psychology as a Natural Science*. The only question was: How does a new discipline become a natural science? Here, psychologists seemed to adopt the very reasonable approach of looking to other successful sciences as their guide. This chapter outlines how Newtonian physics—the ideal of sciences during psychology's formative years—became a prime model for all that early psychologists wished to become. Much of this modeling, however, involved Newtonian assumptions of the world that were accepted uncritically. One of these assumptions, as this chapter reveals, is Newton's own rendition of linear time—absolute time.

The bulk of this chapter outlines how Newton's conception of time has influenced scientific explanations ever since. As we shall see, five characteristics of explanation have devolved from Newton's temporal framework: objectivity, continuity, linearity, universality, and reductivity. The chapter first describes each of these characteristics as it is related to absolute time. Then, criticisms of this framework by philosophers and physicists are discussed. The latter group of critics is especially important because many contemporary physicists have abandoned these temporal characteristics (as well as absolute time) in their explanations. Nonetheless, contemporary psychology—with its identity now somewhat intact—has not looked back to physics. This chapter indicates how psychology currently maintains most, if not all, of these linear characteristics in its mainstream explanations of behavior, mind, and abnormality.

The Rise of Linear Time in Western Culture

As noted, the view of time held by so many psychologists is also the view of time held widely in Western society. In fact, time is not typically seen by lay culture as a "view" at all. It is "out there," flowing like a line from past to present to future. No examination of this linear notion of time is considered necessary because it is part of reality. Past events are viewed as fundamental to explanation, just as in psychology. Indeed, it is considered common sense in Western culture that our personalities and attitudes are caused by our past experiences. The question is: How did this common sense become so common? How has this linear view of time gained such a hold on our culture and such an authority in psychology?

Actually, the predominance of linear time is a relatively recent phenomenon. Ancient peoples did not view time as an objective frame of reference for marking events. They relativized time by making it conform *to* events, rather than events conform to time. For the Romans, each hour of daylight in the summer was longer than each hour of daylight in the winter. Time was a dynamic and adjustable organization tailored to fit our world experiences. Cyclical, rather than linear, views of time dominated these cultures because so many aspects of nature seemed cyclical, such as the seasons and heavenly bodies. Plato believed that the order of world events was destined to repeat itself at fixed intervals. Aristotle's students wondered whether Paris would once more carry off Helen and thus again spark the Trojan War.[2]

Our Western view of time arose primarily as a result of three historical developments: the spread of Christianity, the industrialization of society, and the invention of cheap watches.[3] Pre-Judaic religions complemented the cyclical view of time. They portrayed time either as infinite and possessing no beginning or end, or as a cycle of rebirth and future life with time forever repeating itself. The spread of Christianity brought to bear a "stunning" new conception.[4] Christians considered their God to be the creator and ultimate destroyer of the universe. Hence, the world had a beginning and an end, and important Christian events, such as the birth of Christ, were unique and nonrepeatable. The spread of these conceptions resulted in a competition between the cyclical and linear views during the medieval period.[5,6]

The temporal tide began to turn in the favor of linearity—at least for our Western culture—when industrial economies arose. As Lewis Mumford concludes, "The clock, not the steam engine, is the key machine of the modern industrial age."[7] When power stemmed from the ownership of land, time was considered plentiful and cyclical, being associated with the unchanging cycle of the soil. With the rise of a mercantile economy and the mechanism of industry, however, emphasis was placed on the scarcity of time and "forward" progress.[8] The byword became "Time is money," and implied that time could be saved or spent.

The coup d'état for the linear view was the increased availability of cheap watches. The mass production of watches in the nineteenth century made it possible for linear time to regulate even the most basic functions of living. "One ate, not upon feeling hungry, but when prompted by the clock: one slept, not when one was tired, but when the clock sanctioned it."[9] Regulation of our lives by the clock meant that the abstract assumption of linear time could be endowed with a sort of concrete reality.[10] People now seemed to be able to "see" and "feel" time (the clock). Time also appeared to be one of the causes of psychological factors because the thoughts and behaviors of individuals seemed to turn on what time "told" them. In short, a convenient (linear) way of organizing events became reified as *the* way events were organized.

Psychology was conceived and developed during this temporal zeitgeist; time was a concrete actuality, rather than a point of view. The spread of Christianity, industrialization, and the invention of cheap clocks, all coalesced to make linear time a "reality." Before this coalescence, many scientists, such as Newton, felt it necessary to make their assumption of time explicit. Several views of time were possible,[11] and so one's view had to be identified and supported. Psychologists, on the other hand, were not called upon to articulate their temporal assumptions. Linear time had become a given and required no discussion or defense. Time existed like a line, independently of us, and virtually everyone accepted this reification without awareness.

Newtonian Time

Psychology is not the only discipline to have reified time. Einstein found a similar state of affairs in his own discipline of physics. The quotation from Einstein that serves as this book's epigraph evidences this: "Concepts which have proved useful for ordering things easily assume so great an authority over us that we forget their terrestrial origins and accept them as unalterable facts."[12] Einstein's point here, of course, is that sometimes the very pervasiveness of an idea leads to its anonymity. Certain ideas can be so commonplace and so widely accepted that they go completely unrecognized. Yet it is these very ideas that are often the most influential to thinkers in a discipline.

One of the ideas that Einstein was alluding to in this quotation is the idea of time itself. Part of his genius was the realization that time played an unrecognized role in physics. Indeed, linear time was seen as an absolute truth—an unquestioned part of reality—during the preceding three hundred or so years of physics. There was no reason to examine its "role" because it was not even viewed *as* a view. This led to a curtailment in the number of new ideas in physics.[13] Acceptable ideas about reality had to be compatible with time's supposedly linear properties. Einstein's theory of relativity, however, was largely based upon his examination and eventual rejection of this traditional view of time.[14] He proposed an alternative view that ultimately revolutionized the discipline of physics in the twentieth century (discussed later in this chapter).

Still, this revolutionary view has had little impact upon lay culture. Except for parts of physics and philosophy, the Newtonian picture of the world is by far the dominant one in Western culture.[15] Newton's views are now the common sense of our culture in regard to time. Many historians give Newton an authority "paralleled only by Aristotle" in his influence on Western society.[16] Although his basic ideas probably originated with his intellectual ancestors,[17] Newton gets the credit for assembling the ideas into the current package our culture calls time. The distinguished philosopher and historian, Edwin Burtt, put it this way:

> Magnificent, irrefutable achievements gave Newton authority over the modern world, which, feeling itself to have become free from metaphysics [such as time] through Newton the positivist, has become shackled and controlled by a very definite metaphysics through Newton the metaphysician.[18]

Newton's views have had a similar effect upon psychology. A number of historians and other scholars have noted that psychologists considered Newtonian physics their model of science during psychology's formative years.[19] At the time of psychology's inception, Newtonian physics was the queen of sciences. Modeling Newtonian physics was only natural for a new discipline struggling to become a science. Psychologists took not only their principles of explanation from Newton but also their approach to scientific method. Newton's views of time—views that were later to be challenged, if not rejected, by many later physicists—were implicit to everything adopted by fledgling psychology. And because these views were never subsequently examined, psychologists continue to employ them in close to their original form. Therefore, let us examine Newton's views in more detail.

Newton postulated *absolute time* which "of itself, and from its own nature, flows equably without relation to anything external."[20] Newton needed this assumption for two main reasons. First, his conceptions of motion and causality required an absolute frame of reference.[21] Motion, for example, could not be detected or measured without an objective past and present. The rolling ball begins its roll at some point in the past, but is now at some point in the present. Second, his mathematics required the continuity of events (flowing equably). He regarded moments of absolute time as a continuous sequence like that of real numbers, believing that the rate of this sequence was independent of the events taking place in them.[22]

For these reasons, absolute time became the standard by which all scientific explanations were judged. The order (and directionality) of the world was thought to be synonymous with the absolute and linear organization of events. Characteristics of Newton's absolute time became the "rules" for acceptable scientific explanation for nearly three centuries, and still form the rules for many disciplines such as psychology. It is thus important that we explicate these rules and their modern criticisms, and then check the specific role these rules play in psychological explanation.

Newton's Temporal Framework for Explanation

Newton's approach to time left science with a legacy of five somewhat overlapping implications or characteristics for scientific explanation. These include objectivity, continuity, linearity, universality, and reductionism. Some of these characteristics are the properties of time itself, as envisioned by Newton, and some are the necessary properties of the events to be explained, because they are *in* absolute time.

The assertion that events are "in" time is itself an implication of a temporal characteristic. Newton viewed time as *objective,* existing "absolutely" and independently of consciousness. Time is conceived as a medium *in* which and *against* which events occur and can be related to one another. Motion, causation, and change are seen to exist "out there," and so an absolute framework for evaluating these conceptions must also exist out there, separate from them (and our consciousness). If time were subjective—Newton might argue—distinctions between the temporal dimensions (past, present, and future) would be left up to the perceiver, and an objective science would be in jeopardy. Indeed, the notion that cause and effect require succession in time occurred with the advent of absolute time.[23]

This view of causality was bolstered by another property of Newtonian time, its *linearity.* Just as a line is thought to consist of a succession of points in space, time is considered to consist of a succession of moments in time.[24] The three dimensions of time—past, present, and future—thus occur in a linear sequence. Time begins in the past and advances into the present on its way to the future. (Absolute time is *not* "reversible."[25]) This places the greatest weight upon the past (or the "first" in a sequence), because it is the temporal entity that supposedly starts this process. The metaphor of the line means that the present and future must remain consonant with the past. Moreover, the past is the temporal entity with the most utility. The present is less useful because it is just an evanescent "point" on the line of time, and the future is less useful because it is not (yet) known with any certainty. Only information from the past is viewed as substantive and certain enough to be truly known and understood.[26]

Newton also considered time to be *continuous,* proceeding smoothly and "equably," as he put it.[27] Actually, this characteristic of time has two properties that are worth separating: consistency and uniformity. Consistency is the well-known Newtonian notion that events which happen at one point in time are consistent with events occurring later in time—the past is continuous with the future. This is the origin of Newton's conviction that the world is predictable. If enough is known about the present situation (or the past), then future events or states can be predicted. Uniformity, on the other hand, is the notion that time is homogeneous. Although the events *in* time can move at different rates, time does not itself slow down at some points and speed up at others—it "flows" at a constant, never-changing pace. This uniformity provides the perfect frame of reference for measuring events.

Time's continuity has significant implications for change. In Newton's metaphysic, change can not be discontinuous or instantaneous, moving abruptly from one state into the next.[28] Change has to be continuous and smooth, much as a flower gradually blooms. The reason is that Newton conceived of time as *infinitely divisible*—like a line. No matter how small the interval of time, there is always a line of time (points in time) that spans the interval. This means that change can only be incremental. Whatever change occurs, it is assumed to have intervening levels that correspond to the intervening points in time. Change can occur at different rates, and motions can proceed faster or slower. However, change can not occur through sudden jumps from one stage into another—such as a flower bud jumping to a full bloom—without some points of time (and levels of change) falling *in between* the two stages.

This characteristic of continuity has led to another major feature of scientific explanation, labeled by some authors as "universality,"[29] "atemporality,"[30] or "symmetry."[31] This characteristic of *universality,* as we shall call it here, assumes that natural laws are universal and unchangeable, regardless of the period of time in which they are observed. Natural processes are still thought to unfold across time in the continuous manner just described. Nevertheless, the principles behind the processes are considered to be independent of the events and particular period of history in which they unfold. The laws of planetary motion, for example, are the same laws at one point in earth's history as they are at another point in earth's history. This universality is only possible if time is uniform in the Newtonian sense. If time changes its rate or quality, then the temporal relations between planetary events would not be consistent from one period of history to the next. Scientific laws, in this sense, would not be lawful.

The notion that lawful processes take place across time has had another implication for explanation—*reductionism*. Reductionism results from the fact that any one moment in time contains only a reduced portion of the process. That is, if a process begins at Time 1, continues through Time 2, and ultimately culminates at Time 3, the process *as a whole* literally never exists. Only part of the process can occur *at any one moment* in time. Recording devices, such as an observer's memory, permit a part of the process to be "photographed" and juxtaposed with the next moment's part until all the process is viewed *at the same time*. However, no *direct* access to the process-as-a-whole is ever possible. (A memory of previous parts is not direct access.)

This also makes interpretation of each part's relation to the whole problematic because each part crosses our window of the present independently of the whole. Any properties of the part that may be derived from its relationship to the process-as-a-whole are not available. Without these properties, an understanding of the process-as-a-whole is itself problematic. All that is available at the end of the process is the cumulative record of independent parts, as each part is encountered in time, and not information about how these parts are related as a whole.

Newton brilliantly coalesced all five characteristics of explanation into a coherent package by calling upon *mechanistic metaphors*. He felt the universe—with its motions and chains of causation across time—was directly analogous to the great machine of his day: the clock. Through his writings and research, he combined the implications of absolute time just described—objectivity, linearity, continuity, universality, and reductionism. He represented them all with machine metaphors that seemed to embody these characteristics.[32] Machines seem to operate objectively through a continuous and linear sequence of events. This sequence is universal because it appears to be repeatable, regardless of the period of time in which the repetition occurs. Machines also seem to evidence temporal reductionism in their functioning. Their sequentiality provides no direct access to the whole of their processes at any given moment in time.

When the universe is presumed to possess these five temporal characteristics, explanations that are properly "scientific" also possess these characteristics. Mechanistic explanations of data are, of course, preferred because they naturally embody these characteristics. The reverse is also true—those processes that manifest linear and lawful properties are considered mechanisms and thus accorded appropriate scientific status. Newton even carried his temporal approach to explanation into his *method*. In order to observe parts of the machine universe in its mechanistic regularity, he assumed that one tracked the effect of some antecedent (in time) experimental manipulation on its consequent. Orderly relationships between variables can thus be observed and cataloged until all the universe is understood.

Criticisms of Newton's Framework

As undeniably brilliant and influential as this temporal framework for explanation has been, it has not avoided criticism. G. J. Whitrow, for example, characterizes Newton's conception of time as the "most criticized, and justly so, of all Newton's statements."[33] Many subsequent philosophers and physicists have called Newton's conception into question on theoretical, practical, and empirical grounds. For example, Whitrow notes that the "equable flow" of time is problematic on purely theoretical grounds:

> If time were something that flowed then it would itself consist of a series of events in time and this would be meaningless. Moreover, it is equally difficult to accept the statement that time flows "equably" or uniformly, for this would seem to imply that there is something which controls the rate of flow of time so that it always goes at the same speed. However, if time can be considered in isolation "without relation to anything external," what meaning can be attached to saying that its rate of flow is not uniform? If no meaning can be attached even to the possibility of non-uniform flow, then what significance can be attached to specifically stipulating that the flow is "equable?"[34]

Some have questioned the practical utility of Newton's conception of time as a frame of reference.[35] Because Newton regarded time as uniform and infinite, any position that an object might take *in* time is not discernible from any other position. One portion of time is identical (and uniform) to another. Wherever the object resides (in time), there is no distinguishing feature for that period of time, and there is a similar quantity of time surrounding it in the past and future (infinity). It is therefore impossible to locate an object in absolute time and establish whether it is in motion. Temporal position and motion can only be discerned with reference to another body (e.g., a clock), and Newton's conception of absolute time is unnecessary. Indeed, Newton's conception seems useless for the main reason he formulated it—as a standard for temporal position and motion.

Other criticisms of absolute time are longstanding, and convince most analysts that Newton was "mistaken in several different respects,"[36] or "uncritical, sketchy, inconsistent, even second-rate" as a theoretician.[37] The ancient philosopher Zeno, for instance, provided a penetrating critique of the infinite divisibility and continuity of time.[38] Other critics have focused upon Newton's confounding of linear flow (his theory) and temporal sequence (his data).[39] As noted in the Introduction above, the existence of temporal sequence—"time's arrow"—does not necessarily imply the existence of linear flow—the "first" being the most important in this sequence. Newton, though, considered all physical events to be influenced by the temporal medium in which they supposedly occurred. Therefore, any sequence of related events supposedly involved all the characteristics of absolute time described above.

The trouble is that a sequence of physical events does not *have* to involve these characteristics. Consider the sequence of hydrogen and oxygen gases becoming water. Although this particular set of events has a very definite and predictable relationship, this relationship does not have to be viewed as linear. That is, its predictability is not derived in classical Newtonian fashion from its "past." The past properties of hydrogen and oxygen gases do not permit us to predict the qualitatively different, future properties of water.[40] The predictability of this relationship stems from our repeated observations of this sequence, *not* from its continuous unfolding from a past state. In fact, this particular change (gases into liquid) can be construed as *dis*continuous in nature—from one qualitatively different gestalt to another. The point is that the directionality or sequence of natural events does not require linear or continuous characteristics (or any of the other characteristics of Newton's framework).

Newton, however, extended this confounding of linear theory to his method. Some philosophers, for example, have criticized him for "making a metaphysics of his method."[41] That is, Newton confused his metaphysical theory of the universe (being a linear and continuous machine) with his scientific method (observing the natural order of variables). He experimentally intervened in antecedent events to observe their later effects in time, all the while assuming that linear flow was involved in this sequential relation. In this way, his metaphysics could not be proved wrong. His method (sequential observation) made it seem that his assumptions of time were constantly being affirmed. If, on the other hand, a crucial event for explaining a phenomenon were *simultaneous*, Newton's linear method would be unable to discover it. Such nonlinear explanations would be overlooked owing to the institutionalization of linear explanation in his scientific method (see Chapter 4).

The most significant criticism of Newton's notion of time has come from his fellow physicists. Einstein's conceptual forerunner, the physicist Ernst Mach, criticized the reductive implications of Newton's conception, focusing particularly upon what absolute time did to causality. Mach felt that a linear conception was incapable of embracing the multiplicity of relations in nature. He viewed events of the world as *functionally interdependent*, with no particular event taking precedence over the other just because it occurred before the other in time. He noted that measures of time were themselves based on space, such as the spatial positions of clock hands or heavenly bodies. "We are thus ultimately left with a mutual dependence of positions on one another."[42] In this sense, our dimensions of reality are not time and space but space and space. There is no separate temporal entity against which to measure the past or future of even causal events.[43]

Einstein was also highly critical of Newton's temporal framework. In what follows, Richard Morris summarizes the effects of relativity theory upon absolute time:

> Time is not absolute, it is relative. As the special theory of relativity shows, time measurements depend upon the state of motion of the observer. Time is not a substance that "flows equably without relation to anything external" [Newton's assertion]. According to the general theory of relativity, the presence of matter creates gravitational fields that cause time

> dilation. Finally, if time does "flow," . . . the movement of the "now". . . seems to be a subjective phenomenon. . . . At best, one can only say that time moves onward at the rate of one second per second, which is about as meaningful as defining the word "cat" by saying "a cat is a cat."[44]

Central to Newton's view is the notion that events which are simultaneous for one observer are simultaneous for all observers, regardless of their frame of reference. In other words, a particular instant of time is the same instant of time everywhere in the universe and, hence, absolute or universal. Einstein, however, demonstrated that this is not true through his special theory of relativity. Avoiding Newton's linear methodology, he used *gedanken* ("thought") experiments to show that two or more observers in relative motion do not necessarily agree that two independent events are simultaneous. When events *A* and *B* are simultaneous in one inertial frame of reference, *A* can be observed to occur before *B* in another inertial frame of reference. Moreover, *B* can be observed to occur before *A* in still another inertial frame of reference!

If one assumes an absolute temporal frame of reference, the next question is which observer is *really* correct? This query implies that only one (objective) interpretation of events is correct because there is supposedly only one temporal measure of events. The same events cannot occur in opposite sequences when observed at the same time. Nonetheless, Einstein held that *all* observers are correct within their own inertial frames of reference, and no observer is more correct than any other.[45] In short, there is no absolute truth about the matter. Einstein resolved the apparent contradiction between these observations by noting that time flow is not totally a result of the events themselves. The apparent flow of time is due, at least in part, to each observer's inertial frame of reference.[46]

Modern physicists have not only disputed the reductivity, linearity, and objectivity of time, they have also challenged the continuity of events across time. Many quantum physicists, for instance, contend that electrons move from one orbit to another instantaneously (without time elapse).[47] Electrons simply disappear from one quadrant and reappear in another. Similarly, changes between various stationary states are considered to be discrete and discontinuous.[48] Discontinuous change, as mentioned above, is akin to a flower growing from a bud to a full bloom instantaneously—one instant it is closed, the next instant it is fully opened. This seems to fly in the face of our linear notions of common sense. Our usual notion of time implies that one instant has to be connected to the next with a line, and thus there must be a small interval of time in which the change occurs. Nevertheless, quantum physicists have demonstrated that change can truly be discontinuous—not just faster rates of change but change without temporal duration.

Psychology's Newtonian Framework

These challenges to Newton's temporal framework for explanation have not been widely recognized. Linear time continues to reign supreme in our lay culture and most disciplines other than physics and philosophy. Linear time certainly rules unopposed in mainstream psychology. Psychologists modeled physics just before Einstein's revolution at the turn of the century, and never looked back. Because of the cultural factors described above, early psychologists never concerned themselves with conceptions of time. Linear time was assumed to be part of reality. Criticisms of Newton's temporal assumptions prompted no reexamination in psychology, because no temporal assumptions were even recognized. Psychology's reliance upon Newtonian assumptions, therefore, remains undeterred in virtually every important respect.

First, psychologists view time as happening *objectively,* existing independently of human consciousness. As Ornstein notes, "Most psychologists, in considering time, have taken for granted that a 'real' time, external to our construction of it, does exist, and that this time is linear."[49] Faulconer and Williams also discuss psychology's "objectification" of time,[50] and McGrath and Kelly observe that most research on time is "done on the premise that there is a singular, and known or knowable, objective time."[51] Many psychological experiments, for example, have been conducted to discover how accurately such "real" time is perceived. Time is treated as if it consists of its own stimuli for perception, though real time is always identified with clock-time. The clock, of course, only marks or measures time; the clock is not time itself. To call the clock "real time," as Ornstein points out, "is somewhat like calling American money 'real money:' it is parochial at best."[52]

Second, time is viewed as *continuous.* Psychological events are seen as continuous in the sense of later events being consistent with earlier events. Abrupt "discontinuous" shifts that are incongruent with previous events are thought to be improbable, if not impossible. As the developmentalists, Emde and Harmon have observed, most researchers have "expectations for connectivity and continuity,"[53] presuming a "linkage from early behavior to later behavior."[54] People in general are presumed to be continuous with their upbringing. Personalities and attitudes are traditionally thought to be consistent with the person's past experiences. Any behaviors or thoughts that appear to be exceptions to this rule (sometimes deemed "abnormal") merely indicate that some of the person's past is not known. If it were known, then we would see its continuity to the "exceptional" behaviors and thoughts in question.

Temporal continuity is also used to explain change in psychology. Indeed, in accordance with Newton, change and time are virtually synonymous—both being smooth and gradual. Change from one psychological stage to another must occur through intermediary states (or moments in time). "Spurts" of change are possible, but *some* amount of time must occur *between* changes. For example, changes that researchers consider "discontinuous" are often observed in child development.[55] Still, these are normally viewed as rapid continuous changes—changes across a short span of time—rather than changes with no time or transition between events.[56] A child cannot move from one stage of development to the next without passing "in between." Continuity implies that one instant is connected to the next with a line, and thus there must always be a small interval of time in which change occurs.

Virtually all psychological explanations are *universal*.[57] Psychologists have long sought general "laws" of behavior that are independent of the particular historic situation in which they are embedded.[58] Examples are Fechner's law of the strength of sensation and Skinner's principles of reinforcement—both presumably applicable today, despite their having been formulated many years ago. Most psychologists attempt to look "behind" their data to find the universal principles that underlie them.[59] Cognitive psychologists, for instance, study memory as if principles can be gleaned from experiments that apply uniformly to the memory of all persons in the specified experimental conditions.[60] These psychologists implicitly assume that time itself remains uniform from situation to situation.

The *linearity* of explanation in psychology is also readily apparent. Time is considered to "flow" across psychological events like a line, and distribute psychological processes into linear sequences.[61] This is most clearly observed in the "causal" explanations of psychologists. Any event observed "before" is automatically considered for, if not awarded, causal status over events observed "after."[62] Time intervals or points on the time line between cause and effect must be filled with causal process.[63] From this perspective, it is easy to see why so many psychologists place so much emphasis upon the past. The present is an effect of the past. Moreover, the present is only one point on the line of time, and a durationless and fleeting point at that. A person's life, therefore, consists of the past almost exclusively. It seems only logical that the most theoretical and therapeutic attention is paid to the past.

The fact that psychological processes supposedly take place across time has the same implication it had in Newtonian physics: *reductionism.* No process—whether it be mental, emotional, or behavioral—can exist as a whole at any point in time. A reduction of the process is all that is ever *directly* available for study. Consequently, it is only natural to conceptualize processes as component parts that are separated by linear time. Consider, for example, some models of family therapy. Although family therapists typically wish to conceptualize the whole of the family system, their theorizing often depicts this system as occurring piecemeal along the line of time (see Chapter 8). This type of linear explanation has overlooked reductive ramifications. Because the system as a whole is never present to the therapist at any one point in time, the therapist is resigned to interventions that directly affect only a portion of the system. No truly systemic intervention—at least in the sense of affecting all parts simultaneously—is possible from this Newtonian perspective.

Psychologists also seem to favor mechanistic *metaphors* for explaining psychological processes. As Anthony Aveni rightly declares, "Machinery is, for us, the power tool of metaphor."[64] Just as Newtonian explanations relied upon the clock, psychological explanations have historically relied upon a host of different machines. The human mind, for instance, has been analogized to whatever mechanism was ascendant in that day, from the hydraulics of the steam engine to the relays of telephone switchboards.[65] Today, of course, the computer is the ascendant machine, and true to form, computer metaphors abound in theories of the mind. Even families are understood through computer metaphors.[66] Computers, no less than their mechanistic predecessors, operate across time in temporal stages that minimally included input and output.[67] In this sense, Newtonian time and mechanistic models have served to catalyze the popularity of the other.

Finally, contemporary psychology and Newtonian physics conceptualize scientific *method* with similar temporal assumptions.[68] Psychological scientists view themselves as intervening experimentally, and then observing the consequences of this intervention later in time. This is aided by psychology's decidedly linear approach to causation. Temporal sequence is so conflated with causation that the two are often indistinguishable in research. Psychological experimenters have rarely been accused of "making a metaphysics of their method"[69] (as has Newton), but this may be due to psychologists not making explicit their own assumption of time. Without an awareness that linearity is a part of psychology's metaphysic, psychological researchers cannot be accused of confounding this assumption with their method. Yet, their method may incorporate linear time in a way that prohibits any true test of its validity.

Conclusion

It is important, then, that we identify the linear view of time in all its manifestations. Temporal assumptions cannot be discerned with a method that assumes them. Thus, the process of identification has begun in this chapter with a brief cultural and historical analysis. Our cultural analysis finds psychology's metaphysic to be a product of modern Western culture to some degree—likening time to a continuous line that is independent of the events it supposedly measures. Still, it is unlikely that psychology would have adopted this belief without reputable scientists also endorsing it—hence, the significance of Isaac Newton. Newton, to his credit, made his conception of time explicit. However, there is no indication that early psychologists (particularly those pressing for natural science methods) did likewise. Instead, methods and modes of explanation were adopted that implicitly contained Newtonian temporal assumptions.

Five of those implicit assumptions are delineated. Time is assumed to be *objective*, independent of psychological processes. Time is considered to be *linear*, with the past as primal and the other two time dimensions as following in consistent sequence. Time is also *continuous*. Because all events occur along the medium of a line-like entity, the world takes place in a uniform and smooth manner, ruling out precipitous jumps or cataclysmic changes. Such continuity allows for ultimate predictability and *universality*. Any lawful empirical process can be counted on to retain its original temporal relationship because the passage of time does not alter its quality. The only potential drawback is a lack of direct access to the process as a whole. Only *reduced* pieces are observable as they present themselves across our only portal to the world—the present.

It should not be surprising to find that all five characteristics of Newton's temporal framework are endemic to psychological explanation. Indeed, these five characteristics have served historically as an important guide to scientific explanation in general. Nonetheless, it would be inaccurate to assume that these characteristics have permeated *all* aspects of explanation. As described, modern physics has all but abandoned many of these characteristics. In psychology too, many intriguing anomalies to the linear paradigm have arisen in various subfields. The problem is that some psychological explanations have been considered to be linear when they were actually not, whereas other explanations have been thought to be nonlinear when they were really linear. It is therefore important to examine these "anomalies" to the linear paradigm of psychology. This is accomplished by reviewing the major temporal assertions of several psychological subfields in the next seven chapters.