Realism, Instrumentalism, and Scientific Symbiosis

Psychological Theory as a Search for Truth and the Discovery of Solutions

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Scientific realism holds that scientific theories are approximations of universal truths about reality, whereas scientific instrumentalism posits that scientific theories are intellectual structures that provide adequate predictions of what is observed and useful frameworks for answering questions and solving problems in a given domain. These philosophical perspectives have different strengths and weaknesses and have been regarded as incommensurate: Scientific realism fosters theoretical rigor, verifiability, parsimony, and debate, whereas scientific instrumentalism fosters theoretical innovation, synthesis, generativeness, and scope. The authors review the evolution of scientific realism and instrumentalism in psychology and propose that the categorical distinction between the 2 is overstated as a prescription for scientific practice. The authors propose that the iterative deployment of these 2 perspectives, just as the iterative application of inductive and deductive reasoning in science, may promote more rigorous, integrative, cumulative, and useful scientific theories.

Science, as traditionally conceived, is like interrogating the Greek mythological sea demon, Proteus. Poseidon commissioned him with the minor duty of protecting the seals of the oceans. More pertinent to the subject of our article is a quality Proteus possessed. He was omniscient in matters to do with the seas and could also modify his appearance to anything he wished, any animal, any plant, and even fire. Although elusive in his various appearances, it was possible with judicious interrogation and particularly with the aid of his daughter to extract the truth from him.

A distinction made in the philosophy of science is whether theorists seek to discover truths or to create targeted frameworks that provide adequate prediction for some domain of phenomena and help to solve problems regarding that limited domain. The characterization of science as being like Proteus casts the goal of scientific theories as being to describe the world as it really is, independently of human expectations, perceptions, and measurements. Our aim here is to examine the development of scientific realism and instrumentalism in psychology and the implications of each for how we think about, formulate, and evaluate psychological theory.

Scientists are, by and large, a practical lot, and it is sensible that readers might ask why any of this matters. Given numerous demands, it is understandable why scientists might adopt measures or methods without thinking exhaustively about the underlying assumptions of these operationalizations or how they fit within a broader set. Such constraints are the stuff of which apocryphal stories are fashioned by philosophers of science. More than 60 years ago, Eddington (1939), in his book *A Philosophy of the Physical Sciences*, told the story of a hypothetical scientist who sought to study the fish in the seas. The scientist wove a two-inch mesh net and commissioned a ship on which to sail the seas. Once on the high seas, this individual sailed to various sites, lowered the nets, hauled in a catch, measured and cataloged each fish, returned the catch to the deep, folded the nets, and sailed to another site to repeat the procedure. After several years of investigation, the scientist returned to announce there were no fish smaller than two inches in the seas. Taking the time to discuss the measures and methods we use, the underlying assumptions, their strengths and limitations, and the theoretical implications of these operationalizations may pay dividends in the long term in science.

If the time scientists characteristically take to consider broadly what their measures mean is the equivalent of a brief gaze, the time taken by many to think about even more abstract philosophical issues such as scientific realism and instrumentalism may be the equivalent of a blink. Scientists tend to inherit rather than select these perspectives. This was certainly true of ourselves. But an inherited

Editor's note. Arie Kruglanski served as action editor for this article.

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This research was supported by National Institute of Aging Grant PO1 AG18911. We thank Claudia Wassman, Marilynn Brewer, E. Tory Higgins, Penny Visser, and Cindy Pickett.

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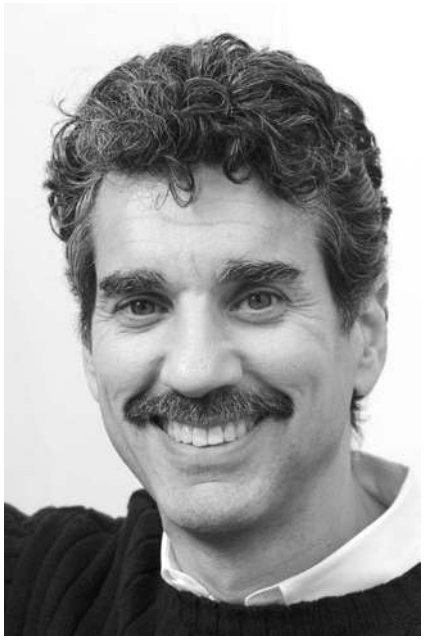
Vol. 59, No. 4, 214–223 DOI: 10.1037/0003-066X.59.4.214



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scientific perspective, like an inherited telescope, can best be appreciated for what it does and does not bring into focus when placed within the context of what other perspectives also reveal.

In the present article, therefore, we review the ontological perspectives of scientific realism and instrumentalism, noting some of the strengths and weaknesses of each. We suggest further that the success of calls in recent years for the reunification of psychology (e.g., Sternberg, 2003) and for multilevel integrative theory and research (Kessel, Rosenfeld, & Anderson, 2003) may be enhanced by capitalizing on the strengths of both ontological perspectives rather than a return to the hegemony of a single perspective.

The Emergence of Scientific Realism and Instrumentalism in Psychology

The scientific method, covered in nearly every introductory psychology textbook and preached in psychological methods courses, consists of observation and description of specific aspects of phenomenon or group of phenomena (e.g., processes, behaviors) in terms of a general model or theory, the formulation of a hypothesis to predict the existence of other phenomena or to predict quantitatively the results of new observations (e.g., a causal or mathematical relation), the performance of experimental study or systematic observation and statistical analyses to rest the predictions, and the interpretation of empirical results to confirm, reject, or revise the theory (see Figure 1). Theory is an abstraction that resides in the conceptual domain, whereas scientific operationalizations, experiments, and data are concrete and exist in the empirical domain. The scientific method relies on both deduction and induction, each in turn, to develop comprehensive scientific accounts of phenomena. Within the conceptual domain, two philosophical approaches have influenced mainstream psychological theory: scientific realism and scientific instrumentalism.

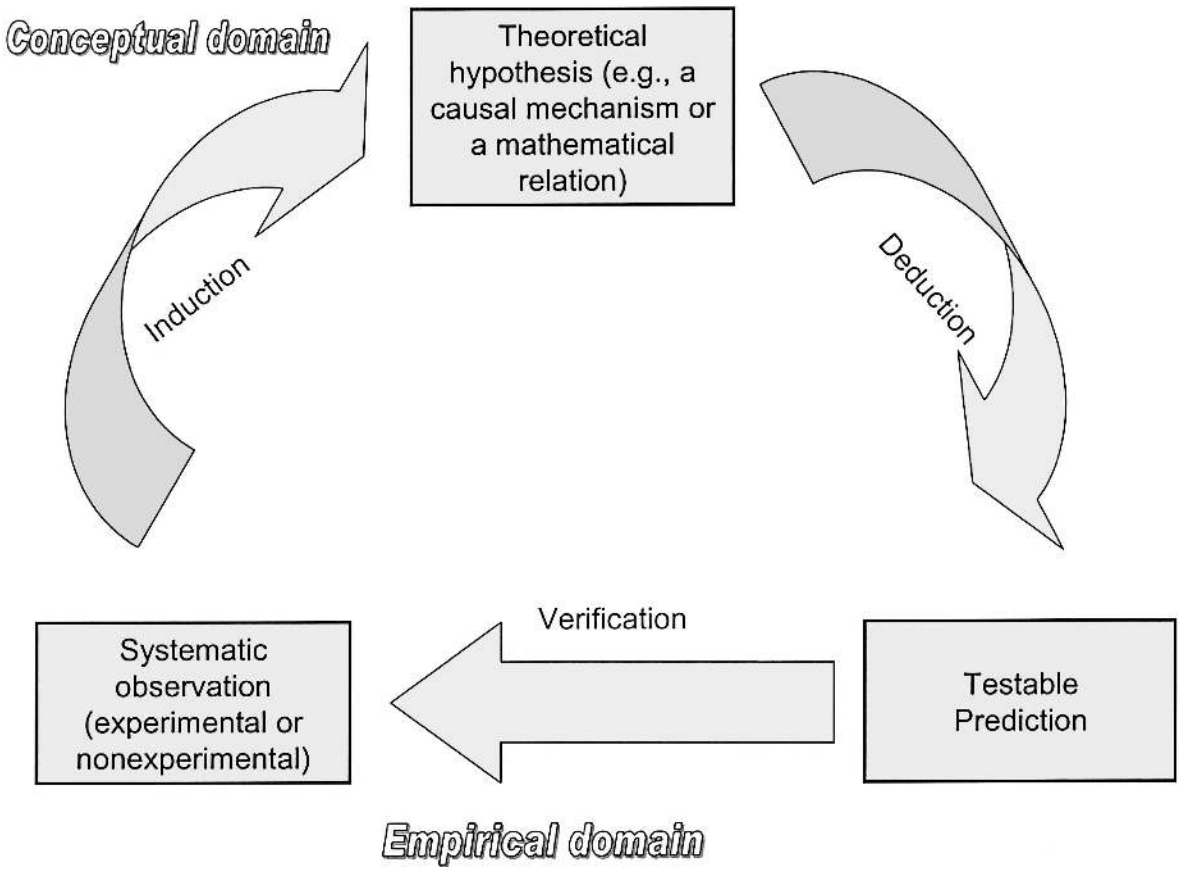
Scientific Realism

Scientific realism holds that scientific theories go beyond data to posit the existence of nonobservable entities—such as quarks, mental representations, and social cognition—which actually exist (Thagard, 2002). According to scientific realists, the product of successful scientific research is knowledge that is independent of theory or methodology (although theories may still be useful devices to organize this knowledge). Psychological theories grounded in the philosophy of realism attempt to describe the world as it really is—independent of human theories, perceptions, or measurements—and to establish what actually exists in it. The depiction of science as akin to mythical Proteus falls squarely within the camp of scientific realism.

Positivism, a form of scientific realism that impacted psychology for decades, was described initially by Auguste Comte, who argued that humankind has seen three major phases in its search for understanding: the theological phase involving a search for God and spirituality, the metaphysical phase involving the search for philosophical truths, and the scientific phase involving the search for facts (Lenzer, 1975). Comte characterized the latter as a search for positive truths that came from the collection of facts and the application of logic independently of human perceptions and conceptions. Positivism further posited that there were no ultimate differences among the sciences and that the same methods for studying truths about physics or chemistry applied to psychology.

Early theoreticians in psychology adopted the position of scientific realism in part because of the laudable goal of building legitimate scientific theories of psychological phenomena by emulating what they thought physical scientists did (e.g., Watson, 1913; Wundt, 1909/1912). Scientific realism received additional impetus in psychology when a group of philosophers known as the Vienna Circle adopted positivism (or what came to be termed *logical positivism*) in the 1920s as the formula to follow if psychology were to become an acceptable science (see Ayer, 1936; Bergmann, 1957). In logical positivism, a statement can be true only if it is a self-evident analytical, deductive truth as is found in mathematics and formal logic or if the statement describes reality precisely. Thus, the statements "Operant performance established by higher reinforcement-ratio schedules extinguishes more rapidly than those established by lower ratio schedules" and "The hippocampus plays a crucial role in spatial learning" are meaningful theoretical statements because we can measure the stimuli and responses and test the proposed relation between them, whereas statements such as "Happiness is a measure of national well-being" and "Stress leads to allostatic load" were thought not to be meaningful because the concepts are vague and therefore difficult to verify. Positivism represented fertile ground for the growth of behaviorism, which argued that a science of psychology should focus only on that which could be observed because only phenomena that could be observed

Figure 1
The Scientific Method and the Cyclic Application of Induction and Deduction



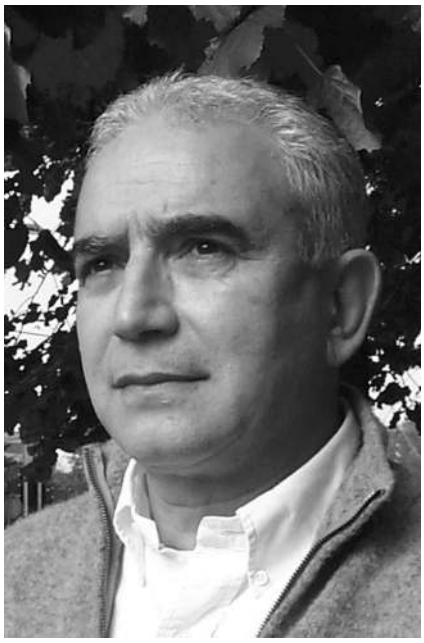
could be measured objectively and reliably (Watson, 1913). Movements were viewed as appropriate subject matter for theories in psychology, but feelings and mentation were not.

Given this backdrop, it became fashionable in early psychology to emulate theory construction in the physical sciences by modeling the structure and form of their formulations after the certainties and invariants of Newtonian physics. In his highly influential *Handbook of Experimental Psychology*, for instance, Stevens (1951) advised

> The scientist is usually looking for invariance whether he knows it or not. Whenever he discovers a functional relation between two variables his next question follows naturally: under what conditions does it hold? The quest for invariant relations is essentially the aspiration for generality, and in psychology, as in physics, the principles that have wide application are those we prize. (p. 20)

Despite the early belief that the realist's approach characterized the physical sciences, whether theory and practice in physics are entirely compatible with the doctrine of scientific realism has been debated for quite some time. For example, gas has long been conceived as a discontinuous medium when explaining thermal behavior but as a continuous medium when explaining acoustic behavior. Because nothing can be both continuous and discontinuous, at least one of these characterizations must be false (Chalmers, 1999). As a second example, Newtonian physics offers a parsimonious account of the behavior of gross physical phenomena, but quantum mechanics is a more comprehensive theory because it also explains the behavior of nuclei, atoms, molecules, and matter in the solid state. This is because the kind of certainty seen in Newtonian mechanics is not possible in quantum phenomena: The initial state of a particle cannot be established with sufficient accuracy, and the more that is known about its position now, the less is known about its momentum and hence its position later (Beiser, 2003). The quantities explored in quantum mechanics, like those in psychology, are probabilities, not certainties. Yet Newtonian mechanics continues to be used in some areas of physics.

Scientific realism, through the work of the logical positivists, nevertheless has a number of strengths that led to advances in psychological theory and method. First, it contributed to the content of theory in psychology being reducible to the truths of logic and mathematics coupled



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with propositions referring to sense experience—that is, to the notion that psychological theory should be subjected to empirical verification.

Second, scientific realists (e.g., Hacking, 1983) argued that theoretical statements about phenomena one cannot observe by traditional empirical standards can be rendered observable by extending the range of our senses through the use of new instruments and procedures whose justification is theory dependent. Thus, scientific realism underscored the importance of the development of new methods for psychological theory: As knowledge of unobservable psychological phenomena (initially theoretical constructs) and instrumental design improves, it becomes possible to detect and measure psychological phenomena previously beyond the reach of reliable detection and measurement.

Third, scientific realism emphasized the importance of a priori hypotheses, preferably embedded within a broader theoretical formulation, to guide empirical observation (McGuire, 1973, 1999). Fourth, realism emphasized that the purpose of empiricism in psychological theory was to test whether the knowledge representation is true. When multiple explanations for a phenomenon existed, scientific realism maintained that at most only one of the conflicting hypotheses and theories could be true. Accordingly, scientific realism promotes theoretical specification, differentiation, warfare, and parsimony.

Fifth, scientific realists, in response to criticisms of underdetermination, expanded the notion that the explanatory power of a theory is defined by its predictive power. A theory among a set of theories that makes the same empirical predictions may be preferred because it explains observable phenomena better than others—where better one might mean generativeness and scope. Thus, a theory that produced a novel prediction is to be preferred over one developed later to account for the observation.

Finally, the realist approach encourages paradigmatic development that may be unique to adherents who are deeply committed to the truth of their guiding formulation. Behaviorism in American psychology was certainly characterized by deeply committed adherents who pushed the boundaries of their guiding theories beyond what less committed adherents would have achieved.

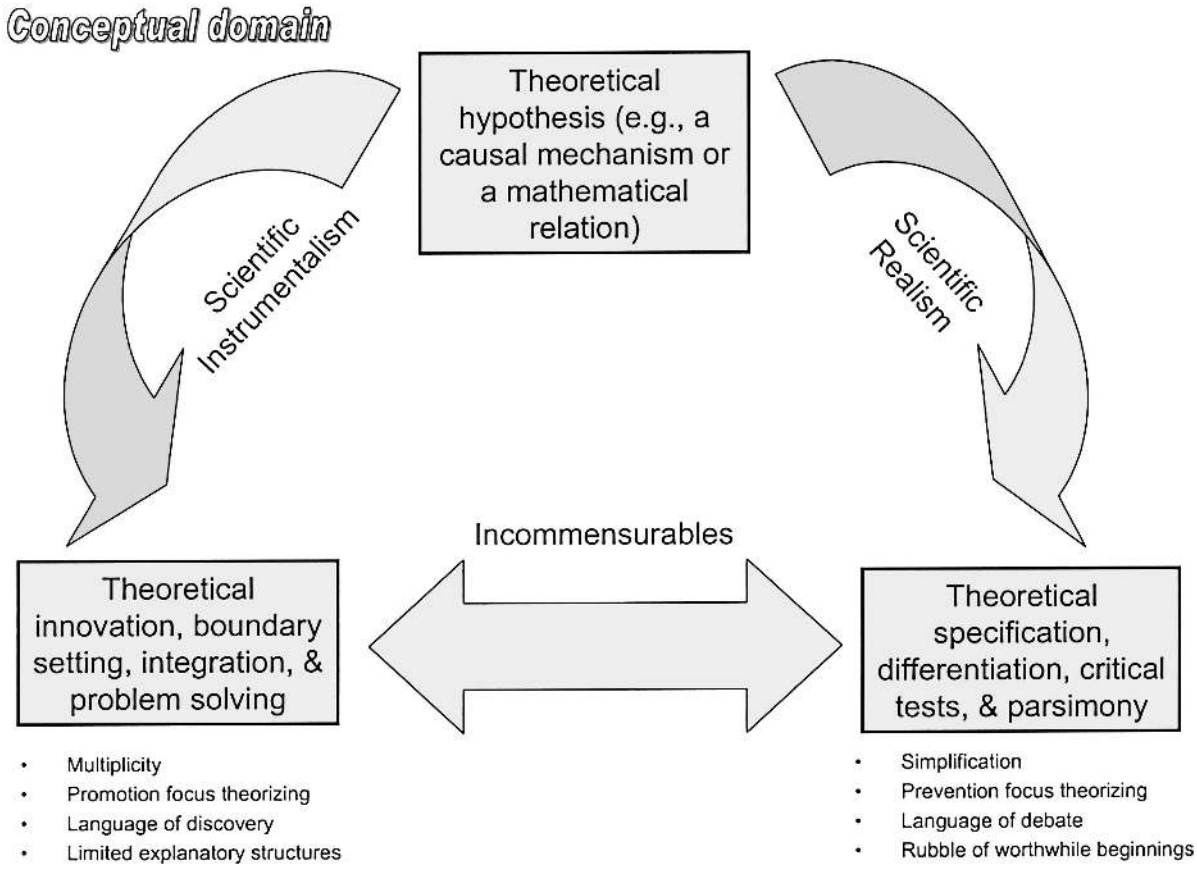
Scientific realism also has its downside, of course. Scientific realism can be characterized as outcome driven in that it seeks to arrive at a conception that the theorist regards as the truth; once discovered, this truth/outcome is defended against all competitors. The disadvantage is that it can impede progress and encourage defensiveness of and commitment to a theory well beyond its utility. That is, theoretical battles not only may eliminate the chaff in a scientific field, they may also savage worthwhile formulations that are less developed, more innovative, less vigorously promoted, or maintained by scientists with less political clout. As a result, realism can leave in its wake the ruins of worthwhile beginnings and the lost utility of theories that have fallen out of fashion. Newtonian mechanics remains a vital theory, because it remains a useful approximation of gross phenomena in its domain, and a similar defense has been offered for rational choice theory in economics in the behavioral domain. If scientific realism does not constitute a strong philosophical basis for such theorizing, what might?

Scientific Instrumentalism

We began by noting that psychological science as conceived in the 20th century is like interrogating the sea demon, Proteus, in an effort to discover the truth. The perspective of scientific instrumentalism holds that the judicious interrogation of Proteus would be valuable even were the sea demon not to know truth but only knowledge that would help solve the problems of his interrogators. According to scientific instrumentalism, the aim of scientific theories is not to discover truth but rather to produce intellectual structures that provide adequate predictions of what is observed and useful frameworks for answering questions and solving problems in a given domain (Thagard, 2002; Van Fraassen, 2002). From this philosophical perspective, scientific theory represents convenient intellectual structures for predicting or describing in more abstract terms observable data, not actual structures in the world. In the view of instrumentalists, rational choice theory in economics, arousal theory in psychology, and Newtonian mechanics in physics each represents an important theoretical structure because they continue to provide a simple explanation for dealing with gross phenomena in its domain even though none is sufficient alone to explain what we now know about behavior in these domains.

Whereas the perspective of scientific realism fosters theoretical specification, empiricism, verification, discrimination, and warfare between competing theories, the perspective of scientific instrumentalism promotes open-mindedness, creativity, integration, consilience, and problem solving (see Figure 2). This distinction is evident in the languages of science, which Wegner (2003) characterized

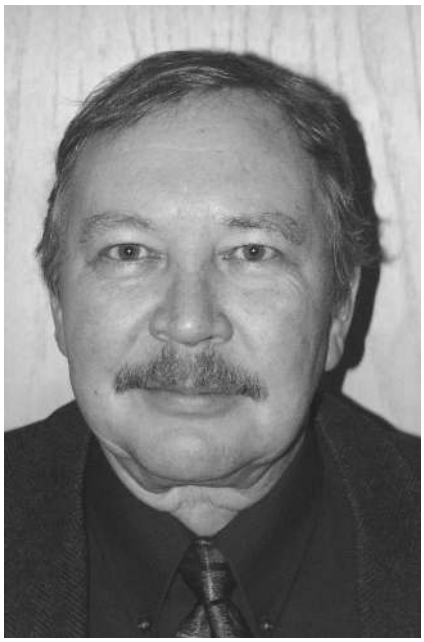
Figure 2
The Contrasting Perspectives of Scientific Realism and Instrumentalism



as debate ("Victory!") or discovery ("Eureka!"). If the realist could be characterized as debater, warrior, and outcome driven (i.e., the search for and battles over universal truths), the instrumentalist could be characterized as diplomat, discoverer, and process driven (i.e., the search for locally useful intellectual structures).

The perspective of scientific instrumentalism in psychology owes much to the writings of Popper (1959), originally a member of the Vienna Circle, who grew to question some of the assumptions of logical positivism and emerged as one of its earliest critics. Popper argued that scientific discovery should proceed in four stages: the formal stage (theory checked for internal consistency), the semiformal stage (propositions with empirical consequences are separated from those that are not), the comparison stage (the theory is compared with extant theories that seek to explain the same phenomena, and any that do not expand on the explanatory power of the extant theories should be abandoned), and the empirical testing stage (all else equal, hypotheses least likely to be true should be tested, as these are the most likely to reveal theoretical flaws and foster theoretical advancement). Although not a scientific instrumentalist, Popper reasoned that the emphasis on verifiability in logical positivism produced a confirmatory bias in theory construction and testing. Popper argued that evidence consistent with a theory did not provide much scientific support because most theories are constructed by bringing together known cases and deriving generalizations that cover them. Evidence consistent with a theory should therefore be easy to find by simply seeking more of the same. There was little incentive in positivism to test novel predictions or bold conjectures, he reasoned. Positivism in essence fostered a prevention over a promotion focus in scientific theories, with the effect being that theoretical innovation and generativeness were suppressed.

The evolution of cognitive dissonance theory, first proposed by Festinger (1957), illustrates both the importance Popper (1959) placed on bold conjectures in science and the resistance by adherents of a theory to abandon it even when disconfirmed. Cognitive dissonance theory was fueled during the 1960s and 1970s by a family of nonobvious predictions (bold conjectures) that were derived and confirmed. Among these predictions were that low monetary incentives to perform a counterattitudinal behavior are



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more persuasive than are high incentives (Festinger & Carlsmith, 1959), mild threats produce greater devaluations of the forbidden object or activity than severe threats (Aronson & Carlsmith, 1963), high effort produces more liking of what it is that one worked to achieve than low effort (Aronson & Mills, 1959), and low credible sources produce greater agreement than high credible sources (Cooper, Darley, & Henderson, 1974). Greenwald and colleagues (e.g., Greenwald, 1975; Greenwald, Pratkanis, Leippe, & Baumgardner, 1986), however, have also argued that dissonance theorists refused to abandon cognitive dissonance theory even after fundamental predictions were falsified. They noted instead that auxiliary hypotheses—such as an attitude-discrepant behavior inducing cognitive dissonance only if the actor was personally responsible for the behavior and the consequences of the behavior were negative and foreseeable—were proposed that insulated the original theory from falsification.

This history is not unique to research on behaviorism, cognitive dissonance, or even psychology. Kuhn (1970; see also Hanson, 1958) criticized the notion that scientists were imaginative, skeptical, and pioneering, arguing instead that most scientists are hesitant to depart from the security of a shared understanding of a phenomenon and prior agreements on the appropriate methods for its study. It is only when sufficient empirical anomalies accrue that a new and radically different paradigm is likely to develop. Kuhn further reasoned that the old paradigm is never shown to be wrong but interest in it simply dwindles over time as fewer and fewer experiments are conducted within its frame of reference. Perceptual approaches to attitude theories such as variable perspective theory (Ostrom & Upshaw, 1968) and social judgment theory (Sherif, Sherif, & Nebergall, 1965), for instance, are rarely seen in the contemporary literature even though they continue to reveal new and interesting effects (Cacioppo, Andersen, Turnquist, & Tassinary, 1989; Epley & Gilovich, 2001; Fazio, Zanna, & Cooper, 1977). Finally, Kuhn suggested that the meaning of a psychological theory is intimately intertwined with the overarching paradigm in which it is developed.

Many of the notions Kuhn (1970) discussed are evident in the recent emergence of cognitive and social neurosciences. One of the pioneers of cognitive neuroscience, Kosslyn (1999), suggested that brain imaging is particularly helpful when it is used to address one of two broad classes of questions—How are information-processing systems implemented in neural tissue? and When are specific types of information processing used? Questions of the former type include (a) Which areas implement systems that confer specific functions? (b) Which areas implement "simple systems" (linked operations)? (c) What operation is performed by a specific brain area? (d) Which are the properties of structures that underlie a particular ability? and (e) Is there more than one way in which a function can be performed? whereas questions about when specific types of information processing are used include (a) What processes can be inferred from the presence of activation? (b) Do variations in activation predict performance? (c) How does processing change with practice? (d) How does processing change with context? and (e) How does processing depend on the goal and the prior sequence of processing? As these questions suggest, the development of brain-imaging techniques has made it possible to develop and test psychological theories based on what is known about the structure, properties, and operations of specific brain regions and systems of brain regions. What is known about the structure, properties, and operations of specific brain regions, in turn, is changing as research and theories in the field unfold.

Kosslyn's (1999) critique, as is evident from the preceding list of questions, also underscores the notion that there is no general methodological procedure that is best for understanding all psychological phenomena. This notion is an explicit feature of Feyerabend's (1975) philosophy for constructing or evaluating scientific theories. Feyerabend began his career as a scientific realist but over time rejected this perspective in favor of a form of instrumentalism he called relativism, which emphasized the value of constructing as many theories as possible about the same phenomenon (theoretical pluralism). He further argued that rather than comparing theories as Popper (1959) had advocated, theoreticians should recognize that all forms of theories are worthwhile and the key is to evaluate the relative informativeness of each theory. Thus, Feyerabend's philosophy for constructing or evaluating theories in psychology not only held that there is no general methodological procedure for all science but also that scientific theories and methods provide useful ways of thinking about phenomena, not revelations of truths. During the drive-versus-incentive wars in the middle of the 20th century, Bolles (1967) emphasized in his influential volume *Theory of Motivation* that contrasting drive and incentive theories may not be the best strategy. Rather, he suggested that

drive and incentive theories merely represent alternative conceptual frameworks for viewing motivated behavior, and their ultimate utility is dependent on which perspective is shown to be more useful. The demise of drive theories and the modern incantation of incentive theories relate to the greater facility of the latter to relate to cognitive constructs such as attention.

Given the fundamental claim of logical positivism that science is the search for truths, reviewers might hold that they are justified in criticizing a grant proposal or psychological formulation for not adopting a preferred level of analysis, methodology, or theoretical approach. Feyerabend's (1975) philosophical perspective explicitly challenged this scientific practice and demanded instead that one think about each theory or approach in its own terms. This does not mean that anything goes or that there are no criteria by which one can evaluate psychological theory. Both scientific realists and instrumentalists characterize science as an organized, systematic interrogation with the aid of diverse means to gather knowledge about the world and the compression of this knowledge through abstraction into testable hypotheses. A general scientific hypothesis that has a body of empirical support constitutes a scientific law, and a logically closely interconnected set of scientific laws constitutes a scientific theory.

McGuire (McGuire 1973, 1999) also recognized logical positivism initially advanced psychological theory and methods but criticized its influence in contemporary psychological theory and research practice. He proposed what he termed *perspectivism*, a formulation that follows Feyerabend's (1975) arguments for scientific instrumentalism. McGuire (1983, 1999) argued that empiricism should be the basis of psychological methods and theory but disagreed that the purpose of such empiricism is to test whether a hypothesis and its theoretical explanation are "true." McGuire (1983, 1999) instead emphasized the generative features of psychological theory and emphasized the creation of new knowledge by revealing the pattern of contexts in which the hypothesis receives support and why. The approaches articulated by Feyerabend and by McGuire (1983, 1999) imply that what might appear to be an invariant principle or relationship in psychology, as in the physical sciences (e.g., gas as a continuous vs. discontinuous medium), may be valid only within a limited range or specifiable contexts. Such formulations can nevertheless serve as a valuable explanatory structure if its range of validity is specified. The simple identity (force = mass $\times$ acceleration) describes a relationship that is invariant in the macroworld but not in the microworld of physics (Beiser, 2003). According to perspectivism, the quest for universals or invariant functional relations in psychology should not obfuscate the possibility that a functional relationship between variables may not generalize across all domains. It would be perfectly acceptable and useful to a scientific instrumentalist if a psychological theory predicted what is observed within specific empirical domains but not within others.

Further, according to scientific instrumentalists, the recognition that theories may have limited ranges of validity could minimize futile theoretical extensions or rejections. A historical example can be found in Lindsley's (1952) theory of arousal. Lindsley proposed arousal as a neurobehavioral construct with many of the predicted cognitive and behavioral effects that can now be found in arousal-based psychological theories (see review by Cacioppo, Berntson, & Crites, 1996). Lindsley's theory, however, was built on the large differences he observed in electroencephalography (EEG) frequency across the behavioral states of death, coma, deep sleep, light sleep, drowsiness, relaxed wakefulness, alert attentiveness, and excited emotion. EEG activation is indeed zero in death, low frequency in coma, somewhat higher frequency in sleep, and so forth. That is, Lindsley's theory is valid within this broad behavioral context. The phenomena that psychological theories address, however, do not tend to appear in many of these behavioral states (e.g., death, coma), and the functional relation between cognition/behavior and EEG activity that was observed by Lindsley evaporates when the behavioral range is restricted to those in which one tends to find waking cognition and behavior. Misapplications of arousal in psychological theories (see Lacey, 1967) might have been avoided had the notion that Lindsley's arousal theory might have a limited range of application been recognized.

Finally, the instrumentalist's argument is that the recognition that psychological theories may have limited ranges of validity may promote comprehensive formulations. Decades of empirical research that attempted to pit Festinger's (1957) cognitive dissonance theory against Bem's (1972) self-perception theory produced a voluminous literature with no theoretical resolution (Greenwald, 1975). Fazio et al.'s (1977) resolution of this dispute was achieved by identifying unique empirical domains in which each made accurate predictions and a moderator variable that determined when cognitive dissonance processes operated and when self-perception processes operated. As noted above, however, scientific instrumentalism can lead to epistemological anarchy and has significant disadvantages.

The Need for an Integrative Approach in Psychological Theory

No longer simply a collection of independent subspecialties based on historical distinctions, psychology in the 21st century represents a multidisciplinary science. The emergent property of the human mind can be thought of as the magic of the symphony, with the biological substrates analogous to musical instruments, the information-processing operations analogous to the musical score, and the orchestration of these production components and the modulation by the social context as analogous to the conductor and musicians and the influences of the symphony hall itself. The *neurosciences dimension* in psychology is concerned with biological substrates, the *cognitive sciences dimension* with information processing elements and operations, and the *social sciences dimension* with the orchestration of the selection and activation of these elements and their modulation by the social context.

The mind is also a moving target, underscoring the importance of two additional cross-cutting dimensions. Early in life, growth trajectories and critical developmental stages provide an opportunity to examine the human mind as it is being built. Later in life, the deterioration of substrates, operations, and orchestrations provides a glimpse of the role each play in the human mind. For an unfortunate few, accidents and disease at random moments in life compromise substrates, operations, and orchestrations—providing invaluable converging information on the role of specific elements in the human mind. The first of these dimensions—the study of the nature and influence of changes in substrates, operations, and orchestrations over the lifespan—represents a *developmental sciences dimension*, and the second of these dimensions—the investigation of the causes and consequences of failures in substrates, operations, and orchestrations—represents a *clinical sciences dimension*.

Although the in-depth study of instruments, scores, and conductors, their changes over time, and the cause and consequences of failures of each is essential, one cannot achieve a comprehensive understanding of the symphony by study of any single element alone. None holds the truth of the symphony. Reductionism, or the breaking apart of nature into its natural constituents, is a proven approach in scientific inquiry. Reductionism is not substitutionism, however (Berntson & Cacioppo, in press; see also Kruglanski, in press). Reductionism provides points of entry into complex systems, with the reason for such an entry being not simply to describe the parts but to develop a better intellectual model of the complex system:

> Complexity is what interests scientists in the end, not simplicity. Reductionism is the way to understand it . . . but dissection and analysis are not all that scientists do. Also crucial are synthesis and integration, tempered by philosophical reflection on significance and value. (Wilson, 1998, p. 54)

Thus, understanding the symphony, as well as the precise role of each element in the production of the magic of the symphony, is fostered by study of these elements in isolation, in various combinations, and as a whole.

Psychological theory in the 21st century is facing a similar challenge, with neither scientific realism nor instrumentalism ideally suited to this task. As noted above, the strengths of the realist's approach is theoretical specification, empiricism, verification, discrimination, parsimony, and rigor, whereas its weaknesses are the zero-sum mentality about theory (which include confirmatory biases), defensiveness, and oversimplification. The perspective of scientific instrumentalism, in contrast, promotes creativity, discovery, integration, scope, consilience, and problem solving, but at the expense of contest, precision, parsimony, and rigor.

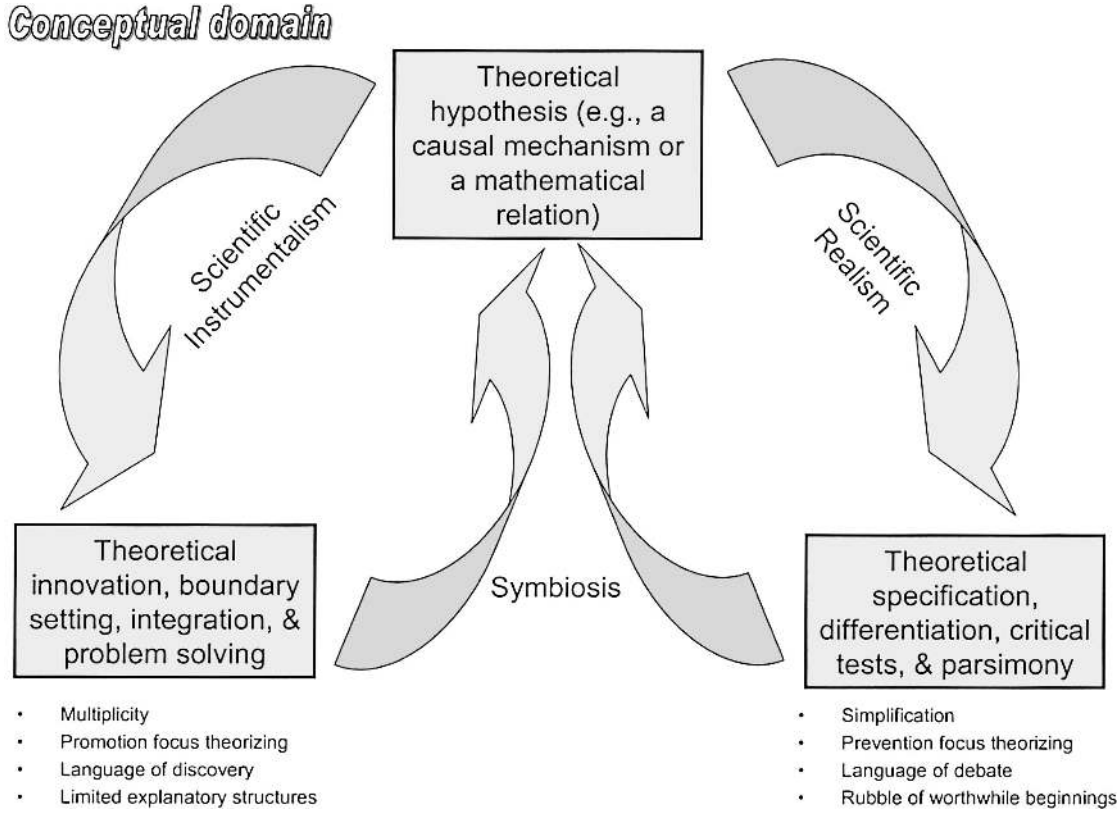
Scientific Symbiosis

Scientific realism and instrumentalism represent such different approaches to scientific theory that they have been viewed as incommensurable perspectives. The categorical distinction between scientific realism and instrumentalism may be overstated as a prescription for scientific practice, however. An important implication of this review is that post hoc concepts, local microtheories, and pragmatic organizational schema will necessarily have an instrumental quality to them. We would suggest, however, that the ultimate goal should be to approach or approximate scientific realism. Some may suggest that neither is likely or even possible. But the instrumental quality of what could be called local science can be mitigated by expanding the generality, enriching the supporting empirical database, modifying the theory to accommodate new or contradictory findings, and confirming bold predictions. Of particular importance in this regard is the linking of concepts to other domains or disciplines—which have their own representations of putative reality. To the extent that such elaborated theories, representing multiple levels of organization and analysis, cohere with physiology, anatomy, sociology, and so forth, there is an increasing probability that it is pointing to some set of phenomena that have a lawful relation to reality and that have generality beyond a local instrumental perspective. We may never really achieve a true scientific realism, but the pursuit confers great benefits on an instrumental approach, from the standpoint of generality, integration with other sciences, and the emphasis on the empirical rather than sociopolitical aspects of the scientific enterprise as the judge of theoretical and methodological merit. In this way, psychologists might recognize the issues with and limitations of scientific realism without falling victim to a shallow instrumentalism.

Our proposal, therefore, is quite simple. Although philosophers may debate whether scientific realism or instrumentalism is best, as a practical lot scientists need not decide between the two but rather can capitalize on the strengths of each by adopting each perspective in an iterative fashion, to guide theory and research. In the scientific method (Figure 1), the apparently incommensurable processes of induction and deduction reflect this iterative process. Within the conceptual domain of psychological theory, we propose that theorists should adopt the approach of a scientific realist and a scientific instrumentalist in an iterative, integrative fashion to guide theory and research (see Figure 3). In the construction and testing of psychological theory, there is a role for the warrior and for the diplomat, for the debater and for the discoverer, because these combined forces have the potential to enrich psychological theory and problem solving.

The tension between and iterative deployment of the perspectives of scientific realism and instrumentalism may be as integral to a useful, adaptable, integrative, and cumulative theory in psychology as is the tension between the iteratively deployed processes of deduction and induction. In the proposed scientific symbiotic perspective, levels of analysis, paradigms, and theories no longer represent imperialistic empires but individual members of a community who are accorded station based on the specialized expertise, abilities, and problem-solving capacities they bring to the community of science. Those members who are prosaic, redundant, or illegitimate fall to the rigors of parsimony, whereas those who are limited, quirky, but useful

Figure 3
Scientific Symbiosis: The Cyclic Application of Scientific Realism and Instrumentalism in the Development, Evaluation, Refinement, and Synthesis of Psychological Theories



are accorded a place in the community. Viewed from this perspective, psychologists may have as important a role to play in creating public policy (i.e., helping to solve societal problems with local theories) as economists, sociologists, and political scientists, especially if psychological theories and their implications for public policy are evaluated in terms of their explanatory and problem-solving power in the face of public needs rather than in terms of their truth or falsity.

Conclusion

Scientific realism and instrumentalism have incommensurable epistemological features, prescriptions for scientific practice, and methodological implications. Although it may not be sensible to view a psychological phenomenon, theory, or method from both perspectives simultaneously, we have suggested it is possible and productive to view them from each perspective in an iterative and ongoing fashion, not unlike the practice with inductive and deductive reasoning in psychological theory and research. Specifically, the world view and language of scientific realism and instrumentalism are incompatible, but it may be useful for the psychological scientist to become "bilingual and bicultural." The advantage that this bestows is that one may apply the strength of each perspective while continually checking for its weaknesses and limitations in one's theory and research. Thus, incommensurability is often considered an insurmountable problem in terms of strict adherence to the one or other team's game rules (rules of science). But if illuminating a phenomenon (whether a process or an outcome) from diverse angles becomes the goal (as in the classic example of gas being treated as a discontinuous medium when explaining thermal behavior but as a continuous medium when explaining acoustic behavior), then one does not have to take sides, as long as one masters the languages of both, because each perspective yields an insight converging on a better theoretical understanding and empirical study of the phenomenon.

In sum, the dichotomy between scientific realism and instrumentalism should be assigned to history, and the respective merits of each concept should be reevaluated with regard to the implications of each for how we think about, formulate, and evaluate psychological theory. The perspective of scientific symbiosis offers an alternative. Replacing the old dichotomy between scientific realism and instrumentalism with a multiangled perspective may also

provide guidance for and promotion of the role of psychology in the formulation of public policy.

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