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Under What Conditions Can Theoretical Psychology Survive and Prosper? Integrating the Rational and Empirical Epistemologies

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This article reexamines some important issues raised by Greenwald, Pratkanis, Leippe, and Baumgardner (1986) concerning the nature of theory and its role in research progress, practical applications of psychological knowledge, strategies for developing and evaluating theories, and relations between empirical and theoretical psychology. I argue that Greenwald et al.'s result-centered methods will not solve problems such as confirmation bias and irreplicability and will aggravate other existing problems: lack of viable theory, fragmentation of the field, mechanical fact gathering, limited applicability of psychological knowledge, and noncumulative development of facts, with needless duplication of results and reinvention of empirical constructs. I conclude that all of these problems are best solved by establishing a balance between the "rational" and "empirical" epistemologies in psychology.

We are currently witnessing an upsurge of interest in theoretical psychology (see e.g., Hyland, 1981), and detailed and fundamental theories are under construction, especially in cognitive psychology, currently one of the most advanced areas of psychological theorizing (Mandler, 1985; Royce, 1978). Royce (1984) has complained, however, that in general, "psychological theories do not mesh well with the relevant data. . . . Psychology's history in this regard reveals a pattern of extreme pendulum swings between observation and theory—that is, between the empirical and rational epistemologies, with only the occasional investigator attempting to bring the two together." (pp. ix–xi).

The rational and empirical epistemologies are complementary frameworks for the pursuit of scientific understanding with important implications for the future course of psychology. The present article shows how these frameworks apply to issues raised by Greenwald, Pratkanis, Leippe, and Baumgardner (1986), henceforth GPL&B. My goal is not to criticize GPL&B but to point out some limitations of the largely empirical epistemology within which psychology and GPL&B have implicitly been operating.

General Approaches of the Two Epistemologies

The approach of the empirical epistemology is to develop a body of reliable facts and real world applications, whereas the approach of the rational epistemology is to develop theories that explain available facts, facilitate practical applications, and predict new facts for future test. This "surface definition" of approaches is deceptive, however, because of hidden differences in how the two epistemologies interpret seemingly straightforward concepts such as "practical application," "fact," and "theory."

Facts Under the Two Epistemologies

Under the empirical epistemology, facts are interesting in and of themselves, whereas under the rational epistemology, theories determine how interesting a fact is: Findings are especially interesting when they fail to fit a well-established theory, or when they fit a newly proposed theory, and most spectacularly, both. Indeed, observations often do not count as scientific facts until a plausible *theoretical mechanism* for explaining them is proposed. For example, science at large refused to consider the large body of well-known observations on selective breeding as scientific fact until Darwin proposed a plausible theory for explaining these observations. Similarly, extrasensory perception currently falls outside the realm of psychological fact not necessarily because researchers on psychic phenomena are "ego-involved theory advocates" (as GPL&B suggest, p. 222), but because no plausible theoretical mechanism has been proposed for explaining the data that have been reported.

Theory Under the Empirical Epistemology

The empirical epistemology defines theories broadly and always in relation to operations: In GPL&B (p. 217), theories (conceptual statements) contrast with operations (specific procedures for fabricating or measuring events) but are related to operations via an "abstractness" gradient; theories vary from very abstract or removed from specific operations (e.g., "Reward contingent on a response increases the probability of a response," p. 217) to less theoretical (e.g., "Presentation of food to a pigeon after its depression of a key increases the rate of depression of the key," p. 217). The fact that the "highly theoret-

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ical" version of this key example is vague or inaccurate when compared with the "less theoretical" version is curious (surely "probability per unit time" was meant, p. 217), but may stem from the empirical epistemology underlying GPL&B's ideas.

GPL&B's view of theory is open to two criticisms. First, concepts and operations are virtually impossible to separate: Even simple operations such as counting require conceptual classification. As Gaukroger (1978, p. 45) pointed out, "If I am counting the number of things in a room, I must restrict myself to a single system of classification. I cannot include a chair, wood, legs, molecules, and oblong shapes in the same total." Even GPL&B's first and repeatedly discussed example of confirmation bias (the experimental findings of Bruner & Potter, 1964, where subjects guess at the nature of objects represented in badly focused pictures) illustrates this inseparability of concepts and operations. Here the "theory" in GPL&B's "theory-predicted bias" (p. 216) refers to misleading verbal instructions provided by an experimenter as to what the blurred picture represents. Because experimental instructions surely fall at the operational end of GPL&B's hypothesized continuum, the cutoff point for use of the term *theory* is at best unclear.

An even stronger criticism is that GPL&B used the term *theory* so imprecisely as to present a real danger of throwing out the baby with the bathwater. Ambiguities in use of the word *theory* are not new (see Underwood, 1957, pp. 175–180), but as GPL&B (p. 217) pointed out, we should choose our terms so as to minimize confusion wherever possible. The remainder of the present article therefore adopts the more specific terms *empirical generalization, hypothesis, unique observation, guiding idea, opinion, theory,* and *theoretical terms,* followed in parentheses with the relevant page number for GPL&B's use of the term *theory.* For example, when GPL&B claim on page 226 that theory testing should "often be displaced from its status as a central goal of research," they clearly mean the testing of empirical hypotheses as described in the section of McGuire's (1983) article entitled "Corrupting Effects of the Hypothesis Testing Method." Similarly, when GPL&B complained (p. 221) that literature reviews often exhibit "theory-predicted bias" by selectively omitting experimental findings contrary to some "thesis," "theory" refers to a unique and in principle irreplicable event, their own failure earlier in the article to cite findings contrary to the Bruner-Potter observations. Finally, GPL&B (p. 222) claimed that some topics (subliminal influence, biorhythms, speed reading, lie detection), and some procedures (for weight control, anxiety reduction, pain relief) are being "researched almost exclusively by advocates who are grinding theoretical axes." As a veteran researcher into subliminal influence (MacKay, 1973), the oldest and most extensively studied of these topics (see Klein, 1977), I can say that these areas have yet to develop and accept theoretical terms (under a rationalist definition of theory), and that if axes are being ground, they are empirical axes rather than theoretical ones. Moreover, recent reviews suggest that, contrary to GPL&B's claim, as many empirical axes are being ground against subliminal influence as for it (see e.g., Holender, 1986; Morton, 1986).

Theories Under the Rational Epistemology

The rational epistemology defines theories much more narrowly, so that GPL&B's (p. 225) "theoretically advanced statement" (begining "Belief change toward agreement with a belief-discrepant statement . . . ") is at best a not very highly evolved empirical generalization under the rational epistemology, a regularity in the relation between empirically defined variables emerging from a large number of experiments. A more highly evolved example is the law of speed–accuracy trade-off. Rationalist theories reduce a large number of such empirical generalizations and their exceptions (see Hempel, 1966) to a small number of conceptually simple theoretical constructs such as nodes (MacKay, 1982, 1987) and hidden units (McClelland, Rummelhart, & the PDP Research Group, 1986). These constructs begin with purely presumptive status and the interactions between them (e.g., altered linkage strength) purport to describe how things (e.g., minds) universally and inevitably work for all time, space, and hypothetical or Gedanken examples (Kuhn, 1977).

Rules of correspondence map theoretical constructs onto empirical generalizations, but these rules are modifiable and open to extension, enabling theoretical constructs to outlast existing means of observation, and to suggest future observations, lines of research, and practical applications that are currently unimaginable. For example, by altering rules of correspondence and adding new ones, the theoretical term *sound wave* has survived for 1,800 years, explaining thousands of originally unimagined observations of an ever more direct and precise nature (Holland, Holyoak, Nisbett, & Thagard, 1986). The "loose and variable" nature of correspondence rules (GPL&B, p. 227) means that full operational definitions for a theoretical construct are impossible: Unlike empirical terms of the sort illustrated in GPL&B, theoretical terms cannot be completely and explicitly defined (see Hempel, 1970, pp. 205–206). This violation of operationalism is undesirable under the empirical epistemology but essential to scientific progress under the rational epistemology. As Hempel (1970) pointed out, it is a noteworthy historical fact that unobservable entities, events, and attributes, and not observations per se, have stimulated the greatest conceptual and empirical advances in science.

Finally, quantitative expression is desirable but not essential for theoretical terms under the rational epistemology. Qualitative statements describing how hypothetical constructs such as nodes relate, interact, or change over time, in the absence of mathematical descriptions or simulations of these phenomena, still qualify as theoretical rather than empirical statements (see MacKay, 1987). However, a progression from qualitative to quantitative expression of theoretical concepts characterizes all major scientific theories. Examples are the wave theory of sound and the atomic theory of matter: Both began in Roman times as qualitative analogies before acquiring their current mathematical form (Holland et al., 1986). Nonetheless, even qualitative theoretical terms are not vague or inaccurate versions of empirical terms, as in GPL&B's (p. 217) key example.

Origins of Theory Under the Two Epistemologies

The origins of theory are not a major concern within the empirical epistemology, and this is certainly true for GPL&B. Their proposed flow chart for result-centered methods (Figure 3, p. 220) contains a box labeled "Develop Theory" that transmits an output to a box labeled "Derive Prediction," but re-

ceives no input whatsoever, a logically impossible situation. The empirical epistemology nevertheless recognizes the importance of developing viable theories and has definite views on how theories originate. The standard claim is that theories emerge spontaneously when a large enough body of data has been amassed. Thus, Underwood (1957, p. 186) argued that many areas of psychology were unready for theory because their "stock of preliminary data" fell below the critical mass required for theory construction. GPL&B (p. 226) added a new twist to this critical mass idea, suggesting that reversing familiar findings or establishing their limits by manipulating situational variables will force theory to develop faster. The "miniature model" approach adds another twist to the critical mass idea. Here the goal is not just to develop small-scale models closely tied to a specific experiment or experimental paradigm, but to integrate a sufficient number of these miniature models into a single general theory.

The rational epistemology rejects all of these critical mass hypotheses on epistemological, hypothetical, and historical grounds. The epistemological ground is that theories as defined under the rational epistemology cannot originate by amassing data or paradigm-specific descriptions: Observations cannot in principle extend across all time, space, and hypothetical examples. The hypothetical ground is that it is difficult to imagine how well-established scientific theories could have originated solely as a result of collecting more and more data, no matter how precise, extensive, or qualified the data are. Consider for example the observation that uranium is yellow whereas hydrogen is a colorless gas: It is difficult to imagine how specifying the conditions under which these observations hold or do not hold could lead *in principle* to the theoretical concepts that uranium atoms have about 238 electrons, whereas hydrogen atoms have only 1. The historical ground is that such theoretical concepts did not originate in this way whatever it is imagined to be. In the actual history of science, theorists often develop highly successful theoretical constructs, such as atoms and sound waves, long before any experimental data whatsoever have accumulated (see Holland et al., 1986). Rational epistemology theories originate as inventions, products of cognition rather than observation. Carnap (1966, p. 230) provided an early summary of this view: "We observe stones and trees and flowers, noting various regularities and describing them by empirical laws. But no matter how long or how carefully we observe such things, we never reach a point at which we observe a molecule or an electron. The term *molecule* never arises as a result of observations. For this reason, no amount of generalization from observations will ever produce a theory of molecular processes. Such a theory must arise in another way." Rational epistemology theories cannot originate in the way that GPL&B (p. 226) recommended, by determining the potentially infinite set of conditions under which experimental findings hold or do not hold.

Practical Applications Under the Two Epistemologies

Both epistemologies express concern over the relative inapplicability of current psychological knowledge (see MacKay, 1988), but assess the problem very differently. The empirical epistemology assumes that particular experimental findings can (and should) be applied directly to the real world and blames theories for the relative inapplicability of psychological knowledge (see GPL&B,[1] p. 216). However, the rational epistemology rejects the assumption that experimental findings can or should be directly applicable. Real-world problems that require a creative solution are never as simple as laboratory situations, which are, of necessity, carefully and deliberately contrived. Often the practitioner does not know all of the empirical factors that are relevant to a real-world problem let alone how these factors interact with one another. The practitioner's goal is to think flexibly about the problem, to come up with as many courses of action as possible, and to try out the best ones, often in tentative, small scale fashion until an acceptable solution is found. Experimental facts are of little help in this process. The very fact that experimental observations originate in rigidly controlled and (one hopes) well understood laboratory situations restricts the applicability of these observations to unsolved practical problems. If an experimental observation applies directly to some real-world problem, the problem has been solved long ago and does not, by definition, require creative solution.

Under the rational epistemology, sophisticated applications derive from theories rather than from experiments per se. Because theories are flexible and general, they can apply across a broad range of practical situations, unlike experimental observations, which by definition and design are restricted to a limited range of controlled conditions. The simplicity of theories also helps the practitioner think about and come up with sophisticated solutions to applied problems: Nodes and the way they interact are easier to think about than the many empirical phenomena that they summarize (MacKay, 1987). Unintegrated scientific observations, on the other hand, are not simple: Empirical factors and the potentially unlimited interactions between them (see GPL&B) are difficult to keep in mind, let alone apply: increasing available facts in the absence of viable theory can actually diminish applicability of psychological knowledge.

Theory Revision Under the Two Epistemologies

Empirical epistemologists often maintain that theories are revised or abandoned if and only if contradicted by observation, as per Hull's hypothetico-deductive program, and they cite Hull's failed program as proof that both theories and theory testing have been tried and found wanting (see Neisser, 1985, pp. 272–173). The rational epistemology opposes this antitheoretical stance: Neither a theoretical epistemology nor theories as defined under the rational epistemology have been tried and found wanting in psychology. Moreover, Hull's method is neither necessary nor usually sufficient for revision of rationalist theories: Data are unnecessary and often insufficient for revising or abandoning *rational epistemology* theories, and experimental tests often play less of a role in actual revisions than

[1] GPL&B (p. 226) correctly noted that practical applications are "greatly facilitated by converting experience into conceptual knowledge (theory) that can serve as the basis for action," and that theories help suggest possible solutions to practical problems such as "producing an explosion based on nuclear fission." In this latter example, however, GPL&B are clearly referring to a theory that fits rational rather than just empirical epistemology criteria.

factors such as elegance, consistency, and "making sense" (see later).

Confirmation Bias and Its Remedy Under the Two Epistemologies

GPL&B viewed confirmation bias as the main subject of their article, and claimed that researchers often fail to report results that do not support their "theories" (empirical hypotheses), and modify their experimental procedures until they obtain supporting results. Three reasons are given for this alleged behavior: First, a general tendency for people to view data as overly consistent with preliminary observations, conceptualizations, and opinions ("theories," p. 216). Second, development of greater reliance on the correctness of an empirical hypothesis ("theory") than on the suitability of the procedures used to test it (p. 227). Third, encouragement within "the social systems of many scientific disciplines" to become ego-involved advocates of empirical hypotheses ("theories," p. 227).

Given such a situation, at least three courses of action are possible *within the empirical epistemology.* One is GPL&B's proposal to (sometimes, somehow) displace the testing of empirical hypotheses (theories) as a central goal of research (see GPL&B, p. 226). As GPL&B noted, nothing short of radical change in the fundamental underpinnings of science could achieve this goal. Moreover, this proposed change would introduce or further aggravate other problems (discussed later) that seem at least as serious as confirmation bias. Finally, GPL&B's recommended change cannot conceivably overcome the problem that they envision. The reason is that researchers can be biased towards falsifying or *undergeneralizing* an empirical hypothesis as well as towards confirming or *overgeneralizing* it. GPL&B's methodological solution faces a problem that cannot be solved by methodology alone.

The other two courses of action are much simpler, more feasible, and more likely to succeed. One is to ensure that future experimenters do not become "ego-involved advocates" of their empirical hypotheses, and acquire greater confidence in the suitability of their procedures. Experimenters should be trained to avoid empirical confirmation bias as automatically as not driving a car through a red light. And as in the case of traffic violations, sophisticated procedures should be developed for detecting and remedying confirmation bias, if possible before it becomes expressed in the literature. The third course of action is for the person(s) testing a theory to be different and presumably less "ego-involved" than the person(s) developing the theory. Under this proposal, experimenters should never test empirical hypotheses derived from a theory that they themselves have developed, a division-of-labor solution that has already been adopted in theoretically advanced sciences such as biology.

Turning to the rational epistemology, confirmation bias is not as serious a problem as GPL&B supposed: Conservatism with regard to established theory is in fact desirable. Newly discovered empirical phenomena that fail to fit established theory do not and should not "discredit" or bring "disapproval" on the theory as GPL&B (p. 226) suggest, because established theories should not be overthrown lightly, and because falsifying a theory is not a straightforward affair (see Quine, 1960; Duhem, 1953). Predictions cannot be tested in isolation from the theoretical network in which they are stated, and predictions often fail not because the theory per se is at fault, but because the situation of test has violated some all-other-factors-being-equal assumptions of the theory. (For dramatic examples from astronomy and neuropsychology, see Churchland, 1986). Because novel observations or judgments "from the hurly-burly of the laboratory" (Churchland, 1986, p. 264) only become really secure and unimpeachable when explained by some theory, the availability of viable alternatives contributes further to the desirability of conservatism in rejecting established theory. Finally, a strong case can be made that developing viable theories in psychology would greatly reduce the likelihood of confirmation bias (rather than increase it as GPL&B suggest). Established theories highlight unpredicted findings as not just surprising and difficult to understand given the pattern of prior knowledge within the presumed domain of the theory, but also as challenging, important, and essential to pursue and eventually, to publish.

Irreplicability Under the Two Epistemologies

Whereas the empirical epistemology blames failures to replicate on "theories" (which encourage researchers to publish irreplicable results; GPL&B, p. 222), some nonreplications reflect lack of real theory as defined under the rational epistemology. Failures to know, understand, or communicate the conditions essential to reproducing a result often reflect lack of viable theory for summarizing available knowledge. As GPL&B noted, investigators who must summarize a mass of unintegrated findings and experimental details often ignore or downplay the seemingly minor procedural events that can completely change the outcome of an experiment and make replication difficult. Secondary sources add to this unprincipled selectivity, not because psychologists are "ego-involved theory advocates," as GPL&B (p. 227) maintained, but ironically, because a strictly empirical epistemology has hindered development of viable theory in psychology.

The Empirical Epistemology in Psychology: Retrospect and Prospect

The empirical epistemology has enjoyed a one-sided victory in American psychology over the past seventy years. The field has been primarily gathering facts, and largely for the sake of fact gathering (see Hyland, 1981; Toulmin & Leary, 1985). Even the best psychologists sometimes seem to assume not just that experiments can proceed in the absence of theory but that potential experiments are finite in number and that our job as psychologists is to do them all (see e.g., Anderson, 1980, p. 16: "Psychological research, extensive as it is, has only scratched the surface of the experiments possible."). Why has the victory been so one-sided? Interestingly, GPL&B echo the deciding historical considerations: irreplicability and confirmation bias.

The method of introspection adopted by many early psychologists resulted in failures to replicate, and proved useless for reconciling conflicting results. Such deadlocks set the stage for behaviorism and the methodological refinement whereby psychologists deliberately and systematically observe the behavior

of others (e.g., see Danziger, 1980). This refinement contributed greatly to progress, but it did not really solve the problem of replicability (see GPL&B), and this fact may help explain why psychologists have continued to adhere to logical positivism and operationalism long after physics and the philosophy of science rejected both (see Hyland, 1981): When seemingly minor procedural modifications give rise to differing results, stressing operational details becomes necessary under the empirical epistemology to determine the conditions under which an empirical phenomenon will or will not occur. This concern over procedural detail has contributed to the rise of experimental paradigms in contemporary psychology: To ensure replicability, and to enhance their technical competence, many psychologists have restricted their frame of reference to narrow experimental paradigms such as the memory search and lexical decision paradigms (see Grossberg, 1982). The implicit goal within such a methodological paradigm is to explore the effects of a limited number of well-known factors on behaviors of subjects in the paradigmatic situation. Once these factors have been mined, participants typically abandon the depleted paradigm and move on to a new one, as in GPL&B's (Figure 3, p. 220) "Abandon Problem" option. Paradigmatic fact gathering has interfered with rather than promoted development of theories for integrating available knowledge (see Baddeley & Wilkins, 1984) and has splintered the field into progressively more narrow and diverging pockets of interest, a fragmentation process that could go on indefinitely because procedural variations are unlimited in number.

A second historical battle revolved around the idea that theories "can obstruct research progress" (GPL&B, p. 217). Unreplicable introspective reports (1890–1914) often seemed suspiciously similar to the conceptual bias (theory) of the lab from which they emanated, leading to harsh and heated accusations of confirmation bias. The behaviorist remedy for this (alleged) problem was strikingly similar to GPL&B's (p. 217) call for more operational and less "theoretical" descriptions of empirical events and hypothetical constructs: Leading behaviorists mounted an attack not just against introspective methods but against the goal of developing a theory of mental events (see Gardner, 1985). Under the behaviorist stricture, the theoretical domain of psychology was to be limited to observables (external operations, stimuli, and behavior). Theoretical analyses of the mind underlying these observables became virtually unpublishable.

Effects of the behaviorist stricture seem predictable in retrospect. A similar stricture in other fields would have ruled out such fundamental theoretical constructs as atoms, sound waves, and electrons, none of which were observable when first proposed. Without these originally unobservable constructs, progress in these fields would have been severely retarded. The same is true in psychology, and will be even more so if GPL&B's result-centered methods are adopted. Many psychologists (e.g., Blumenthal, 1985; Tulving, 1979) have complained that this "dreary" projection (GPL&B, p. 225) for result-centered methods ("an accumulation of increasingly precise results limited to ever shrinking domains") is already with us and is not cumulative: Our ability to gather facts has outstripped our ability to remember and use these facts, and old experiments and concepts are being forgotten and reduplicated out of ignorance (Cole & Rudnicky, 1983) because lack of viable theory makes it difficult to integrate and to build on available psychological knowledge.

The more interesting question is why we continue to hear echoes of the behaviorist stricture in contemporary psychology. One aspect of the problem is that behaviorist attitudes toward theory have been passed on to subsequent generations. Many American psychologists have, like myself, been trained under a strictly empirical epistemology to put hypotheses to immediate and rigorous test and to reject assumptions that are not directly disconfirmable. Another aspect of the problem is that the behaviorist stricture is self-perpetuating. Confining theories to observable or operationally defineable entities rules out the possibility of developing viable theory, so that once the behaviorist stricture has been successfully imposed, the antitheoretical effect becomes self-perpetuating; because theoretical efforts under the stricture are doomed to failure at the outset, their actual failure reinforces the antitheoretical position, and ironically, exacerbates the problems that first prompted the stricture: irreplicability and experimenter bias.

Under What Conditions Can Theoretical Psychology Prosper?

My answer to the first question posed in the title of this article is that theoretical psychology cannot survive if we continue to practice psychology under a strictly empirical epistemology and a thinly disguised behaviorist stricture. However, development of theoretical psychology under a rational epistemology carries potential benefits for the field at large: integration of available facts, unification of the field, more sophisticated application of psychological knowledge, and reduced likelihood of irreplicability and bias in the reporting of results (see MacKay, 1988). This raises the second question: Under what conditions can theoretical psychology prosper?

Three basic conditions stand out. One is for psychology to develop a broad-based understanding and respect for the process of theory construction. The advanced sciences provide especially good examples of how important, but also challenging and difficult it is to develop viable theory. For instance, during most of the present century, a large number of purely theoretical physicists, each with special training, have been spending full time on developing a unified field theory for physical forces. Until very recently, however, no such theory has emerged that satisfactorily accounted for existing empirical regularities.

A second condition for the greening of theoretical psychology is to provide future theoretical psychologists with special PhD level training, and to support full time careers devoted to theory construction. Special training is desirable because theorists and experimenters must learn fundamentally different skills. For example, theorists must learn how to reduce complex sets of empirical generalizations to general principles that are elegant, and above all, simple, whereas experimenters must learn not to oversimplify their observations (as GPL&B noted, p. 217). And full-time careers devoted to theoretical psychology are desirable on grounds of confirmation bias (discussed earlier) and division-of-labor. Together, theoretical and experimental psychology will eventually become too complex and arduous for any one individual to master and pursue. The human brain is the

most complex physical system known to science, and both theories and experiments must eventually reflect this fact. Having the same person collect data and create theories, as currently happens in psychology, will also become undesirable because conducting experiments requires fundamentally different conceptual abilities from creating and evaluating theories (see also Grover, 1981). For example, subjective abilities that seem out of place in the realm of observations play a major role in theory evaluation. Theories are valued not just for the number of empirical generalizations they explain but also for the subjective disconnectedness or apparent diversity of these generalizations. "Making sense" is another subjective judgment required for evaluating theories but not for observing facts (one hopes; see GPL&B): Theorists generally revise or reject a theory not because it proves difficult or impossible to test, but because it no longer makes sense to them or contains subjectively fundamental internal contradictions (see Brandt, 1984). Finally, aesthetic judgments are routinely used in evaluating theories (but not in recording observations) because elegance and simplicity help scientists remember a theory and the facts it summarizes. This may explain why scientists continue to adhere to and use a theory long after it has proven inadequate or insufficient for explaining all of the available facts (Kuhn, 1962): Because theories help in recalling facts, scientists will continue to use an old theory until a new one comes along that enables better recall of the facts. Such nonempirical/nonpolitical factors suggest that GPL&B's claim that survival of theories is "governed more by political selection criteria than by empirical ones" (p. 227) is incomplete and underdocumented.

A final condition for the greening of theoretical psychology is cooperation between rational and empirical epistemologists: Theory development and fact gathering are fundamentally interdependant enterprises, and theoretical psychology cannot proceed as a *totally* separate area of training and specialization. Theories unrelated to facts are not science, and theory development at the expense of fact gathering is not a viable concept. Even though tensions can be expected to arise between theorists and experimenters, attributable in part to the differing skills and abilities required for doing experiments versus developing theories, experimental and theoretical psychology share the same basic goal: to understand how the mind works, and ultimately, to enable sophisticated applications of that understanding. In order to explain the full range of increasingly complex and precise empirical laws, psychological theories will become more detailed, sophisticated, and general, causing corresponding increases in the technology and interdisciplinary teamwork (see Gardner, 1985, p. 136) required to develop and test a theory. Theory construction in psychology eventually will become so time consuming that no single individual will be able to work on the entire theory, let alone conduct experiments as well, so that collaborative groups composed of theorists and experimenters will become commonplace. More interestingly, the social pressures of such collaborative teamwork can be expected to further reduce the viability of GPL&B's "Abandon Problem" option, and its companion, confirmation bias.

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