The Journal of Mind and Behavior
Winter 1999, Volume 20, Number 1
Pages 1–16
ISSN 0271–0137

Objectivity and Subjectivity in Psychological Science: Embracing and Transcending Psychology's Positivist Tradition

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Scientific psychology's positivist roots have led researchers to strive for disinterested objectivity in all phases of the research process. However, scrutiny of a six-stage model of psychological science reveals that subjectivity is unavoidable during certain stages of this process, due to: (a) the ways that people process information and solve problems; and (b) the formal and informal safeguards against fraud and bias implemented by scientists. During some stages of the research process, subjectivity can actually foster knowledge acquisition and theory-building. Thus, it may be time to modify the assumptions underlying psychology's empirical approach so that subjectivity in psychological science can be used productively, rather than being denigrated or denied.

> Science as something existing and complete is the most objective thing known to man. But science in the making, science as an end pursued, is as subjective and psychologically conditioned as any other branch of human endeavor.
>
> —Albert Einstein (quoted in Dittman, 1983, p. 198)

> The ideal scientist thinks like a poet and works like a bookkeeper.
>
> —Edward O. Wilson (1998, p. 7)

Beginning with its emergence as an independent discipline in the 19th century, scientific psychology has embraced positivism with gusto. During psychology's early years, a positivist approach helped foster the development of a science of behavior and mental processes that mirrored the well-established "hard" sciences (e.g., physics). Initial success in laboratory studies of

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sensation, perception, learning, and memory led to increasing reliance on a positivist framework, as psychologists feared losing credibility within the larger scientific community by varying from a hard-line empiricist stance (Wertz, 1994, 1995). Sundry versions of introspectionism and behaviorism have waxed and waned during the 20th century, but positivism has remained a unifying force throughout much of the discipline.

The marriage of psychological science and positivism has endured, but it has not been the most comfortable of unions. As time went on, the limitations of objectivity in scientific inquiry (in general), and psychological science (in particular) became increasingly apparent (Bronowski, 1956; Couvalis, 1997). While some theoreticians and researchers continued to defend the proposition that a truly objective scientific psychology was possible (e.g., Fodor, 1984; Skinner, 1953), most psychologists gradually dispersed into four camps with respect to this issue.

In one camp are those who view objectivity as an ideal, approachable but never fully attainable (the *tempered positivist* view). According to this view, the primary limitations on scientific objectivity are intentional and unintentional bias on the part of researchers, and the favored solutions involve implementing procedures that minimize bias and move science closer to its positivist ideal (Kilbourne and Kilbourne, 1983). Intentional bias (i.e., fraud) can be minimized through normative pressures brought by scientific colleagues, and through public dissemination (and attempted replication) of published research findings (Koshland, 1987). Unintentional bias (e.g., inadvertant misinterpretation of experimental data) can be minimized through sophisticated procedures (e.g., masked designs, reliability assessments) that make the scientific enterprise as objective as possible (Rosnow and Rosenthal, 1997).

In a second camp are those who argue that a positivist approach is better suited to the natural sciences than the social sciences (the *relative positivist* view). Relative positivists contend that because the subject matter of social science is inherently value-laden, a certain degree of subjectivity is inescapable in psychological research. According to this view, behavioral scientists' personal beliefs help determine what questions they ask, how they frame these questions, and how they interpret the results of their investigations (Buchanan, 1994; Mahoney, 1976). To minimize subjectivity in psychological science, researchers strive to adopt a disinterested attitude wherein knowledge acquisition is the only goal, regardless of the theoretical and social implications of this newly-acquired knowledge. Subjectivity and bias that inadvertantly creep into scientific research can be minimized through a rigorous pre-publication review process, which itself is assumed to be reasonably objective and unbiased (see Bornstein, 1991).

A third position has been taken by those who view scientific inquiry as inextricably linked with our evolving social construction of knowledge and truth (the *constructivist* view). In contrast to tempered positivists and relative positivists, constructivists contend that: (a) disinterested objectivity is neither possible nor desirable in the social sciences; and (b) by adhering inflexibly to a positivist stance we are deceiving ourselves and hindering our discipline (Nichols, 1993). In this context, Mitroff (1974) argued that subjectivity is inherent in all social sciences because at a personal level, empirical findings are only acceptable to social scientists to the degree that they affirm and reinforce the scientist's a priori beliefs. Among the influential constructivist perspectives in psychology in recent years are those derived from hermeneutics (Habermas, 1971) and deconstructionism (Sherman, 1987).

A fourth position has been taken by those who call for the development of a scientific psychology that embraces subjectivity rather than rejecting it (the *subjectivist* view). Subjectivists argue that the most fundamental questions faced by psychologists cannot be addressed using traditional methods (Husserl, 1954; Maslow, 1966). As Wertz (1994, p. 169) noted, "the inability of science to relate to humanity's deepest concerns stems not from a lack of competence, but from the narrowness of its specialization. The very expertise of the scientist consists of employing concepts and methods that are traditionally handed down and taken for granted without any rigorous reflection on their historical and personal meaning." During the latter half of the 20th century, the subjective side of science has been championed by humanistic and existential psychologists who favor idiographic over nomothetic research strategies (see Schneider and May, 1995).

The tempered positivist, relative positivist, constructivist, and subjectivist perspectives on psychological science differ in many ways, but they share a fundamental assumption, namely that the objectivity–subjectivity debate is best framed in either–or terms. Most psychologists (unreconstructed positivists included) view objectivity and subjectivity as opposing — even mutually exclusive — ingredients in the research process: to the extent that one perspective is strengthened, the other is weakened, and vice-versa.

The purpose of this paper is to suggest an alternative view of objectivity and subjectivity in psychological science — one that simultaneously embraces and transcends the positivist approach. The central tenet of this perspective is that objectivity and subjectivity operate differently at different points within the research process. At certain points objectivity is desirable, and to a great extent attainable. At other points objectivity would be undesirable, even if it was attainable. In other words, not only is a certain degree of subjectivity inherent in psychological science, but at times this subjectivity — if made explicit and nurtured cautiously — can actually strengthen our research efforts.

To provide context for a thorough exploration of the complementary roles of objectivity and subjectivity in psychological science, it is useful to consider how these terms have been defined by scientists and philosophers. The term *objectivity* typically refers to a mental state wherein one is uninfluenced by personal feelings or prejudices, and where beliefs are based exclusively on facts and free from bias. In contrast, *subjectivity* describes a mental state wherein decisions and thought processes reflect an individual's personal, idiosyncratic perspective rather than some universal human experience (Couvalis, 1997).

In the following sections I divide the research process into a series of discrete (but necessarily overlapping and interrelated) stages, so that the objective and subjective elements of this process may be evaluated more precisely. At the same time, I bring psychological principles (e.g., findings regarding human information processing) to bear on these issues, so that the objective and subjective aspects of psychological science may be better understood.

Scientific Psychology: A Six-Stage Model

Table 1 summarizes the central elements in a six-stage model of scientific psychology. Alongside each stage are listed: (a) some of the key *safeguards* against bias and subjectivity at that stage of the research process; and (b) some important *limitations* on scientific objectivity during that stage. These lists are intended to be illustrative, not exhaustive. As will become apparent, many of the safeguards and limitations in Table 1 apply to a variety of scientific disciplines, but some of these safeguards and limitations (e.g., certain ethical principles and experimental procedures) are unique to psychology.

Table 1

A Six-Stage Model of Psychological Science

Stage	Safeguards Against Subjectivity and Bias	Limitations on Objectivity
Interpretation of existing literature	Review process	Preexisting beliefs/assumptions Information-processing heuristics
Selection of focus/ topic of study	—	Influence of dominant paradigm(s) Knowledge politics
Study design	—	Ethical principles Mental set
Study execution	Reliability assessment Masked designs	—
Data analysis	Public dissemination/ replication Ethical principles	Statistical convention
Data interpretation/ presentation	Review process	Influence of dominant paradigm(s) Cultural/discipline-wide stereotypes

Interpretation of Existing Literature

The objectivity of even the most well-intentioned scientist is constrained in several ways when he or she is evaluating extant research findings. Early in this process, the scientist's a priori beliefs help determine the kinds of information he or she seeks out, which can lead to selective (often self-affirming) information-seeking. Later in the process, the scientist's beliefs influence his or her evaluation of this information.

Studies have demonstrated that many people display a powerful "confirmatory bias" in problem-solving, seeking out information consistent with their a priori beliefs, and even distorting contradictory information to make it fit more squarely with these beliefs (Wason, 1960). The mental strategies we use to try to counter the automatic biasing effects of beliefs and personal stereotypes take up considerable cognitive capacity, and are rarely completely successful (Devine, 1989). One might expect that scientists would be less susceptible than laypersons to confirmatory bias and the distorting effects of a priori beliefs and assumptions, but in fact they are just as susceptible as laypersons — perhaps moreso (Mahoney and DeMonbreun, 1978).

The same information-processing heuristics that affect everyone's thinking also constrain scientific objectivity when published literature is being evaluated. Just as perceivers' judgments in the social world are tainted by the accessibility of information in memory (the availability heuristic), and by the degree to which an unfamiliar entity resembles one or more previously-encountered entities (the representativeness heuristic), researchers' scientific judgments are tainted by insurmountable limitations in the human information-processing apparatus, and by the heuristics we use to maximize processing capacity in a complex, demanding environment (Faust, 1984; Kunda and Nisbett, 1986; Simon, 1983).[1]

The key safeguard against subjectivity and bias in literature interpretation is the manuscript review process. Presumably, reviewers and journal editors will point out instances wherein the researcher has misconstrued a finding or idea, and the misinterpretation can then be corrected before a manuscript is published. Evidence indicates that this component of the review process works fairly well, although critics note that reviewers and editors can fall victim to the same belief biases and heuristic-derived distortions as other scientists (Abramowitz, Gomes, and Abramowitz, 1975; Mahoney, 1987). In

[1] The information-processing distortions that impede objective, unbiased assessment of the research literature by individual scientists have played a role in the development of meta-analytic techniques that are now widely used to summarize and synthesize research results. Of course, meta-analytic methods themselves are neither objective nor unbiased, so in certain respects meta-analyses simply replace one set of conceptual and methodological difficulties with a different set of obstacles and interpretive limitations (Rosenthal, 1984).

this way, misinterpretations of research findings sometimes make their way into the literature, on occasion becoming so entrenched that they are reified for subsequent generations of scientists (see, e.g., Jones' [1992] discussion of researchers' near-universal erroneous interpretation of the well-known "Hawthorne Effect").

Subjectivity in the evaluation of extant research findings may be unavoidable, but it is not invariably harmful. To examine this issue, it is useful to divide research evaluation into two overlapping stages: *knowledge acquisition* and *synthesis*. When the evaluation process is parsed in this way, it becomes clear that objectivity is most critical during the knowledge acquisition stage, while subjectivity plays a central role in the synthesis of that knowledge. Put another way, a focused, analytical approach to the evaluation of published literature helps build the knowledge base necessary to become fluent within a particular domain (Langley and Jones, 1988). Among other things, this fluency enables the scientist to: (a) chunk domain-specific information more effectively (thereby retaining greater quantities of information); and (b) organize this information in a series of richly-elaborated hierarchies that make explicit key relationships among relevant ideas and findings (Faust, 1984).

Anecdotal accounts (Csikszentmihalyi, 1996) and controlled empirical studies (Finke, 1990) both indicate that once the knowledge base has been established, a more intuitive, subjective strategy in literature interpretation promotes innovative synthesis of information within that knowledge base, setting the stage for the "intuitive leaps" that lead to scientific insight. When a scientist deliberately employs a subjective approach in assessing the published literature, he or she may discover subtle patterns or anomalies that are missed when a more linear, focused cognitive strategy is used (Lipschitz and Waingortin, 1995). Divergent thinking can enable the scientist to discern connections to other research domains that are not apparent when convergent thinking is emphasized (Rothenberg, 1979). Thus, an evaluative strategy that blends disinterested objectivity with intuition and subjectivity may lead to greater insights regarding the published research literature than either strategy alone.

Selection of Focus/Topic of Study

The researcher selecting a topic for study can find it difficult to overcome the influence of the dominant paradigm(s) in his or her field. These paradigms not only dictate which theoretical perspectives are most widely accepted, but also help determine what types of questions may be asked, what methods may be used, and how data should be analyzed and interpreted (Kuhn, 1962, 1977). The effects of these paradigms on the scientist's thinking may be especially powerful if the prevailing paradigms were already in place during the scientist's early training and apprenticeship.

Beyond the subtle (often implicit) restricting effects of one or more dominant paradigms on the scientist's thinking, a more explicit, practical concern helps determine the topics chosen for study by the working scientist. Mahoney (1987) coined the term "knowledge politics" to describe the process by which some scientists gradually refine their research programs to maximize the likelihood that they will produce findings acceptable for publication in the most prestigious, selective journals. The relatively low base rate of manuscript acceptance in the social sciences accentuates the impact of knowledge politics on psychological research (Mahoney, 1985). Moreover, as the ratio of submitted manuscripts to available journal space increases, the impact of knowledge politics also tends to increase (Bornstein, 1990). The personal and professional consequences of ignoring this aspect of the research process can be substantial (Garcia, 1981).

The implicit constricting effects of paradigm dominance and the more explicit restricting effects of knowledge politics may be countered to some degree by acknowledging the value of intuition and personal bias in the topic selection process. The history of science is replete with examples of "trivial" or "unacceptable" ideas that eventually became highly influential (see Bronowski [1956], Garcia [1981], and Mahoney [1987] for examples). Many groundbreaking concepts stemmed from a lone scientist's personal hunch, coupled with a strong desire to convince others of the veracity of his or her perspective. Csikszentmihalyi (1996, p. 288) put it well when he noted that the "tendency to take one's dreams and hunches seriously . . . is clearly one of the most important traits that separates creative individuals from otherwise equally competent peers . . . [but] even the most original ideas have little chance to make a difference without the persistence to convince others of their rightness."

Study Design

With respect to study design, psychological science differs in at least one important way from other social sciences, and from the natural sciences as well: while psychology's laboratory tradition places great value on controlled experimentation, the subject matter of psychology — behavior and mental processes — does not always allow scientists to control or manipulate the variables of interest as completely as they would like. On many occasions, ethical treatment of participants precludes designing the most methodologically "tight" experiment possible (Fisher and Younggren, 1997). Perusal of the American Psychological Association's [APA's] *Ethical Principles of Psychologists* (APA, 1992) illustrates the omnipresent, unavoidable tension between scientific rigor and ethical treatment of participants in psychological research (Ethical Principles 6.11b, 6.11e, 6.13, and 6.15b are particularly germane in this context).

Without question, informed consent and minimization of deception are important from an ethical perspective, but they also introduce into psychological science the potential for certain forms of bias that might not otherwise exist. For example, the fully-informed participant will sometimes display self-report and self-presentation biases that the uninformed participant would not. Experimental designs that minimize deception often introduce additional avenues through which participant bias (and, on occasion, experimenter bias) may influence a study's results (Rosnow and Rosenthal, 1997).

The situation in psychology stands in stark contrast to that in other social sciences (e.g., sociology, economics) wherein field investigations rather than laboratory experiments are the prototypic empirical approach. This situation also contrasts with that in the natural sciences, most of which — like psychology — favor experiments over observational and correlational studies. Except for certain areas of life science research (e.g., biomedical investigations, in vivo studies of ecological systems), ethical principles do not constrain experimental designs in the natural sciences to nearly the same degree that they do in psychology.[2] In this context, Plous (1991, 1993) noted that scientists' and laypersons' concerns regarding ethical treatment of nonhuman research participants tend to vary according to the degree to which those participants are perceived as having "human-like" qualities (e.g., faces with quasi-human features). Consequently, those domains of natural science that focus primarily on organisms with few ostensibly human qualities (e.g., microbiology, plant physiology) are generally less constrained by ethical concerns that often compromise research designs in psychology and other social sciences.

Beyond ethical concerns, mental set (i.e., our tendency to approach unfamiliar problems inflexibly, clinging to strategies that have proven useful in the past) may limit objectivity among psychological scientists as they design empirical studies. Numerous investigations have demonstrated that mental set can distort and restrict our thinking and problem-solving efforts in real-world settings. Mental set also constrains the objectivity of the scientist: it is difficult to envision alternative routes to problem solutions if we have been repeatedly exposed to the same experimental measures and methods over a period of months or years (Rothenberg, 1979, 1994). The increased ratio of submitted manuscripts to available journal pages, coupled with a hypercompetitive job market in many disciplines, combine to increase external pressure on beginning researchers to generate publishable results as

[2] Recently, many social sciences — including psychology — have begun to utilize computer simulations in lieu of laboratory or in vivo studies when certain types of hypotheses are being tested. However, the prototypic empirical approaches continue to differ across disciplines, with psychology relying more heavily than other social sciences on controlled laboratory experimentation.

quickly as possible — a situation that amplifies the deleterious effects of mental set on scientific problem-solving and creativity (Amabile, 1983; Mahoney, 1987).

These barriers notwithstanding, it is important to recognize that objectivity — even if flawed or limited in certain respects — plays an important role in study design. A dispassionate, analytical strategy enables the scientist to construct experiments that yield the most compelling, unambiguous results possible, thereby maximizing the likelihood that his or her studies will have an impact on the discipline. Disinterested objectivity can help the scientist recognize and correct design flaws before a study is conducted, rather than discovering these flaws during the review process, after considerable effort and financial resources have already been invested in the project.

Subjectivity also plays an important role in study design. By looking beyond established procedures within a domain, the researcher may envision alternative methodologies that can be applied to reframe and reexamine a heretofore intractable scientific question (Wertz, 1995). As was true for literature evaluation, divergent thinking during the study design process may foster creativity, and enable the scientist to perceive heretofore neglected connections between the topic at hand and other, ostensibly unrelated topics within and outside the discipline (Wilson, 1998)[3]. Empirical evidence in this area is scanty, but it suggests that subjectivity during the study design process can: (a) facilitate "conceptual synthesis" of ideas and findings (Rothenberg, 1994); (b) help the scientist apply alternative problem-solving strategies that transcend a unidirectional means–end analysis (Finke, 1990); and (c) lead to increased likelihood of creative insight (Langley and Jones, 1988).

Study Execution

Psychology's safeguards against subjectivity and bias in study execution are well-established and widely-accepted. On a manuscript-by-manuscript basis, these safeguards undergo repeated scrutiny throughout the review process, and again after a paper is published. They are refined and updated as new procedures and methodologies are introduced. In fact, there are no substantive external limitations on objectivity during study execution that cannot be minimized via established scientific procedures (e.g., assessment of interrater reliability for ambiguous outcome measures, use of masked experimental

[3]This is not meant to imply that all interdisciplinary research is inherently subjective. On the contrary, this line of argument simply suggests that divergent thinking can increase the likelihood that the scientist will discover subtle parallels between ostensibly disparate concepts in different areas of inquiry.

designs).[4] Consequently, study execution may be the most purely objective step in the entire research process. In this domain, the positivist tradition continues to serve psychology well.

Data Analysis

Most instances of scientific fraud take place at this stage of the research process (Kilbourne and Kilbourne, 1983), although the available evidence suggests that scientific fraud is a relatively rare event (Koshland, 1987). Subjectivity and bias in data analysis arise more frequently from the subtle effects of statistical convention — that is, firmly entrenched norms regarding how psychological data are best analyzed.

Scientists make myriad choices regarding what statistical tests to use, the order in which data are entered into certain statistical procedures (e.g., multiple regression), and the best ways to control for Type 1 and Type 2 errors under various conditions. All these choices can potentially affect the outcome of data analysis (Cohen, 1994; Levine, 1974). In fact, Frick (1996), Rosenthal (1990a), and others have shown how longstanding statistical conventions can lead psychological researchers to draw erroneous conclusions from ostensibly objective data. Among other things, scientists' overreliance on significance testing in lieu of direct evaluation of experimental effect sizes has led to misinterpretation of numerous research findings in the behavioral and biomedical sciences (see Rosenthal [1990a] for several noteworthy examples). Along slightly different lines, Hutchinson and Alba (1997) have shown how informal "eyeballing" of data — a practice common among researchers — can lead to erroneous conclusions regarding these data, and influence the scientist's subsequent data-analytic strategies.

Two related safeguards help minimize the potential for subjectivity and bias to contaminate the data-analytic process. First, scientists occasionally attempt to replicate published research results. While the overall base rate of replication in psychological science is low, the frequency of replication increases when a finding is particularly noteworthy or counterintuitive (Rosenthal, 1990b). Moreover, Ethical Principle 6.25 (APA, 1992) requires scientists to share data with other researchers who seek to substantiate published claims and conclusions, formalizing the scientist's obligation to disseminate publicly (at least within the scientific community) the raw material underlying his or her analyses.

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[4]Although masked designs are effective in minimizing participant and researcher bias in many psychological experiments, it is not possible to implement these designs in every investigation where they would be desirable. For example, certain quasi-experimental and archival studies cannot be conducted using fully masked designs.

Data Interpretation/Presentation

Subjectivity and bias enter into the data interpretation process when the existence of a dominant paradigm or theoretical perspective leads researchers to interpret data in a self-limiting, norm-affirming manner. A case in point: during the 1960s and early 1970s, prevailing models of human information processing did not readily accommodate the existence of perception without awareness. Consequently, data that appeared to demonstrate implicit perception were ignored, or attributed to experimental artifact or error. To some extent researchers' reluctance to accept these counterintuitive findings represented healthy scientific skepticism (Merikle, 1982). Nonetheless, when perception without awareness became more widely accepted in the early 1990s, it also became clear that reasonably strong data supporting this effect had existed for some time (Bornstein and Pittman, 1992). Researchers' unwillingness to accept data that ran counter to the prevailing perspectives in experimental psychology had led to widespread misinterpretation of these data (see Kunst–Wilson and Zajonc [1980] for a noteworthy demonstration of implicit perception published more than a decade before scientists' widespread acceptance of this phenomenon).

A similar situation can arise when data appear to contradict a widely-held cultural stereotype. Consider, for example, gender differences in interpersonal dependency. Psychologists and laypersons alike have long believed that in general, women are more dependent than men, and prevailing theoretical models of dependency helped reify this belief (Bornstein, 1993). Consequently, when men's scores on widely used dependency tests exceed those obtained by women, this difference has traditionally been attributed to a flaw in test construction. As a result, psychologists have drawn erroneous conclusions regarding gender differences in dependency for nearly forty years. Only recently did it become clear that when a test with low face validity is used to assess dependency in adults, men's scores are slightly — but significantly — higher than those of women (Bornstein, 1995).

The subtle biasing effects of paradigm dominance and cultural stereotypes on data interpretation can be minimized through the manuscript review process, and through the self-correcting mechanisms of science. Unfortunately, the utility of the review process in this domain is constrained by the degree to which the reviewers themselves have accepted the prevailing paradigms and stereotypes (Abramowitz et al., 1975; Goodstein and Brazis, 1970), and science's self-correcting properties are slow and imperfect (Mahoney, 1985; Meehl, 1978).

Discussion

A forthright assessment of scientific psychology requires that we acknowledge the inescapable presence of subjectivity in certain phases of the research process. At times subjectivity hinders psychological research by introducing personal bias into an aspect of the process that would benefit from disinterested objectivity on the scientist's part (e.g., data interpretation). At other times (e.g., in study design), subjectivity may actually promote knowledge acquisition and theory-building. While the positivist approach has played a key role in psychology's scientific growth during the 20th century, an uncritical devotion to disinterested objectivity in all phases of the research process is neither useful nor productive. A more accurate and heuristic view of psychological science is one that makes explicit its subjective elements as well as its objective features, recognizing the role that each plays in the research enterprise. A dialectic involving the interplay of objectivity and subjectivity can lead to greater insights and more powerful research strategies than an uncompromisingly objective approach or an emphatically subjective one.

In certain respects, this viewpoint is not new. Kuhn (1962) discussed at length the limitations of objectivity in scientific research and theory-construction, although Kuhn focused primarily on the "macro" elements of scientific subjectivity — the sweeping paradigm shifts that alter in fundamental ways the direction of a discipline. In contrast, the present analysis focuses on the interplay of objectivity and subjectivity in a "micro" context, as these complementary processes interact to foster (or impede) scientific growth. The present analysis also differs from extant perspectives in its contention that objectivity and subjectivity operate in different ways at different points in the research process, with contrasting benefits and costs at different stages.

There are some interesting parallels between the present analysis and prevailing theoretical models of scientific insight. Beginning with Hadamard (1949), theoreticians and researchers have generally divided the mental processes underlying insight and discovery into four phases: preparation, incubation, illumination, and verification/elaboration. Although certain features of this model (e.g., the role of unconscious processes during the incubation phase) remain controversial, contemporary research on scientific insight continues to draw heavily from Hadamard's framework (see Couvalis, 1997; Langley and Jones, 1988). It is noteworthy that — like the present analysis — Hadamard's model posits that objectivity and subjectivity both play key roles in scientific discovery: objective, analytical reasoning is central to preparation and verification, whereas subjective, intuitive processing is central to incubation and illumination.

Thus, the interplay of objectivity and subjectivity in scientific inquiry exists on at least three levels. Kuhn (1962) made explicit the role of scientific subjectivity at the paradigmatic level, while Hadamard (1949) and others discussed objectivity and subjectivity in the mental activities of the working scientist. The present analysis complements these earlier discussions by emphasizing the interaction of objectivity and subjectivity during different stages of the research process, when hypotheses are being tested empirically.

The present perspective on objectivity and subjectivity in psychological science has three noteworthy implications for working scientists. First, this viewpoint suggests that researchers should alter their approach to designing studies, so they can nurture more effectively the subjective elements of the research process. To the extent that a more subjective approach can help researchers transcend preexisting beliefs and stereotypes (Wertz, 1995), gain much-needed perspective on long-standing statistical conventions (Cohen, 1994), and overcome the restricting effects of mental set and knowledge politics (Mahoney, 1987), subjectivity can actually result in a greater number of novel hypotheses and innovative experimental designs.

Second, we must alter our approach to training young scientists. By helping novice researchers employ techniques that foster creativity and divergent thinking, we may help these researchers overcome some widespread limitations on scientific information-processing and problem-solving (Morse and Morse, 1995; Wilson, 1998). In this context, critical analysis of psychology's dominant paradigms and methods can only have beneficial effects, strengthening those paradigms and procedures that continue to be heuristic, and hastening the decline of those that have outlived their usefulness (West, 1997).[5]

Third, we must devote greater attention to studying the impact of scientists' information-processing and problem-solving strategies on the research enterprise. Some preliminary efforts in this regard have already appeared (e.g., Finke, 1990; Hutchinson and Alba, 1997; Morse and Morse, 1995; Rothenberg, 1994). More are needed. Psychological researchers are in a unique position to develop a formal "cognitive science of science" — an approach to studying the research process that uses psychological principles and research findings to understand more completely the behavior and mental processes of the practicing scientist.

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[5]On an individual level, one might ask whether it is possible to move back and forth fluidly between objectivity and subjectivity in one's approach to science. For some researchers, the answer to this question is probably *yes;* for others, *no.* In this regard the task of the scientist is akin to that of the naturalistic painter. As the naturalistic painter works, he or she continuously moves back and forth between the objective (creating a recognizable two-dimensional representation of three-dimensional visual elements), and the subjective (communicating to the viewer some personal, private experience of these elements). Panofsky (1955) argued that great works of art are those that manage to strike a compelling balance between the universal and the personal. According to Bronowski (1956), the same is true of great scientific ideas.

Conclusion

Psychology's positivist tradition has served the discipline well for many years, and can serve it well for many years to come. However, to apply positivist principles to psychological science as effectively as possible, we must acknowledge the limitations of objectivity in psychological research, and the important role that subjectivity can play in enhancing our research efforts. By looking more closely at those phases of the research process that are enhanced by a positivist approach, and those phases of the research process that may not be amenable to a strict positivist framework, we can create an even more productive scientific psychology.

In many ways, this is an ideal time to undertake such a conceptual shift. Psychology's scientific status is increasingly secure within the broader intellectual community, and other branches of science draw upon psychological concepts and methods more vigorously than ever before. Thus, improvements in psychological research strategies will likely have a salutary effect that goes beyond psychology per se. By simultaneously embracing and transcending the positivist approach, we will not only benefit psychology, but other disciplines as well.

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