Centenary of William James's *Principles of Psychology:* From the Chaos of Mental Life to the Science of Psychology

John T. Cacioppo
Ohio State University

Louis G. Tassinary
Texas A&M University

William James's views on the science of psychology were as provocative as his observations of psychological and behavioral phenomena. His perspective on psychology as a natural science is reviewed briefly, the concept of "levels" is defined, and several emerging principles illustrating the importance of multilevel integrative research on mind-brain relationships are described. These emerging principles, which are not derived from, but would be at home in, James's Principles of Psychology, *are the* principle of multiple determinism, *the* corollary of proximity, *the* principle of nonadditive determinism, and the principle of reciprocal causation. *These principles illustrate how the understanding of social psychological phenomena can inform and be informed by the study of both environmental (situational) and organismic (biological) factors.*

> Psychology is the Science of Mental Life, both of its phenomena and of their conditions. The phenomena are such things as we call feelings, desires, cognitions, reasonings, decisions, and the like; and, superficially considered, their variety and complexity is such as to leave a chaotic impression on the observer. The most natural and consequently the earliest way of unifying the material was, first, to classify it as well as might be. . . . This is the orthodox "spiritualistic" theory of scholasticism and of common-sense. Another and a less obvious way of unifying the chaos is to seek common elements *in* the diverse mental facts rather than a common agent behind them, and to explain them constructively by the various forms of arrangement of these elements, as one explains houses by stones and bricks. . . . The very Self or *ego* of the individual comes in this way to be viewed no longer as the pre-existing source of the representations, but rather as their last and most complicated fruit.
>
> — Wiliam James
> (1890/1950a, pp. 1-2)

AUTHORS' NOTE: Preparation of this manuscript was supported by National Science Foundation Grant No. BNS-8818557/8940915. The authors thank David E. Leary, John H. Harvey, and Barbara L. Andersen for providing excellent comments on an earlier draft. Requests for reprints may be addressed to John T. Cacioppo at the Department of Psychology, Ohio State University, 1885 Neil Avenue, Columbus, OH 43210-1222.

Personality and Social Psychology Bulletin, Vol. 16 No. 4, December 1990, 601-611

William James viewed thoughts, feelings, and commonsense as the data to be explained in psychology, but he contended that a science of psychology could not be based on commonsense. He posited that mind is connected to the body in essential ways but rejected the idea that mind could be understood simply by the study of brain/body. In this article we outline briefly James's perspective on the science of psychology and on the relation between mind and brain. We further define the concept of levels and review several integrative principles illustrating the explanatory potential of multilevel integrative analyses of psychological and behavioral phenomena.

JAMES'S PERSPECTIVE ON THE SCIENCE OF PSYCHOLOGY

Inconsistencies in James's discussion of philosophy and psychology led some to conclude that "his excursions into philosophy were . . . in the nature of raids" (Santayana, 1920, p. 67), and conflicting interpretations of James's work are attributable, in part, to conflicting positions espoused by James: "Dewey and Edman see James in the camp of modern objectivism; Boring billets him with the subjectivists. The truth is that James moved from tent to tent, as if driven now by his own tough-mindedness, and now by his own tender-mindedness" (Allport, 1943, p. 99).

In addition, James's imaginative descriptions of experience as a flux of mental discourse in which divisions and units are vague and shifting, his eloquent analysis of functional constructs such as attention, will, and the self, and his shift toward idealism in his later writings make it easy to overlook the basically monistic approach he advocated in much of *Principles*.[1] Yet James, who came to psychology by way of medical training and who taught physiology before psychology and philosophy, was explicit in the preface to *Principles* about this monistic approach to psychology:

> This book, assuming that thoughts and feelings exist and are vehicles of knowledge, thereupon contends that psychology when she has ascertained the empirical correlation of the various sorts of thought or feeling with definite conditions of the brain, can go no farther—can go no farther, that is, as a natural science. If she goes farther she becomes metaphysical. . . . I have therefore treated our passing thoughts as integers, and I regarded the mere laws of their coexistence with brain-states as the ultimate laws of our science. (James, 1890/1950a, p. vi)

James was *not*, however, an advocate of reductionism as the only means for identifying lawful psychological principles. On the contrary, he lamented that "many persons nowadays seem to think that any conclusion must be very scientific if the arguments in favor of it are all derived from twitching of frogs' legs—especially if the frogs are decapitated—and that, on the other hand, any doctrine chiefly vouched for by the feelings of human beings—with heads on their shoulders—must be benighted and superstitious" (Perry, 1936, p. 30). In the introductory chapter of *Principles*, he acknowledged the service performed by the Spencerian formula that "the essence of mental life and of bodily life are one, namely, 'the adjustment of inner to outer relations' " (James, 1890/1950a, p. 6) while rejecting the study of psychological phenomena through the study of physiological processes alone. James instead emphasized the active, selective character of the mind: "Minds inhabit environments

which act on them and on which they in turn react" (1890/1950a, p. 6; see also 1890/1950b, pp. 1234-1235). In his chapter on automaton theory, he first made the case for a reductionistic view of consciousness, void of any causal influence, and then argued that this automaton analogy was too one-sided: "It is to my mind quite inconceivable that consciousness should have *nothing to do* with a business which it so faithfully attends. And the question, 'What has it to do?' is one which psychology has no right to 'surmount,' for it is her plain duty to consider it" (p. 136).

In sum, James favored a multilevel integrative (i.e., psychophysiological) approach to the study of psychological and behavioral phenomena. For this reason he has long been credited with being one of the fathers of psychophysiology (Darrow, 1964; see Cacioppo & Tassinary, 1990).

JAMES'S "PSYCHOPHYSICAL RIDDLE"

If mind and body/brain were viewed by James as being interdependent, the precise nature of this interdependence proved more elusive:

> What shall we do? Many would find relief at this point in celebrating the mystery of the Unknowable and the "awe" which we should feel at having such a principle to take final charge of our perplexities. Others would rejoice that the finite and separatist view of things with which we started had at last developed its contradictions. . . . It may be a constitutional infirmity, but I can take no comfort in such devices for making a luxury of intellectual defeat. They are but spiritual chloroform. Better live on the ragged edge, better gnaw the file forever! (James, 1890/1950a, pp. 178-179)

Still, James's views regarding this riddle are surprisingly contemporary:

> All the centers, in all animals, whilst they are in one aspect mechanisms, probably are, or at least once were, organs of consciousness in another, although the consciousness is doubtless much more developed in the hemispheres than it is anywhere else. . . . Like all other organs, however, [nervous centers] *evolve* from ancestor to descendent, and their evolution takes two directions, the lower centres passing downwards into more unhesitating automatism, and the higher ones upwards into larger intellectuality. Thus it may happen that those functions which can safely grow uniform and fatal become least accompanied by mind, and that their organ, the spinal cord, becomes a more and more soulless machine; whilst on the contrary those functions which it benefits the animal to have adapted to delicate environing variations pass more and more to the hemispheres, whose anatomical structure and attendant consciousness grow more and more elaborate as zoological evolution proceeds. (James, 1890/1950a, pp. 78-79)

In their review of the field of cognitive neuroscience, Churchland and Sejnowski (1988) similarly notes: "Psychological phenomena may be associated with a variety of levels. Some perceptual states such as the 'raw' pain of a toothache might be a low-level effect, whereas attention may depend on a variety of mechanisms, some of which can be found at the level of local neural networks and others at the level of larger neural systems that reside in many different locations of the brain" (p. 742).

TABLE 1: Illustrative Levels of Organization

LEVEL	*EXEMPLAR*
Organismic-environmental transaction within a sociocultural context	Competitive behavior
Organismic-environmental transaction	Behavior
Organism	Human being
Body system	Somatic system
Organ	Muscle
Tissue	Muscle tissue
Cellular	Muscle cell
Molecular	Actin, Myosin

LEVELS OF ORGANIZATION AND LEVELS OF EXPLANATION

"Levels" is a key concept in James's and in contemporary analyses of the psychophysical riddle. The term *levels* has been used to refer to the level of structural organization or representation (e.g., Tolman, 1959; Weiss, 1941) and to the level of explanation (e.g., Shaw & Turvey, 1981).[2] *Level of organization* refers to the different scales in which the body or behavior can be represented. The level of organization of psychological phenomena can vary, for instance, from the chemical (e.g., actin, myosin) to cellular (e.g., muscle fiber) to tissue (e.g., striated muscle) to organ (e.g., biceps) to body system (e.g., muscular system) to the human organism to the environmental context (see Table 1). Although what constitutes a level of organization is often guided by knowledge of anatomy or physiology, the ultimate criterion is the usefulness of the posited organization in shedding light on some designated psychological or behavioral phenomenon. This is important because a particular representation makes certain information explicit at the expense of other information and hence renders some operations or insights easy and others quite difficult (e.g., see Marr's, 1982, discussion of the multiplication of arabic vs. roman numerals). The point is that no single level of organization (representation) is best for all questions or for all purposes.

Levels of explanation refers to the representation of a psychological phenomenon in terms of the classes of questions that can be asked about it—or, as Marr (1982) put it, "the different levels at which an information processing device must be understood before one can be said to have understood it completely" (p. 24). The computational level encompasses questions about the main constituents of the task or phenomenon, including the goal of the computation and the logic of the strategy by which the computation can be performed. The level of the algorithm encompasses questions about a procedure for achieving the correct output from a designated input. Finally, the level of implementation refers to questions about the physical instantiation of the

behavioral function and the cognitive algorithm—the manner in which the algorithm is realized physically.

Marr (1982) noted that "almost never can a complex system of any kind be understood as a simple extrapolation from the properties of its elementary components" (p. 19)—a position reminiscent of James's own perspective (1890/1950a, p. 192). The study of the elements of a system (i.e., reductionism) may produce eloquent descriptions but fall short of a satisfactory explanation. If the properties of the system are not isomorphic with those of its elementary components, a situation that often obtains with biological systems (cf. Boring, 1936), a focus on elementary components contributes to an explanation only when considered in conjunction with events occurring at different levels of the system.

LEVELS OF BEHAVIORAL ORGANIZATION

The reference by James in the quotation above to "lower" and "higher" centers refers to levels of organization. Spinal reflexes, for instance, consist of an effector, a conductor, and an initiator (Gallistel, 1980). Because all three of these components are required to transform an environmental input into a behavior, they are said to constitute an elementary (i.e., "lower") unit of behavior. Because of the simplicity of structure, such reflexes are fast; because of their parallel organization, the interference among the spinal reflexes is minimal; and because of the limited afferent information to which each responds and efferent output with which each responds, these elementary behavioral units are relatively inflexible. In his chapter entitled "The Functions of the Brain," James referenced classic work by Hughlings Jackson in 1864 demonstrating that functions implemented at the level of the spinal cord (e.g., motor reflexes) are rerepresented at higher neural centers as increasingly abstract organismic-environmental transactions (Jackson, 1958). Thus, as one of many elementary units under the guidance of a suprasegmental neurophysiological structure, the separable operations of the spinal reflexes are integrated to produce a function that no one constituent performs by itself. It is this characteristic that defines the suprasegmental neural structure as a superordinate (i.e., higher-level) behavioral unit (Gallistel, 1980).

The convergence of afferent information and the divergence of efferent information are magnified at each ascending level of integration in the central nervous system, and the potential for integration, abstraction, and categorization, as well as flexible action, is increased as one moves from elementary to increasingly complex (i.e., lower to higher) units of behavior.[3] Consistent with the associated costs of this organization in terms of the speed of information processing, James cautiously endorsed reaction time procedures as probes of higher-order mental processes.[4]

As one moves up the hierarchical organization of the nervous system, organismic-environmental transactions are represented in what James termed "ideational processes" (e.g., see James, 1890/1950a, p. 24, footnote). Ideation is causal in that it emerges in transaction with the environment, past and present, and determines, at least in part, the ideational processes that follow. Though associated with specific brain processes, the ideational processes may in some instances be simpler to identify and, therefore, can contribute to the discovery and characterization of the neurophysiolog-

ical substrata. Moreover, certain ideational processes were conceptualized within James's scheme as part of a feedforward response system, not unlike the way peripheral bodily responses were conceptualized in the generation and maintenance of emotional states:

> Wherever movement follows *unhesitatingly and immediately* the notion of it in the mind, we have ideo-motor action. We are then aware of nothing between the conception and the execution. All sorts of neuromuscular processes come between, of course, but we know absolutely nothing of them. We think the act, and it is done; and that is all that introspection tells us of the matter. (James, 1890/1950b, p. 522)

To illustrate the hierarchical organization of the central nervous system, consider the classic research by Flynn and his colleagues on predation in cats (Flynn, 1972; Flynn, Edwards, & Bandler, 1971; MacDonnell & Flynn, 1966). When a nonpredatory (e.g., satiated) cat is touched on the cheek, its head turns away; when the cat is touched on the lips, its lips purse. The opposite reflexes are activated in the predatory (e.g., food-deprived) cat. A touch on the cheek elicits a turn toward the touch; a touch on the lips elicits a jaw-opening reflex. Indeed, under conditions of food deprivation, the receptive field for the jaw-opening reflex increases in size and the threshold for the elicitation of the jaw-opening reflex decreases. Flynn and his colleagues also demonstrated that specific nuclei in the diencephalon determined the overall behavioral motivation, whereas the lower-level reflexes, under the guidance of these higher-level nuclei, implemented the details of the transactions with the environment: "By potentiating a coherent spectrum of possible behaviors, a central motive state establishes an overall direction to behavior, but leaves it to the potentiated circuits to determine how that direction shall be maintained given the circumstances attending the execution of the behavior" (Gallistel, 1980, p. 408).

In sum, James's belief that higher-level psychological phenomena (e.g., consciousness) influence and are influenced by lower-level physiological processes, though paradoxical half a century ago (Allport, 1943), has gained credence as a result of research on brain and behavior relationships.

INTEGRATIVE PRINCIPLES THROUGH ANALYSES ACROSS LEVELS

James emphasized that psychological phenomena are influenced by both situational and biological factors and that it is in the transaction between the brain and the environment that organizational principles of behavior sometimes emerge. This is not to suggest that principles of behavior cannot be identified in studies within a level of organization (e.g., behavioral analyses). In fact, most of the classic research by Flynn and his colleagues was conducted completely within the behavioral level of organization. A large corpus of principles about social behavior has derived from ingenious experiments using self-report measures. However, orderly data sometimes become more apparent when examining psychological phenomena across, rather than within, levels of organization.

Social psychology as a discipline is usually conceived as cutting across at least two broad levels of organization—the intrapersonal and the interpersonal. A variety of psychological phenomena, such as attraction, group cohesion, social facilitation, and persuasion, are uniquely social in that these phenomena emerge as a function of human association, whether the human association is imagined, real, or remembered. Examination of the intrapersonal processes underlying a target social behavior, however, may reveal that what appeared to be a unitary phenomenon can more fruitfully be conceptualized as similar social outcomes of distinctive psychological processes. James's views on emotion exemplify this point (see also Fazio & Cooper, 1983; Zanna & Cooper, 1974, on attitude change following attitude-discrepant behaviors). James is well known, and has been roundly criticized, for his assertion that emotion is the perception of the somatovisceral reactions that follow the exciting fact (e.g., Baldwin, 1894; Cannon, 1927; but see Ekman, Levenson, & Friesen, 1983). Yet James (1894) did not regard all emotions as deriving from somatovisceral reactions, but instead agreed with Baldwin (1894) that associative processes could also govern the emotions (or at least the "subtler" emotions; see James, 1890/1950b; pp. 1084-1085). Thus, there was more than one means by which an emotion could be stimulated. The passions are not unique in being multiply determined. Research on a psychological phenomenon as different from emotion as an individual's intelligence (or behaviors indicative of intelligence) indicates it to be determined by both biological (e.g., genetic) and environmental inputs and by the interaction between genetics and environment (Plomin, 1989). A general principle illustrated in these works is that a given effect at one level of organization (e.g., emotion, intelligence) may have multiple antecedents within or across levels of organization. This has been termed the *principle of multiple determinism* (e.g., Cacioppo, Petty, & Tassinary, 1989; "New Frontiers in the Behavioral Sciences and Mental Health," 1989).

A corollary of this principle (the *corollary of proximity*) is that the mapping between elements across levels of organization becomes more complex (e.g., many-to-many) as the number of intervening levels of organization increases. The reason is that an event at one level of organization (e.g., voting behavior) can have a multiplicity of determinants at an adjacent level of organization (e.g., attitudes, social norms), which, in turn, may have a multiplicity of implementations at lower (e.g., neurophysiological) levels of organization, and so forth. The implication is not to avoid venturing across the abyss separating physiological and behavioral levels of organization, but to proceed incrementally. Linking physiological functions to social behavior via intervening psychological and social processes may improve predictions of these behaviors and, more important, differentiate similar social behavior achieved by different means (see Cacioppo & Petty, 1986). This, in turn, should yield greater understanding, prediction, and control of social phenomena.

The brain and behavioral effects of social facilitation, group cohesion, and so on are the *consequences* of human association, and hence social processes can be viewed as being causal. Indeed, following James, social phenomena can be construed as both inputs to and outputs of physiology:

> As a gregarious animal, man is excited both by the absence and by the presence of his kind. To be alone is one of the greatest evils for him. Solitary confinement is by many regarded as a mode of torture too cruel and unnatural for civilized countries to adopt. To one long pent up on a desert island, the sight of a human form in the distance would be the most tumultuously exciting of experiences. In the morbid states of mind, one of the commonest symptoms is the fear of being alone. (James, 1890/1950b, p. 430)

This does not mean that there are nonphysical processes serving as the proximal causes. There are neurophysiological processes which are affected by human association and which underlie the associated psychological and social phenomena. However, James contended that these psychological and social phenomena shape physiological events in ways that would not be evident from studies of the physiology isolated from the social or environmental context in which they manifest.

In an illustrative study, Haber and Barchas (1983) found that the administration of amphetamine to primates had little consistent effect on their social behavior until the animal's position in the social hierarchy was considered: Amphetamine increased dominant behaviors in primates high in the social hierarchy but increased submissive behaviors in primates low in the social hierarchy. Although this result can be explained in terms of Hull-Spence drive theory, this study is interesting for a different reason: It demonstrates how the effects of the physiological changes on behavior can *appear* unreliable (or chaotic) until analysis is extended across multiple levels of organization. The observation that the relationships between stimuli and physiological events, and between physiological events and behavior, can be modulated or gated by the presence or strength of factors at another (e.g., social, environmental) level of organization has been termed the *principle of nonadditive determinism* ("New Frontiers," 1989). There is, of course, an underlying biological mechanism for these emergent properties, but the identification of this mechanism may be served better by careful observation within various levels of organization and by a dialogue between or integrative analyses across multiple levels of organization than by reductionistic (or molar) methods alone.

Finally, in an interesting review of research on sex and aggression, Zillmann (1984) shows that violent and erotic material influences the level of physiological arousal in males. He shows further, however, that the level of physiological arousal has a reciprocal influence on the perceptions of and tendencies toward sex and aggression. Research in behavior genetics has similarly revealed that there are a wide variety of genetic influences that are inhibited unless or until certain environmental factors are introduced—that is, brain and behavioral processes are a function of particular genetic factors, which, in turn, are determined by environmental agents (Plomin, 1989). This iterating influence between biological and environmental factors illustrates what has been termed the *principle of reciprocal causation* ("New Frontiers," 1989).

CONCLUSION

In sum, James depicted psychological phenomena as being a function of situational as well as biological factors, with the underlying brain and ideational processes a

determinant and a consequence of organismic-environmental transactions. He contended that knowledge of the body and brain could usefully constrain and inspire concepts and theories of psychological function, since there are any number of ways in which a particular outcome might be achieved. He further contended that knowledge about the functional organization of mental activities could usefully guide the study of the underlying biological mechanisms (e.g., brain processes), since the possible presence and significance of particular physiological mechanisms and events could be suggested by the observed mentation and behavior.

James (1890/1950a) also contended that the study of ideational processes serves more than the function of surrogate for unspecified brain processes, for they can also reveal relationships among "feelings, desires, cognitions, reasonings, decisions, and the like" (p. 1) that can be both intellectually satisfying and socially important. Thus, James's view of psychology as a natural science draws on but goes beyond the description of experience and of the structure or function of neurophysiology to determine the functional and physiological principles governing the organism in transaction with its physical and sociocultural environment. The psychologist's fallacy (the confusion of the phenomenon of interest with the psychologist's own viewpoint) is therefore a siren that can be avoided in a science of mental life (James, 1890/1950a, p. 196).

Many of the details of the relationship between mental life and physiological phenomena were not available to James. Nevertheless, his essentially monistic and integrative perspective for the science of psychology presaged several emerging principles relevant to the full explanation of social and psychophysiological phenomena: (a) the *principle of multiple determinism*, which states that psychological and behavioral phenomena are determined by a multiplicity of factors within and across levels of organization; (b) the *corollary of proximity*, that the mapping between elements across levels of organization becomes more complex (e.g., many-to-many) as the number of intervening levels of organization increases; (c) the *principle of interactive effects*, that certain properties of, or the order underlying, a behavioral phenomenon may emerge only when examined across levels of organization; and (d) the *principle of reciprocal causation*, that the expression of organismic events underlying psychological and behavioral events both influences and is influenced by social and environmental events. These principles, though not derived from James's work, would in retrospect be at home in his *Principles of Psychology*.

NOTES

1. Because James poses something of a moving target, we focus primarily on the positions he espoused in the early portions of *Principles*, where he dealt explicitly with the topics of the mind/body riddle and the science of psychology, and in his final chapter, where he dealt with the genesis of experience and science. Interested readers may wish to consult Leary (1990) for additional information about the historical context in which *Principles* was written.

2. *Level of analysis* is yet another term found in the literature. The term *level of analysis*, however, has been used in a variety of ways—among others, to refer to level of organization and to refer to level of explanation. We prefer to avoid the confusion that can come with the use of the term *levels of analysis*.

3. We wish to thank Gary Berntson, whose revealing discussions on neuropsychology and cortical function made these points apparent.

4. Unlike some of his contemporaries, James explicitly criticized the simplistic analogy between complex neural processes and complex mental processes. Although he saw the utility of reaction time measurement in the investigation of attention, he remained highly critical of the assumptions underlying the indiscriminate use of reaction time:

> I trust I have said enough to convince the student that this minimum time by no means measures what we consciously know as discrimination. It only measures something which, under experimental conditions, leads to a similar result. But it is the bane of psychology to suppose that where the results are similar, processes must be the same. Psychologists are too apt to reason as geometers would, if the latter were to say that the diameter of a circle is the same thing as its semi-circumference, because, forsooth, they terminate in the same two points. (James, 1890/1950a, pp. 527-528)

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