

## How Thoughts Affect the Body: A Metatheoretical Framework

Irving Kirsch

*University of Connecticut*

Michael E. Hyland

*Plymouth Polytechnic*

The rise of cognitive psychology has heralded a revival of interest in the mind-body problem. As a heuristic, Hyland (1985) suggested that mind terms and body terms be thought of as complementary descriptions of the same event. Complementarism precludes causal relations between mental and physiological events, and instead posits identity relations between these two types of variables. Independently, Kirsch (1985) proposed that for all causal sequences linking one mind state to another, there is a corresponding causal sequence of physiological states. Rather than being mind-body philosophies, complementary and causal isomorphism are shown to be logical consequences of virtually all monist philosophies, including those that are currently most prominent. Their heuristic value is demonstrated with respect to empirical questions about psychophysiological phenomena. Complementary and causal isomorphism are also used to reconceptualize situational and behavioral variables as causes and consequences of cognitions.

Interest in the mind-body relationship has varied during the history of psychology. Wundt (1897/1969) devoted a chapter to this topic in his *Outlines of Psychology*, in which he presented his theory of the actuality of mind, essentially a double-aspect monist position. Likewise, James (1890) wrote a chapter called "the relation of minds to other things" in *The Principles of Psychology*. However, to most behaviorists, the mind-body relationship was seen as irrelevant. Watson (1913) maintained that for a behaviorist, "the mind-body problem affects neither the type of problem selected nor the formulation of the solution of that problem. I can state my position here no better than by saying that I should like to bring my students up in the same ignorance of such hypotheses as one finds among the students of other branches of

science" (p. 166). Neobehaviorists avoided dealing with the mind-body issue by avoiding mentalist constructs (Hull, 1943) or by emphasizing an instrumentalist interpretation of theoretical terms (Tolman, 1932). Radical behaviorists rejected any form of theoretical description as being unnecessary for a "scientific" explanation of behavior, and this rejection included both mental and physiological accounts of behavior (Skinner, 1953).

The demise of behaviorism and the rise of cognitivism heralded a revival of interest in the mind-body relationship, particularly when cognitions are interpreted in terms of mental content (see Bindra [1984] for an account of different uses of the term cognition). At the same time, research linking mind states and physical illness was developing, and this research required a meta-theoretical framework to underpin the developing theories.

In recent years, there have been a number of publications which relate to the mind-body problem. Two of these, one by Hyland (1985) and one by Kirsch (1985), reached similar conclusions about the relationship between mental terms and physiological terms, conclusions which were arrived at independently and through different means. Hyland's ideas were based on the notion of complementarity, Kirsch's on causal isomorphism. The purpose of this paper is to extend Kirsch's and Hyland's work in three ways: (a) to demonstrate that complementarity and causal isomorphism are *logically implied* by (not merely consistent with) most monist mind-body positions; (b) to demonstrate the heuristic value of these concepts; and (c) to consider the implications of complementarity to the way psychologists conceptualize stimulus and behavioral response variables.

### Complementarity

The concept of complementarity was introduced by Bohr (1934, 1949) to account for certain phenomena in physics. Specifically, it was used to account for the apparent necessity of using both wave and particle descriptions of micronature, despite the fact that these descriptions logically preclude each other. The exact meaning of Bohr's use of this concept has been the subject of some discussion. Popper (1963, p. 101) concluded

I have explained Bohr's "Principle of Complementarity" as I understand it after many years of effort. No doubt I shall be told that my formulation of it is unsatisfactory. But if so I am in good company; for Einstein refers to it as "Bohr's" principle of complementarity, a sharp formulation of which . . . I have been unable to attain despite much effort which I have expended on it.

In fact, there are several related aspects of Bohr's complementarity, one of which is that the observer alters what is being observed. This aspect of complementarity is clearly relevant to psychology (Snyder, 1983a, 1983b) and is consistent with a social constructionist perspective (e.g., Gergen, 1985). A

second issue concerns the question of whether complementarity is a statement about nature or whether it is a statement about temporary or permanent limitations of our knowledge of nature. According to the former interpretation, the nature of reality is such that to describe it completely requires the use of incompatible forms of description (e.g., Bronowski, 1973). Others (e.g., Feyerabend, 1958), however, have argued that there *must* be a single absolute form of knowledge and that complementarity is simply a working model before reaching that absolute knowledge.

MacKay (1958) developed and extended Bohr's idea of complementarity so as to make it applicable to any discipline. MacKay argued that complementarity is a logical consequence of certain sorts of descriptive language and is therefore not just a working model but a true representation of reality. He suggested that "complementarity statements are essential when one chosen language-system is logically precluded from representing some of the distinctions or relationships which are discernible in the subject matter" (p. 121). According to MacKay, descriptions of minds and brains are complementary because each precludes some of the distinctions discernible in the other. In fact, MacKay's approach is consistent with Wundt's (1897/1969) contention that minds and brains are "components of *one* experience regarded from different points of view" (p. 314). A similar though independent application of complementarity to the mind-body relationship was suggested by Globus (1976).

Hyland's (1985) use of the term complementarity derives from MacKay's but with two differences. First, Hyland does not commit himself as to whether complementarity is a true representation of reality or only a working model. He suggests that whether ultimately true or not, complementarity is a pragmatic viewpoint to accept at this present stage of psychology's development. As such, Hyland treats complementarity as a metatheoretical heuristic, rather than a metaphysical statement. Hyland's use of the term complementarity is therefore quite different from that of Bohr's (who is assumed to make an ontological statement).

The use of the same term with different meanings has led to some confusion (Hyland, 1987; Snyder, 1986). We shall therefore refer to Hyland's complementarity as *methodological* complementarity as opposed to *metaphysical* complementarity. Methodological complementarity is consistent with the definition of complementarity described above from MacKay but carries no metaphysical implication.<sup>1</sup> Specifically, methodological complementarity (hereafter simply referred to as complementarity) does not imply any particular

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<sup>1</sup>MacKay treats complementarity from a number of perspectives, one of which, the relation between scientific and theological thought (MacKay, 1974) appears more consistent with theoretical rather than metaphysical complementarity. A theoretical approach to complementarity within a Piagetian framework is provided by Oser and Reich (in press).

mind-body metaphysic. Instead, it is a set of heuristic rules for the use of mind terms and brain terms in theory construction.

The second way in which Hyland's use of the term complementarity differs from MacKay's is that Hyland uses "surplus meaning" as a criterion for distinguishing different types of complementarity in psychology. In their classic paper on a distinction between hypothetical constructs and intervening variables, MacCorquodale and Meehl (1948) suggested that hypothetical constructs had surplus meaning, that is, meaning which was not contained in their operational definitions. The surplus meaning describes what the hypothetical construct is like (i.e., its nature) rather than what it does. Hyland argues that there are categories of surplus meaning in psychology: one category provides insight into the relationship between mind states and behavior and another provides insight into the relationship between physiology and behavior. (A third mechanistic category is not relevant to the present discussion.) These sources of surplus meaning give rise to different forms of complementary description.

One assumption underlying methodological complementarity, as well as metaphysical complementarity, is that causal relations cannot occur between different types of complementary description. Hence, Hyland suggests that causal relations can occur only between mind and mind states or between body and body states. However, mind-body connections are established through identity relations which are complementary descriptions of the same event. Causal and identity relations should be used together in psychosomatic explanation as shown in Figure 1. In this and subsequent figures, horizontal arrows represent causality and vertical lines denote identity relations. Thus, feelings of inadequacy cause illness-oriented thought and hormonal changes cause illness. However, illness-oriented thoughts cannot be the cause of hormonal changes. Nevertheless, a relation between thoughts and hormonal changes is possible because thoughts and their corresponding brain states are different descriptive terms for the same event.

One negative consequence of identity relations is that mental states may often be identified with unknown physiological states. That is, the physiological state is, and may remain, purely hypothetical. However, the solution to this problem is itself heuristic: there is a better chance of discovering an

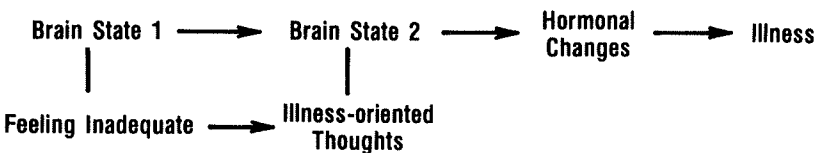


Figure 1. Causal and identity relations in the development of psychosomatic illness.

identity relation between a mental and physiological state when the mental state is described *precisely*. For example, "stress" is sometimes postulated as an initial cause of a psychosomatic problem. However, "stress" is a very general concept and may in different instances refer to very different psychological states. Research in this area might benefit from a more detailed phenomenological analysis of the types of psychological states that are relevant to particular physiological problems.

### Causal Isomorphism

The idea of causal isomorphism was proposed by Kirsch (1985) as a means of accounting for some of the effects of placebos on physiological function. Placebos (and active drugs as well) induce expectancies for changes in subjective experience. For example, people expect to become relaxed if they take tranquilizers and energized if they take stimulants. Considerable data demonstrate that these "response expectancies" are self-confirming, in that they tend to generate the expected response. Because of the ubiquity of these effects, Kirsch proposed the heuristic hypothesis that these effects of expectancy on subjective experience were immediate (i.e., not mediated by other psychological states), in the same way that intentions have been hypothesized to be immediate determinants of voluntary behavior (Ajzen and Fishbein, 1980).

In addition to affecting self-reports of subjective experience, experimental data have shown placebos to have predictable effects on physiological function. For example, placebo tranquilizers produce decreases in blood pressure and pulse rate, whereas placebo stimulants have opposite effects (Brodeur, 1965; Frankenhaeuser, Jarpe, Svan, and Wrangsjö, 1963; Kirsch and Weixel, in press). Similarly, self-reported enhancement of sexual arousal as a function of placebo alcohol has been accompanied by increases in penile tumescence, heart rate, and skin temperature (Briddell et al., 1978; Lansky and Wilson, 1981; Wilson and Lawson, 1976). The question that these data pose is: How can these *physiological* changes be produced by expectancy, which is after all a *mental* construct?

Kirsch's (1985) answer to this question begins with the assumptions that: (a) there is (in principle) a physiological counterpart to any instance of a mental event, and (b) the relation between a mental event and its physiological substrate is better described as an identity relation than as a relation of cause and effect, an assumption that is equivalent to Hyland's (1985) independently conceived notion of mind-brain complementarity. According to Kirsch, these assumptions are not based on any one mind-body philosophy, but are instead implicit in virtually all nondualist philosophies.

The idea of causal isomorphism is a logical consequence of the two assump-

tions described above. If there are physiological substrates to all mental events, then for any causal sequence of mental events, there must be a corresponding sequence of physical events. In other words, for any true statement indicating that one mental event has caused another mental event, there must be a true statement about two corresponding physiological states. This principle is illustrated in Figure 1 with respect to feelings of inadequacy, thoughts of illness, and their corresponding physiological substrates. If feeling inadequate causes illness-oriented thoughts, then the brain states that correspond to those feelings must cause the brain states that are identified with those thoughts. In Figure 2, this principle is applied to the question of how placebo stimulants produce increases in pulse rate. Properly speaking, a placebo-induced increase in pulse rate is not caused by expectancy. Rather, it is caused by the physiological (brain) state with which the expectancy is identified.

Despite the similarity in terminology, the concept of causal isomorphism should not be confused with the gestalt hypothesis of psychophysical isomorphism (Köhler, 1947, 1969). Köhler hypothesized an isomorphic relation between the structure of an experience and the structure of the underlying brain process. For example, he assumed that "when the visual field exhibits a thing as a detached entity, the corresponding process in the brain is relatively segregated from surrounding processes" (Köhler, 1947, p. 201). In other words, the gestalt principle of isomorphisms claims that the shape of a perceptual configuration corresponds to the locations of the areas stimulated in the cortex.

In suggesting the principle of causal isomorphism, Kirsch (1985) made no assumption about the degree of structural similarity between an experience and its physiological substrate. Instead, he posited that the functional relationship between two experiences corresponds exactly to the functional relationship between the two corresponding brain states. It is true that causal isomorphism can be inferred from the gestalt principle of structural isomorphism. If there is a brain state that corresponds to any given experience, then the functional relations between experiences must be isomorphic to the functional relations between brain states. But this is equally true in the absence of any structural similarity between an experience and its physical substrate. Thus, Wundt was able to endorse causal isomorphism, while at the same time denying structural isomorphism (see Wundt [1897/1969, p. 319] and Köhler [1969, p. 64]).

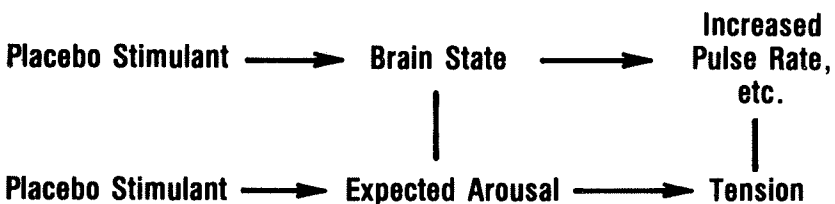


Figure 2. Causal isomorphism as illustrated through the effects of a placebo stimulant.

### Methodological Complementarity and Causal Isomorphism as Logical Consequences of Mind-Brain Philosophies

Hyland introduced the assumption of complementarity as a heuristically useful linguistic convention, rather than as an ontological statement. Similarly, Kirsch introduced the related notion of causal isomorphism without implying any particular philosophy of mind. Specifically, complementarity and causal isomorphism are metatheoretical statements. That is, they are statements about relationships between theoretical terms and relationships between theories containing these terms. They are not metaphysical statements about minds and bodies. In this section, we examine the relation between complementarity (and by extension, causal isomorphism) and prominent mind-body philosophies. We demonstrate that complementarity and causal isomorphism are logically implicit in virtually all monist mind-brain philosophies.

Mind-body discussions typically entail consideration of two separate issues, often without distinguishing between them. The first is the metaphysical issue of the relation between mental states and their physiological substrates. The second is the epistemological issue of the relation between perceptions and the objects of perception. In this section, we are concerned only with the first of these issues. For that reason, some of the most familiar stances (e.g., subjective idealism and neutral monism) need not be considered. Also, with respect to the traditional mind-body philosophies that we do consider, our emphasis is on contemporary versions of these positions. Thus our concern here is specifically with the relation between mind and brain, rather than the more general question of the relation between mind and body.

Since Descartes, the fundamental issue in mind-body philosophies has been the distinction between monism and dualism. The underlying question is, "Is the world composed of just one kind of substance or two (i.e., a mind substance and a body substance)?" For those who assume a dualist answer to this question, the focus for discussion is the relation between these two fundamentally different kinds of substance. For the monist, the comparable issue is to define the character of the single substance of which the world is composed and to account for the fact that there appears to be two substances. Traditionally, these latter positions have taken three general forms: materialism, idealism, and double-aspect theories. Only two of these stances, however, pertain to the relationship between mind and brain. These are materialism (i.e., identity theory and functionalism), and double-aspect monism.

#### *Double-Aspect Monism*

Double-aspect theorists view mind and body as two aspects—or ways of viewing and describing—the same thing. As originally proposed by Spinoza,

the double-aspect position pertained to all phenomena, including inorganic objects, thereby resulting in panpsychism.<sup>2</sup> However, psychologists who adopt a double-aspect position (e.g., Wundt, 1897/1969) typically restrict it to a subset of living organisms. As a mind-brain theory, it is the position that mental events and brain states are two ways of describing a single underlying unitary reality. This, of course, is identical to the definition of mind-brain complementarity as an ontological statement, and it therefore necessarily implies methodological complementarity. It also implies causal isomorphism, because (as we have shown above), causal isomorphism necessarily follows from the principle of complementarity.

Double-aspect theories are rarely discussed and even less frequently defended by contemporary philosophers of psychology. Traditionally, philosophers have been uncomfortable with the lack of definition of an "aspect" or "point of view" and with the failure of double-aspect monists to specify the underlying unity of which mind and body were hypothesized to be aspects. A more current objection is that panpsychism seems inconsistent with empirical data linking mental events only to specific types of physical events. However, when the limitation is imposed that only some events have a mental aspect (though all have a physical aspect), one is left with a position that is difficult to distinguish from materialism in that all phenomena are presumed to be physical. For these reasons, the most popular current mind-brain positions are one or another form of materialist philosophy.

### *Central State Identity Theory*

The defining claim of materialist philosophies is that the universe is entirely composed of physical phenomena.<sup>3</sup> Mentalistic terms (e.g., sensation, thought, or feeling) are either meaningless or they refer to physical (generally physiological) phenomena. The most prominent modern formulation of materialism is the identity thesis (Smart, 1963). According to the identity thesis, "mental" events *are* physical events, in the same way that water is H<sub>2</sub>O. Specifically, mentations are states of the nervous system, the particular state of the nervous system to which any mental term refers being an empirical question.

Although materialist philosophies need not be reductionist (Boyd, 1980), most are. Reductionist theories are not compatible with metaphysical complementarity, because the notion of complementarity as proposed by Bohr

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<sup>2</sup>Panpsychism is the idea that there is a mental aspect that corresponds to any physical entity.

<sup>3</sup>Some philosophers (e.g., Marx) who are termed "materialists" (by themselves or others) allow the existence of nonphysical mental phenomena, but view those phenomena as dependent on material events (e.g., physiology). This view is more accurately categorized as "epiphenomenalism," a variety of dualism.



(1934, 1949) is based on the assumption that any reduction of wave theory to particle theory (or the reverse) would be factually incorrect. Nevertheless, even reductionist, mind-brain, identity theories imply methodological complementarity (and, therefore, causal isomorphism as well). This is true because mind states and brain states are posited to be identical to each other, rather than causally related. If water is  $H_2O$ , it is not *caused* by  $H_2O$ , even if theoretical reduction is possible. This can be seen even more clearly with other examples cited by materialists as analogous to the relation between mind and brain. Because Muhammad Ali is Cassius Clay, it would be factually incorrect to say that Cassius Clay *causes* Muhammad Ali. Thus, contemporary versions of materialism logically imply both mind-body complementarity and causal isomorphism.<sup>4</sup>

### *Metaphysical Functionalism*

Metaphysical functionalism is a recent philosophy of mind inspired by the field of artificial intelligence (Block and Fodor, 1972; Fodor, 1968). It begins with the materialist assumption that there is a physical substrate for any mental event, but it rejects the assumption that the physical substrate is *necessarily* a state of the central nervous system, an assumption that would limit mind to organisms containing central nervous systems and thereby precludes the possibility that a computer might think. This problematic consequence is avoided in metaphysical functionalism by taking into account the distinction between function and structure.

Functionalists propose that although any particular mental state is a physical event, its classification as a *type* of mental state does not depend on its physical structure. Instead, the classification of mental states depends on their causal relations to stimuli and responses, and to other mental states. For example, although any particular pain can be identified as a specific physical state, dif-

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<sup>4</sup>As commonly defined by philosophers of psychology, mind-body reductionism consists of the assertions that (a) mental events are physical events and (b) because *all* events can be described in the language of physics but only some in the language of psychology, physical descriptions are more general or fundamental than psychological description (cf. Fodor, 1975). This does not imply that mental terms are meaningless (in fact, the first assertion is a statement of what mental terms mean) or that psychological theory and research ought to be abandoned. For example, the explanation of chemical bonding in physical terms has strengthened the belief that chemistry can be reduced to physics, but that does not mean that chemical research and theory ought to be abandoned. Reductionism does require that psychological theory be consistent with physical theory (as does complementarity). It also suggests that causal psychological laws ought to be discoverable and that physiological theory ought to be consistent with those laws. Furthermore, because psychological constructs (e.g., sensations, feelings, and thoughts of various kinds) can be more easily identified than their physical substrates, it is likely that even if reductionism is true in principle, psychological theory will be established prior to and provide a heuristic for corresponding physiological theory.

ferent pains may be different types of physical states. In human beings, pains are physiological states; pain in a computer would presumably be an inorganic physical state. The classification of both states as instances of pain would be based on shared functional (causal) characteristics, such as being consequences of physical damage and leading to avoidance of the situations in which they occur.

In postulating that mental states are physical events, metaphysical functionalism posits complementary rather than causal relations between mental events and their substrates. Because every instance of a mental event is presumed to have a particular physical substrate, a functional relation between mental states implies a corresponding functional relation between the substrates. Furthermore, these causal relations provide the basis for the classification of mental states. Thus, functionalism not only posits causal isomorphism, it also makes it the criterion by which mental terms are defined.

### *Structural Realism*

Pribram's (1986) structural realism is similar to functionalism in its emphasis on relations between events. However, rather than beginning with the assumption of a materialist metaphysic, Pribram adopts a position which resembles double-aspect theories, but which answers the objection that double-aspect theories fail to identify the nature of the underlying unity of which mind and body are aspects. According to Pribram, "informational structure" is the underlying essence of which mind and brain are "realizations" or "embodiments." In giving ontological primacy to informational structure, Pribram's position seems to be at least distantly related to Plato's theory of forms. In any case, since these informational structures implicitly include causal relations, the idea of causal isomorphism necessarily follows.

### *Dualism*

Dualist theories begin by denying that mental states can be *identified* with states of the nervous system. The fundamental question for dualism is to account for the apparent correlation between mental and physical events. Interactionism and epiphenomenalism are clearly incompatible with complementarity and causal isomorphism because they are based on the assumption of casual relations between mind and body. Parallelism, on the other hand, posits an isomorphic relation between sequences of mental and physical events. Although physical events correspond to mental events, the relationship between the two is not one of identity. Nevertheless, because direct causal relations between mental and physical events are precluded, the heuristic consequences of parallelism may not be appreciably different from the assumption of complementarity.

### Heuristic Implications

We have demonstrated that although the assumptions of mind-brain complementarity and causal isomorphism are inconsistent with some philosophies of mind (e.g., interactionist dualism), they do not require a commitment to any particular alternative. We have further shown that complementarity and isomorphism are not only consistent with both materialist and double-aspect mind-brain theories, but that they are logically deducible consequences of those philosophies. In fact, any monist theory that accepts both mental and physiological terms as meaningful *must* imply complementarity (and as a consequence, causal isomorphism as well.) This is true because to allow both types of terms without specifying that they refer to the same thing is, by definition, dualism. Having shown that complementarity and isomorphism can be deduced from most current mind-brain philosophies, we turn now to the heuristic value of these assumptions. In particular we intend to show that the most common alternative generates pseudo-answers to improperly formulated questions.

Of all mind-body philosophies, only interactionist dualism allows that mind can have a direct causal effect on the body. There are abundant data of mental events influencing bodily processes, but we also want to know the mechanism by which this occurs. However, precisely because interactionism postulates a direct causal relation, it is not very helpful in the search for causal mechanisms.<sup>5</sup>

A typical dualist strategy is to look for some physiological variable that may mediate the relation between a mental cause and a physical effect, a strategy that is also used to provide "explanatory" mechanisms for mind-mind causal sequences. Endorphin release, for example, has been proposed as an explanation of placebo-induced pain reduction. However, this is really a pseudo-explanation. Let us suppose that increased endorphin release is associated with placebo-generated expectancies for reduced pain. (In fact, the current data are inconclusive.) Instead of answering the original question ("How can expectancy reduce pain?"), it merely replaces it with a new and more complex question ("How can expectancy cause an increase in endorphin release?"). From an interactionist perspective, this could be answered only by finding some new intervening physiological event, which would in turn require explanation.

In contrast to dualist interactionism, the assumptions of complementarity and causal isomorphism that are implicit in monist philosophies preclude asking the question "What physiological variable mediates the effects of mental

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<sup>5</sup>Epiphenomenalism is even less helpful heuristically, in that it leads to the suggestion that the problem be abandoned as illusory.

states?" They thereby avoid the infinite regress to which that question leads. In its place, these assumptions suggest the following questions: (a) What are the causal relations between mental states, (b) What are the physiological states with which those mental states are identified, and (c) What nonconscious physiological processes mediate the effect of one physiological state on another? The first of these questions provides a complete psychological explanation, the third provides a complete physiological explanation, and the second establishes the correspondence between the two. A complete psychophysiological explanation thus requires answers to all three questions.

Technically, the assumptions of complementarity and causal isomorphism suggest that the question "How does a mental state produce a physiological effect" is improperly formulated. The proper questions are (a) What are the psychological consequences of the identified mental state, (b) What is its physiological counterpart, and (c) How does that physiological state generate the observed physiological effect?

Figure 3 illustrates how the question "How does perceived danger produce an increase in pulse rate?" might be approached given the assumptions of complementarity and causal isomorphism. Let us assume that perceived danger leads to fear, and that there are no *psychological* (i.e., mental) states intervening between the perception of danger and the experience of fear. In other words, we are assuming that the relation between perceived danger and fear is immediate and that at the psychological level, the causal explanation is complete. At this point, we may say that the perception of danger leads to an increase in pulse rate because it causes fear, and because increased pulse rate is part of the physiological substrate of the experience of fear.

From this perspective, the phenomenon of endorphin release is irrelevant to a purely *psychological* explanation of placebo-induced pain reduction. At the psychological level, the task is to establish whether there are any mentalistic variables (e.g., anxiety reduction) that mediate the connection between the expectancy and the actuality of reduced pain. If endorphin release is a reliable concomitant of this phenomenon, then it is either (a) part of the

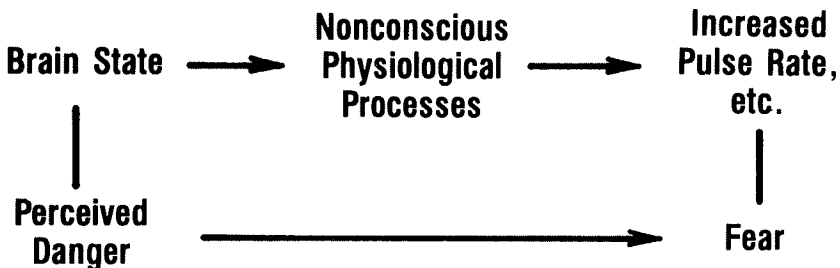


Figure 3. Complementarity and causal isomorphism as heuristic guides to questions of how mental states "cause" physiological effects.

physiological substrate of perceived danger, fear, or an intervening psychological state, or (b) a consequence of one of these physiological states.

### Situation and Behavior

Our discussion so far has focussed on minds and brains but without considering the *situations* and *behaviors* which are inextricably part of mind and brain theories. Situation and behavior are just two of several similar descriptive labels which are used in psychology. The following terms have similar (though not identical) meanings to the situation: stimulus, environment, setting, cue, and environmental press. The terms response and action are similar though not identical with behavior.

There are several dimensions on which situation terms and behavior terms differ. One dimension has to do with level of specificity: for example, a cue is more specific than a situation. A second dimension has to do with the amount of information embedded in the situation or behavior. For example, the term "setting" (Harré, 1979) denotes that socially relevant information is "out there" (see also Parker, 1987). Similarly, in Gibson's theory of perception, complex aspects of the situation are located in the environment and are perceived directly rather than needing interpretation by some internal process. A third dimension relates directly to our earlier discussion of minds and bodies: to summarize our argument in advance, some situation and behavior terms should be considered mind terms whereas others should be considered physical terms.

During the period of behaviorist dominance, the terms stimulus and response were used to refer to physical aspects of the situation or behavior. Indeed, because observability was the underlying philosophy of science at the time, the situation and behavior *had* to be described in physical terms. However, some psychologists were dissatisfied with such physical description, particularly those influenced by Gestalt notions of perception. For example, Murray (1938) introduced the term "press" as a "psychologically relevant" alternative to physical descriptions of the situation.

It can be said that a press is a temporal Gestalt of stimuli which usually appears in the guise of a *threat of harm* or *promise of benefit* to the organism. It seems that organisms quite naturally "classify" the objects of their world in this way: "this hurts," "that is sweet," "this comforts," "that lacks support." (Murray, 1938, pp. 40-41.)

What is clear from Murray's account of press is that it constitutes a mental description rather than a physical description. That is, it is a description of the stimulus in terms of its meaning to the organism instead of in terms of its physical characteristics. Gibson's (1979) concept of "affordance" is similar to Murray's concept of "press": an affordance is an aspect of the situation

described in terms of that which enables the organism to do something.<sup>6</sup>

In psychological experimentation, we often choose and categorize stimuli in terms of their meaning to subjects rather than their physical characteristics. In testing a proposed treatment for phobic disorders, for example, we might have a sample that includes some subjects who are afraid of snakes and others who are afraid of spiders. These subjects might be tested by having them rate their fear of "the phobic stimulus" and by asking them to approach it as closely as they are able. But "the phobic stimulus" would be a snake for some subjects and a spider for others. Physically these are different stimuli, but in terms of their meaning to the subjects they are the same.

This emphasis on the mental rather than the physical is also characteristic of Tolman's distinction between his concept of "molar acts" or actions and the concepts of "physical responses" used by other behaviorists. According to Tolman, an action is described in terms of its "purpose" (i.e., the goal that is achieved), and an action is not equivalent to a series of physical movements. Thus, in different instances, the same behavioral act can be composed of different physical movements. Rychlak (1987) argues that current psychology lacks a term to refer to behavior in terms of goal orientation and proposes the term "teleosponse" in addition to the nongoal-oriented term of "response."

Although a minority of authors have argued that the situation and behavior should be described in terms of psychological meaning rather than physical properties, the old habits laid down during the period of behaviorist dominance die hard. Many cognitive psychologists use situations and behaviors as physical variables, yet assume, problematically, that those physical variables can then cause and are caused by mental states. If behavior is a physical event, how can it be caused by a mental event?

Some materialist philosophies hold that situations and behaviors are indeed physical variables, and that mental description can always be reduced to the physical. However, materialism need not be reductionist (e.g., Boyd, 1980), and other complementarist philosophies (e.g., double-aspect monism) are clearly inconsistent with reductionism. Following the arguments of Murray, Tolman and others, we assume that it is not possible to reduce psychological descriptions of the situation and behavior to physical descriptions. When situations or behaviors are defined and classified in terms of purpose, significance, or any other mentalistic construct, they can be regarded as mental rather than physical variables.

Both physical *and* mental descriptions of situations and behaviors are relevant to psychological theories. Specifically, physical and mental descriptions of situations and behaviors are complementary in the sense suggested by

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<sup>6</sup>The "physical versus mental" dimension is related to the "much information out there versus little information out there" dimension. If the situation is described in terms of much information, that information tends to be of a mental rather than physical nature.

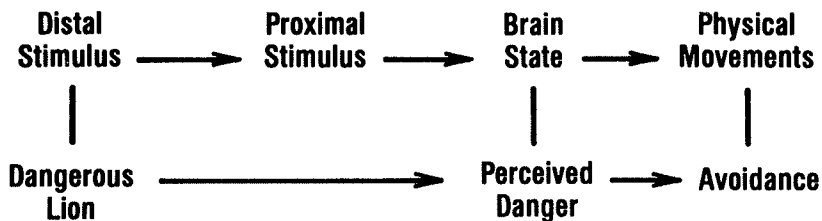


Figure 4. Situations and behaviors described in different ways when causally related to mental or physiological hypothetical constructs.

MacKay (1958). Any situation or behavior can be described in terms of its meaning and in terms of its physical properties. The two sorts of description are complementary and one cannot be reduced to the other: greater precision of physical description does not necessarily imply greater precision of mental description.

The above account of situations and behaviors can now be linked to the ideas of complementarity and causal isomorphism described above: complementary and causally isomorphic accounts include the situation and behavior as well as mental and physiological processes. In Figure 4 we show physical/physiological and mental causal sequences (and relevant identity relations) for a person running away from a dangerous lion.<sup>7</sup> Notice that although the distal stimulus is the lion, the two forms of description are not interchangeable. The “dangerous lion” is a description of the situation in terms of its meaning, in this case as a discernible threat. The “distal stimulus” is the traditional physicalist description of a situation. As a physical stimulus, the lion may be described in terms of its biological structure, or as a pattern of ambient light or sound waves. The proximal stimulus is a physical description of the pattern of sensory stimulation to which the distal stimulus gives rise.

It would be a mistake to assume that the psychological description of the situation simply has more information than a physical description. Instead, these two forms of description provide *different kinds* of information. Although a psychological description provides information about what lions typically do (e.g., eat people), it does not provide information about the spectral qualities of the lion’s fur. Nor does it tell us about the shape or size of the lion. These two types of description are not interchangeable. People do not run away from light waves or fur. Retinal stimulation is not due to the propensity of lions to eat people. Psychological and physical descriptions of situations are therefore complementary.

<sup>7</sup>We do not mean to imply that the proximal stimulus is sufficient to give rise to the brain state with which the perceived threat is identified. Other determinants of that brain state are pre-existing physiological structures, including those that correspond to the person’s knowledge and beliefs.

The arguments which lead to the distinction between physical and psychological descriptions of the situation, lead also to a distinction between physical and psychological descriptions of behavior. Although any specific instance of avoidance can be identified as a particular set of physical movements, avoidance is not merely those movements. In a different context, the same movements may not be an instance of avoidance (when a person is running toward rather than away from something, for example). Conversely, the same act of avoidance may be composed of an entirely different set of movements (for example, when the person has a vehicle at his or her disposal). In terms of the isomorphic causal sequences, the distinction is even more salient. A brain state does not cause avoidance, and a perceived threat does not cause a particular set of physical movements.

The above example illustrates an important principle: when the situation or behavior is described, the act of describing results in the selection of only part of the total available information. The act of description thus leads to meaning attenuation. That is, in selecting one mode of description rather than another, some information is necessarily lost. It is this fact that renders reductionism untenable. The particular type of selection and corresponding attenuation of meaning depends on one's theory (this is an aspect of the theory-laden nature of observation) and on what one wishes to explain or predict. Thus, descriptions of situations and behaviors in physiological theories are different from descriptions of the same situations and behaviors in cognitive theories.

The conclusion, then, is that although mental and physiological theories may be causally isomorphic (from situation to theoretical process to behavior), one type of theory cannot be reduced to the other. Instead, each theory provides a different kind of incomplete information, and the different kinds of information are complementary to each other. Complete psychophysiological explanations require knowledge of three kinds of facts: (a) causal relations between psychological events; (b) causal relations between physical events; and (c) noncausal identity relations between mental and physical events. Psychophysiological explanation requires a detailed account of the phenomenology of the precipitating mental states *as well as* a detailed account of physiological processes. Thus, statements indicating causal relations between mental and physical events are either abbreviated references to a conjunction of these three types of relations or they are meaningless.

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