CONSIDERATIONS OF MENTAL CAUSATION IN BEHAVIORAL MEDICINE

by

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ABSTRACT

Metatheoretical and theoretical considerations of mental causation are explored in this thesis. The discussion is based on concepts from selected issues in contemporary philosophy, psychology, cognitive science, and behavioral medicine. A metatheoretical framework is used to organize the concept of mental causation as it is addressed from philosophical, theoretical, and empirical perspectives.

Chapter One is a consideration of three historical trends in twentieth century philosophy of science. The earliest and still dominant position is derived from logical empiricism. This "standard view" came under attack in the 1950's by historians of science, culminating in Kuhn's famous 1962 critique of logical empiricism in The Structure of Scientific Revolutions. Other philosophers such as Feyerabend, taking their inspiration from Kuhn, argued that observation is theory-laden and that science must be understood as a social and historical activity in which disciplines develop their own rules of practice.

More recently, other theorists have acknowledged the influence of social and historical forces without accepting the "anarchistic" implications of Feyerabend's views. They contend that science can achieve a progressive approximation to a true account of the real world. This third view is called Fallibilist Realism. Two features of Fallibilist Realism are particularly relevant to Chapter Two: a rejection of the traditional Humean analysis of causation and a stratified conception of nature. The latter feature implies the composition of natural phenomena in differing levels of organization in which natural properties emerge from lower levels of complexity.

Chapter Two contains a brief overview of current materialist hypotheses in the philosophy of mind including identity theory, eliminative materialism, and functionalism. Each is examined and a materialist alternative termed emergentism is proposed. The hypothesis, as

articulated by Roger Sperry and Philip Hanson, contends that mental states are natural properties which emerge from interactions among their neural constituents. As natural properties, these mental states have causal powers unique to their ontological level. A causal relation termed demergence is proposed in which mental properties have a concomitant influence on neural structures.

Chapter Three is an examination of mental causation from an empirical perspective. Research linking the immune system with the neuroendocrine system implies that mental states can influence the immune system. Three groups of studies serve to illustrate the extent of this influence: classical conditioning of the immune system, effects of stress on the human immune system, and attempts to influence the immune system through conscious mental effort.

The aforementioned metatheoretical framework is used in Chapter Four to illustrate the relevance of the previous ideas to large scale scientific enterprise. Hypotheses are generated regarding the immune system and self-regulation of the individual. The concept of homeostasis with respect to earlier scientific and philosophical perspectives is addressed. Questions regarding the nature of health are raised.

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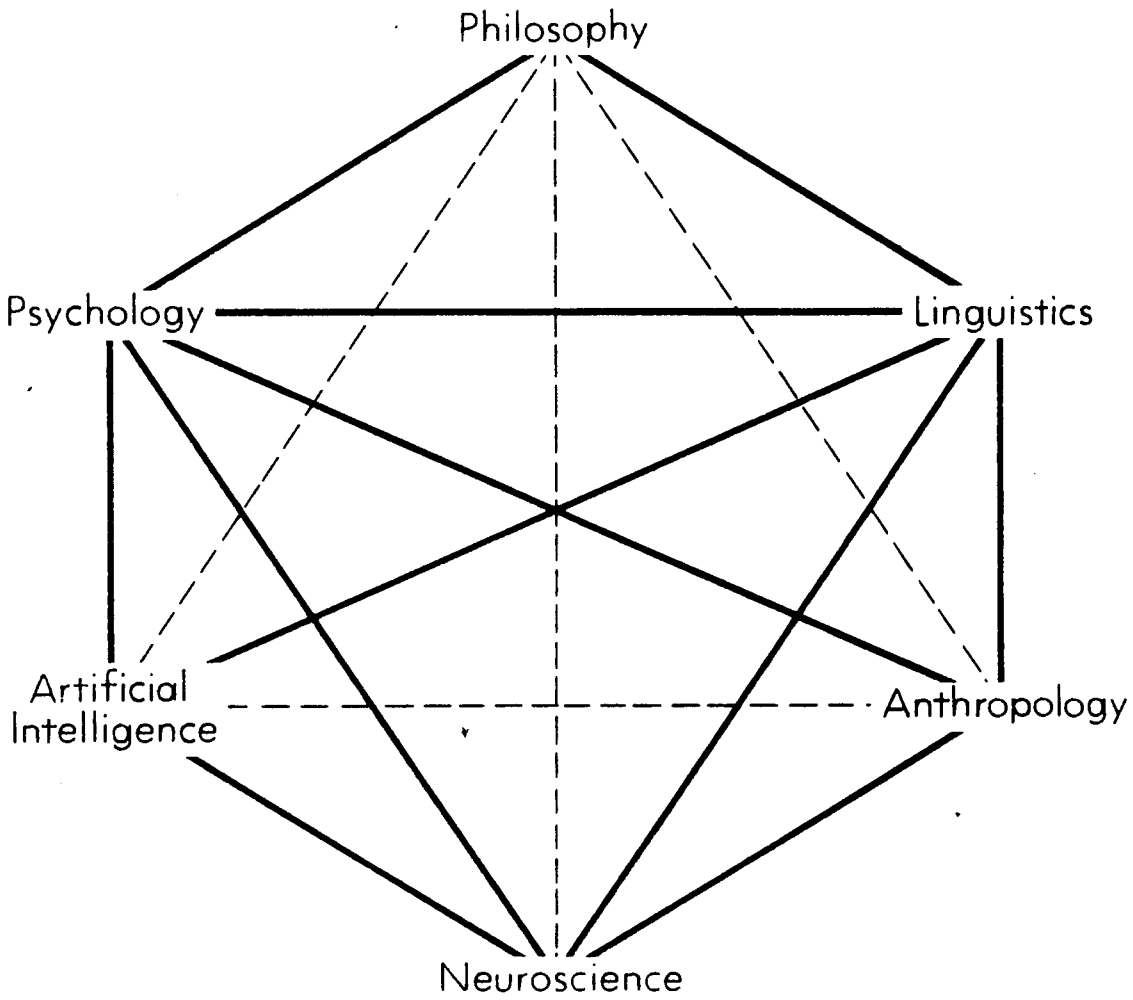
INTRODUCTION

Over the past thirty years, North American psychologists have witnessed a shift in their discipline from the dominant perspective of behaviorism, which failed to recognize cognitive or mind related elements as the primary matter of psychology, to more cognitively oriented methodologies. Royce (1982) acknowledges this shift, but comments that it has created a more fragmented scientific framework than behaviorism. He states that psychology, as a result, has become "multimethodological, multivariate, multiepistemic, multi-world-view, multiparadigmatic, multisystemic, multitheoretic, and multidisciplinary"(p.259).

One of the more robust successors to the behaviorist tradition has been the cognitive sciences. Gardner (1985) defines cognitive science "as a contemporary, empirically based effort to answer long-standing epistemological questions particularly those concerned with the nature of knowledge, its components, its sources, its development, and its deployment"(p.6). Distinguishing features of the science include: a necessary level of analysis as some type of mental representation, the use of the computer to model functions of the human mind, rootedness in classical philosophical problems, and belief in interdisciplanary studies. The primary disciplines involved are philosophy, psychology, artificial intelligence, linguistics, anthropology, and neuroscience.

A sketch of the interrelations among the six constituent fields was prepared by members of the Sloan Foundation in their State of the Art Report in 1978 (see figure 1). The support of the Sloan Foundation Cognitive Sciences Program in the mid 1970's expanded upon the shift that Royce recognized and a surge of interaction amongst the separate disciplines resulted. A similar program for the neurosciences was supported by the foundation in the early 1970's.

Conferees of the foundation acknowledged that, cognitive science was not as mature as neuroscience had been at the time of the latter's support but concluded that "nonetheless



Connections among the Cognitive Sciences

KEY: Unbroken lines = strong interdisciplinary ties
Broken lines = weak interdisciplinary ties

Figure 1 Disciplines of Cognitive Science

(from Gardner, 1985, p.37)

there is every indication confirmed by the many authorities involved in primary explorations, that many areas of the cognitive sciences are converging, and moreover, there is a correspondingly important need to develop lines of communication from area to area so that research tools and techniques can be shared in building a body of theoretical knowledge" (Sloan Foundation 1976, p.6).

From 1975 to 1982, the Foundation's financial support for the cognitive sciences was extensive, in excess of one hundred million dollars (US) dispensed over that time. The end of the program's course in 1982 did not produce a consensus on specific research paradigms for the cognitive sciences. Any working formulation of the field remains tentative. While many of the program's participants were enthusiastic, their optimism was tempered by a sense of the difficulties in countering long standing behaviorist and positivist traditions.

> We may be at the start of a major intellectual adventure: somewhere comparable to the position in which physics stood toward the end of the Renaissance, with lots of discoveries waiting to be made and the beginning of an inkling of an idea of how to go about making them. It turned out, in the case of the early development of modern physics that the advancement of the science involved developing new kinds of intellectual sophistication: new mathematics, a new ontology, and a new view of scientific method. My guess is that the same sort of evolution is required in the present case (and, by the way, in much the same time scale). Probably now, as then, it will be an uphill battle against obsolescent intellectual and institutional habits. (Sloan Foundation 1976, p.10)

Return to Mentalist Concepts

Cognitive scientists recognize mental states as opposed to behaviors as their primary subject matter. In part, because of this recognition, the ontological status of mental states has become a viable question within the philosophic community. Part of the argument within that community is whether mental states have natural properties unique to their ontological level. If these natural properties include causal powers that can influence physiological processes,

then it is imcumbent upon the scientific community to explore the nature of these causal powers and thus the role of mind and mental causation.

Traditional science operated upon the axiom that some observations are theory neutral, but Thomas Kuhn and others demonstrated that all observation, in fact, is theory driven, thus calling into question the modus operandi of the previous scientific tradition. This position acknowledged the place of social and historical forces in the development of science. Kuhn's ideas, in turn, were expanded by the fallibilist realists who recognized not only the cultural components of science, but also the stratification of nature which could provide a rationale for the mind's unique ontological status, as well as its causal powers.

The fallibilist realist position concerning the compositional or special ontological status of mind, as well as its causal aspects have also been addressed by materialist philosophies of mind. From a welter of theories on this subject, three materialist philosophies of mind have dominated speculation in this area. Central state identity theory, eliminative materialism, and functionalism all attempt to address the compositional and causal questions necessary to a cogent theory of mind. Another less known theory that addresses these questions is emergent interactionism. The basic question of each of these approaches is how the physical complexity of neural organization gives rise to mind.

Although it is difficult to establish any one of these approaches as correct, the emergent interactionist and fallibilist realist positions are used in this thesis to assist in understanding the role of mind in a philosophical and scientific context.

Psychoneuroimmunology

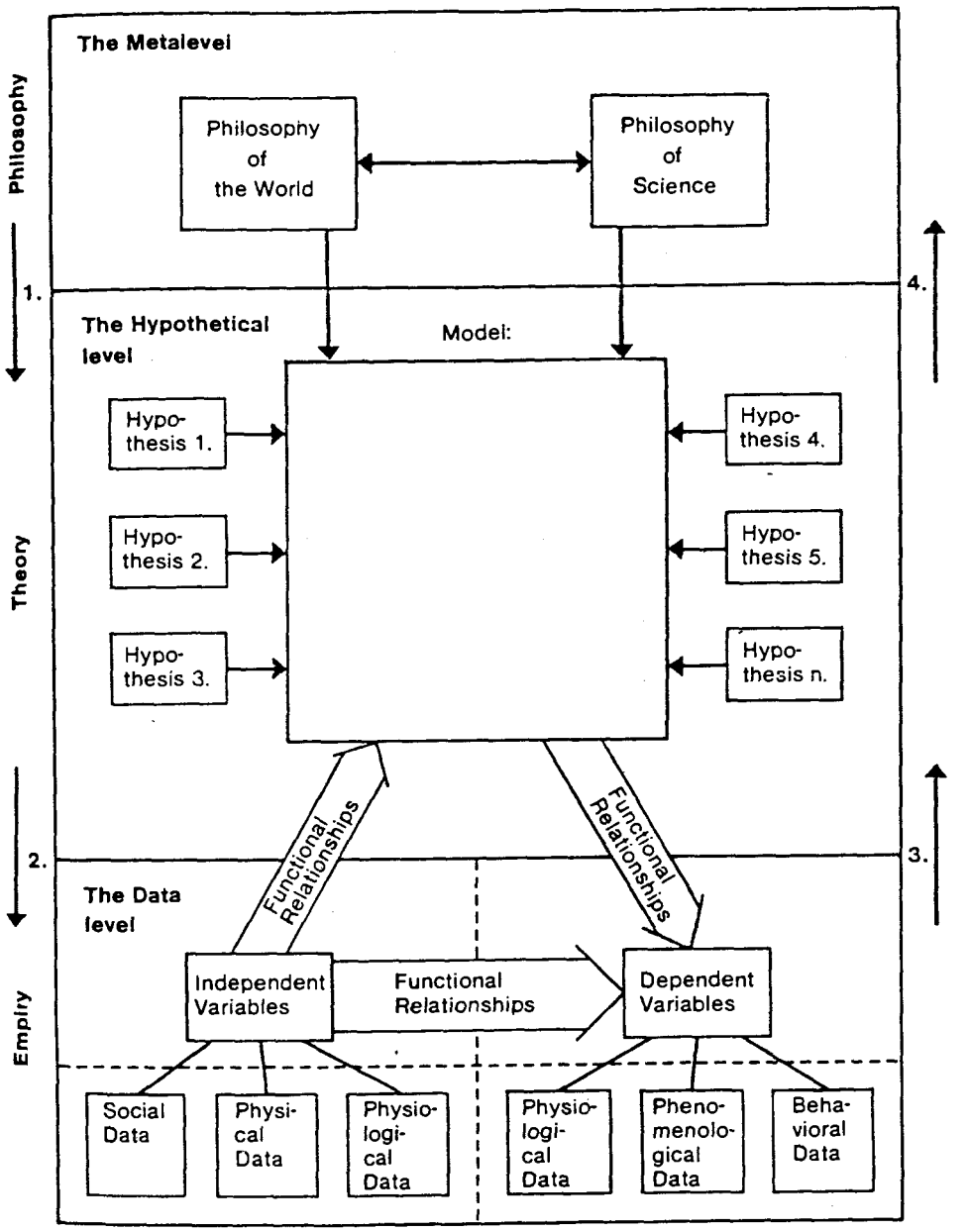
As discussed above, the scientific context, which is where the observations take place, is best construed in light of the larger theoretical and philosophical forces which influence it. A

diagram as constructed by Madsen (1985) serves as an example of a metatheoretical framework that is useful in recognizing the interplay amongst the levels of inquiry in a scientific enterprise (see figure 2). The specific enterprise in question for this thesis is psychoneuroimmunological research which describes the ways in which mental states influence processes in the immune system. Madsen's diagram provides three levels of concern entailed in scientific endeavors: the empirical or data level; the theoretical or hypothetical level; and the philosophical or meta-level. While psychoneuroimmunological researchers postulate mental causes as the best explanation of certain empirically determined physiological effects, the question arises as to how such postulations can or should be understood and what explanatory and predictive significance they have. Thus it is a goal of this essay to consider an account of mental causation, within the broader framework of empirical, theoretical, and philosophical positions as outlined in Madsen's diagram.

Chapter one is a consideration of three historical trends in twentieth century philosophy of science. Chapter two contains a brief overview of current materialist hypotheses in the philosophy of mind including identity theory, eliminative materialism, and functionalism. Each is briefly examined and a materialist alternative termed emergentism is proposed.

Empirical examples of what is asserted to be the influence of mental processes on physiological systems in both rodents and humans are presented in chapter three. Examples are taken from the interdisciplinary science called psychoneuroimmunology (PNI), which explores the interrelationships among the nervous, endocrine, and immune systems. The nervous system, the source of mental states, is the intermediary between mind and other physiological systems.

The concluding chapter returns to Madsen's diagram and reviews some of the main issues raised throughout the essay. It acknowledges that mental states play a key role in regulatory processes that maintain optimal conditions of health.



Our metatheory, called "systematology," conceives of a scientific text as consisting of three levels of abstraction: the *metalevel*, containing metatheses (i.e., propositions about the philosophy of the world and the philosophy of science); the *hypothetical level*, containing hypotheses and explanatory models; and the *datalevel*, containing datatheses (i.e., general functional relationships and specific descriptive propositions).

Figure 2 Metatheoretical Framework

(from Madsen, 1985, p.3)

CHAPTER I

PHILOSOPHY OF SCIENCE

In general, twentieth century philosophy of science has witnessed the evolution of two dominant trends: what will be called the standard view and the Kuhnian alternative. Manicas and Secord (1983) considered the standard view to be the dominant philosophy of science and affirm its prevailing currency among psychologists and other social scientists. A third trend, the fallibilist realist approach, in the opinion of Manicas and Secord, entails "a virtual Copernican Revolution . . . that has profound implications for the human sciences". The authors contend that the implications for psychology could greatly influence experimental psychology, statistical and probabilistic explanations, social psychology, and the problems of consciousness.

Various Conceptions of Philosophy of Science

The Standard View

Historical development of the standard view stems from a widespread desire among twentieth-century philosophers to escape the idealism and constructivism of the Kantian legacy (Jones, 1975). Their reaction evolved into a number of varying approaches such as the revival of realism, the crystalization of analytic philosphy, and the resort to pragmatism. Subsequent developments include logical positivism which further solidified principles derived from these approaches and attempted to link them into a unified scientific movement. Contemporary examples of the standard view are the covering law model and the neopositivist model (Robinson, 1981).

Manicas and Secord cite five distinguishing features of the standard view:

1. Scientific propositions are founded on data. The test of the truth of propositions is

correspondence between theory and data. Ultimately some propositions must be held as basic in order to constitute the test sentences for scientific theory. In other words, hypotheses are to be tested against the facts.

2. Theories are understood to be hypothetico–deductive systems. Theoretical terms or hypothetical constructs gain their meaning implicitly through their systemic relations to other terms in the theory, or explicitly by being connected to other observations.

3. Research is more or less atheoretical, with researchers avoiding theory, as much as possible, and seeking to test only hypotheses related to variables that can be closely tied to observations. Few investigators attempt to develop full–blown theories.

4. The standard view takes the Humean conception of causality for granted. Causal relations are regular, contingent relations between events.

5. An explanation of a scientific phenomenon is subsumed under the covering law model. In the standard view, explanation and prediction are exactly symmetrical. A full complete (or ideal) explanation is deductive–nomological. In research practice, explanations are inductive–statistical, so that one achieves a better explanation when the probability statement "predicts the dependent variable more accurately by identifying additional independent variables, by better defining the relationship among these independent variables (and) by specifying more accurately the relationship of each of the dependent variables. . ."(Hempel, 1963).

The Kuhnian Alternative to the Standard View

The methods and conclusions of the standard view came under sustained attack in the 1950's. Critics of the standard view included Toulmin (1953,1961), Bohm (1957), Polanyi (1958), and N. Hanson (1958). A more decisive blow to the standard view came with the 1962 publication of Thomas Kuhn's, "The Structure of Scientific Revolutions". The above critics argued that observation was theory–laden and that science must be understood as a

social activity in which disciplines develop their own rules of practice. They contended that observations were profoundly shaped by the observers' perceptions and theoretical background. Theory determines observations rather than observation determining the theory. The assumption of unambiguous logical connections between theory and observation was deemed to be naive. As a social enterprise, science was seen to be subject to influences outside the internal criteria of science (Manicas and Secord, 1983). The new view rejected formal logic as the primary tool for the analysis of science and replaced it with a reliance on a study of the history of science (Brown, 1977).

> Most scientific research consists, in this view, of a continuing attempt to interpret nature in terms of a supposed theoretical framework. This framework plays a fundamental role in determining what problems must be solved and what are to count as solutions to these problems; the most important events in the history of science are revolutions which change the framework. Rather than observations providing the independent data against which we test our theories, fundamental theories play a crucial role in determining what is observed, and the significance of observational data is changed when a scientific revolution takes place (Brown, 1977, p.10)

The large scale frameworks which guide the direction of science are termed paradigms in the Kuhnian nomenclature. A scientist tends to perceive phenomena in the manner characteristic of the framework in which he or she was trained. The perception of a phenomenon through another paradigm could require a radical reorientation in mental set, perhaps one not readily achieved.

Kuhn uses religious allusions, such as a "conversion", to describe the shift from an old paradigm to a new one. Converts to a new theory are made through persuasion and . . . "the light is eventually seen, or, if not, that the new theory gains ascendancy when the opposing generation dies in the wilderness" (Sheffler, 1982, p.18). In Max Planck's words:

> A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die and a new

generation grows up that is familiar with it (Planck, 1949, cited in Kuhn, 1970, p.151).

The Kuhnian view inevitably leads to a relativist view of scientific progress. Paul Feyerabend has been more explicit in admitting that reality actually depends upon choice. He says flatly, "we decide to regard those things as real which play an important role in the kind of life we prefer" (1981, p.xiii). Feyerabend considers that there is no more ultimate way of referring to reality than through the particular tradition to which we belong and that relativism is not limited to scientific endeavor but can be applied to any sphere (Trigg, 1985). Trigg has criticized the "bewildering conclusion" of the views of Kuhn and Feyerabend,

> . . . science is not a path to truth at all, let alone the only one. It sometimes looks as if some philosophers are saying that there is no such thing as truth. The incoherence of that is revealed if we realize that they are asserting as true the proposition that there is no such thing as truth (p.19).

Kuhn acknowledges the relativist implications of his position and suggests that truth may be a term with only intratheoretic applications. Yet, in another sense, he disavows the relativist label, since he believes that scientific development is evolutionary. "For me, scientific development is, like biological evolution, unidirectional and irreversible. One scientific theory is not as good as another for doing what scientists normally do" (Lakatos and Musgrove, 1970). In Trigg's view, Kuhn wants to retain all the benefits which the concept of truth provides while saying that there is no such thing as truth external to theories (Trigg, 1973).

Realist Refinements to the Kuhnian View

The lack of a criteria for truth is the primary deficiency of the Kuhnian alternative to the standard view. Nevertheless, major portions of the Kuhnian view are incorporated into a more recently proposed alternative. This third view has been variously called transcendental realism by Roy Bhaskar (1975, 1979), and fallibilist realism by Donald Campbell. The realist view shares some origins with the Kuhnian views of Toulmin, Bohm, and Polanyi. Manicas

and Secord also credit Bunge (1959), and Michael Scriven (1956, 1962, 1964) with early anticipations of fallibilist realism. The decisive contributions, however, are credited to Rom Harre' (1970, 1972; Harre' and Madden, 1975) and later Bhaskar (1982).

Manicas and Secord attribute the following four features to the fallibilist realist view: First, it subscribes to the Kuhnian view that knowledge is a social and historical product. There is no preinterpreted given, and the test of truth cannot be correspondence.

> Epistemologically there can be nothing known to which our ideas (sentences, theories) can correspond. But versus the unknowable Kantian thing-in-itself, it is precisely the task of science to invent theories that aim to represent the world . . . The crucial point is that it is possible for these criteria to be rational precisely because on realist terms, there is a world that exists independently of cognizing experience . . . As Bhaskar has noted, one must be a realist ontologically to be a fallibilist epistemologically (Manicas and Secord, 1983, p.401)

A second feature of the fallibilist position is that it:

> holds naturalism to be nonreductive or emergent, both the world and science are stratified. The basis for this view is the idea that the things of the world are complex composites . . . Ordinary table salt is not, usually, just NaCl, since the purest of it contains other things. But more important at another level, the compound NaCl is a complex of elements, Na and Cl. Sodium and chlorine each have causal properties and NaCl has causal properties that are not true of either sodium and chlorine. But at still another level, sodium and chlorine are themselves complexes of electrons, neutrons, quarks, and so on... analogously the activities of persons in society may be seen as a set of interacting, interwoven structures at different levels (p.401).

Third, the traditional Humean analysis of causation is rejected. Rather, the fallibilist framework admits the role of causal properties that exist and operate in the world rather than the Humean conception which associates causality with events or classes of events, regularly or randomly connected in time and place. This framework provides a rationale for the emergentist account of mental causation to be discussed in chapter two.

Finally,

> the (fallibilist) realist theory of science rejects in toto the covering law model of scientific explanation and the attending instrumentalist idea that explanation and prediction are symmetrical. On the realist view, events such as the collapse of a bridge or the cancerous growth of an organ are the conjunctions of causal process operating in open systems. Such outcomes are the result of different mechanisms of very different kinds combining in many different ways. But if so, the covering law model is, at best, seriously misleading (p.403)

The fallibilist realists subscribed to Kuhnian perspectives which concern themselves with epistemological questions. The fallibilists, however, refined Kuhn's views of the philosophy of science. Where Kuhn considered science's epistemological foundations, for example, how theory drives science, the fallibilist also considered its ontological foundations, in other words, what science examines, as well as the methods of science.

Two features of fallibilist realism, namely the stratification of nature and the rejection of Humean causality are relevant to the emergent interactionist philosophy of mind. Instead of advocating a contingent view of causality in which mental states are merely associated with a particular organization of neural matter, the fallibilist position implies the stronger claim that there is a necessary relationship between neural organization and the manifestation of mental states. In other words, given a particular organization of neural matter, mental states necessarily result. A version of this view was held earlier by the Gestalt psychologists. The notion that mind necessarily results from matter, can provide a viable foundation for a materialist theory of mind.

CHAPTER II

PHILOSOPHY OF MIND

"The ancients have stolen all our best ideas".

. . . Mark Twain

Historical figures such as Pythagoras, Plato, Descartes, Sherrington, and Penfield all espoused some type of interaction between the mind or soul and the body. This essay also ultimately assumes an interactionist account in which mind, having ontologically different properties while sharing compositional origins with the body, causally influences processes of the body. This hypothesis is an emergentist account, a more recent result of the ebb and flow of generations of philosophical analyses. This view accommodates an historical perspective as well as current trends in cognitive science, information theory, and intentional systems (P.P. Hanson, 1986). The essence of the hypothesis is entirely compatible with the common sense notions that mind and body are somehow different and one can influence the other.

These common sense notions are part of "folk psychology".

> [It's] that rough-hewn set of concepts, generalizations, and rules of thumb we all standardly use in explaining and predicting human behavior . . . [It's] the psychological lore in virtue of which we explain behavior as the outcome of beliefs, desires, perceptions, expectations, goals, sensations, and so forth. It is a theory whose generalizations connect mental states to other mental states, to perceptions, and to actions" (P.S. Churchland, 1986, p.299).

Folk Psychology has been defined by those philosophers, such as Churchland, who intend to illustrate how mistaken those common sense notions really are. They support the position known as "eliminative materialism", which is one of three materialist positions to be briefly described before a closer look at emergentism is in order.

Three Dominant Hypotheses of Mind

Central State Identity Theory

From the point of view of philosophy, the three dominant positions in the philosophy of mind over the past thirty years have been central state identity theory, eliminative materialism and functionalism. Central state identity theory (CSIT), gained ascendency in the 1950s as a result of papers published by U.T. Place (1956), Herbert Feigl (1958), and J.J.C. Smart (1959). Its claim is that mental states, processes, and events are simply physical states, processes, and events of the brain. But this is subject to different construals. The earlier and stronger version of CSIT maintained that every mental state–type was numerically identical with, i.e. was not just qualitatively similar but was one and the same particular neurological state–type. For example, the sensation of pain in some part of my body is nothing other than the firing of nerves called c–fibres. Type–CSIT, however, could not be supported with empirical evidence. Rather, the evidence pointed to a plasticity of brain function, where in some cases of destruction of neural tissue, other portions of the brain are able to take over the function for the damaged area. This was the basis for Lashley's concept of equipotentiality (1929). If different areas of the brain are capable of serving the same function which could be a given mental state, it becomes increasingly difficult to sustain an argument for the strict identity of one physical brain location for that mental state.

As a result of such difficulties, most supporters of CSIT retreated to a weaker version called token–CSIT.

> According to this view, while, e.g., pain is not identical to stimulations of c–fibres, my being in pain at time t could be numerically identical to some neurological state I am in at t — e.g., my c–fibres firing at t. Different tokens of pain, i.e., of the same mental state type, might then well be identical, respectively, to tokens of different neurological or physical state types. (P.P. Hanson, 1986, ch.2, p.4)

One argument against CSIT uses Leibnitz's Law to refute numerical identity. The law states that if two items are numerically identical then any property had by either is also had by the other. In the case of CSIT, if mental states have some property that is not shared by brain states (or vice versa), CSIT is refuted because numerical identity will no longer obtain.

The notion of qualia also figures in the argument.

> Qualia or qualitative contents are the subjective qualities had by some mental particulars, e.g., conscious sensory or emotional experiences, such as feeling painful, or looking green, i.e., looking the way that something that is green looks to someone with normal vision in normal light. Qualitative contents are controversial in that each person can only experience his own, and some regard this as a poor basis on which to build "objective" psychological explanations. (P.P. Hanson, 1986, ch.4, p.5).

"Controversial" is used here to be distinguished from "uncontroversial bodily phenomena" which "include the various physical, chemical, biological, and neurological phenomena attributable to our bodies on the basis of standard physical, chemical, biological, and neurological theory" (P.P. Hanson, 1986, introduction, p.2).

Using these definitions, Hanson states his argument against CSIT as follows.

1. The inner, subjective, qualia of my sensations are knowable to me by introspection.
2. The outer, objective - i.e. "uncontroversial" properties of my brain states are not knowable to me by introspection. Therefore
3. The inner, subjective qualia of my sensations are not identical to the outer, objective, uncontroversial properties of my brain states. (ch.2, p.11).

Eliminative Materialism

Eliminative materialism takes a strategy different from that of CSIT. Rather than considering the one to one matchups between mental and neural states, eliminative materialists assert that the matching strategy is ill founded. Mental states can't be matched because our construal of them a la folk psychology is a misrepresentation of their true nature.

> Our common-sense psychological framework is a false and radically misleading conception of the causes of human behavior and the nature of cognitive activity . . . Accordingly, we must expect that the older framework will simply be eliminated, rather than be reduced (as in CSIT), by a matured neuroscience. (P.M. Churchland, 1984, p.43)

Table 1 (Bunge, 1980) illustrates how an eliminativist would explain mental events. It is interesting to note Bunge's choices in naming the "rival" accounts. The emergentist account as articulated in this essay would not deem mentalism and psychobiology mutually exclusive. Table 1 also illustrates the difficulties in trying to eliminate mental states from some explanatory role. If some poor chap became irritable because his wife nagged him, one could suspect the problem may not simply be due to the volume of her voice or inopportune timing of her dissension. Generally the specific content of dissension plays a large part in such affairs.

A major stumbling block for eliminative materialism (as well as for CSIT and functionalism), is to account adequately for the nuances of subjective or phenomenological experience. Philip Hanson discusses this difficulty for eliminative materialism.

> . . . the problem then is how to be an Eliminative Materialist without pulling the empirical rug from under one, so to speak. If we want our "objective" psychological explanations to be "empirical" in the sense that they are appropriately "based on experience", then it seems that we must countenance "experience". But is not talk of experience to be cashed out in terms of talk about particular peoples' particular experiences? It is for such reasons, at any rate, that I find little, prima facie, to recommend attempts to dissolve the Mind-Body Problem by refusing to accept its pretheoretical characterizations, in experiential terms, of mental phenomena.I just do not see any empirical mileage in it. (1986, ch.2, p.7)

Hanson admits that such considerations will not sway the eliminativists who also want to discount empirical considerations. Patricia Churchland is one such theorist. She explains that the reason why the denial of the existence of mental states as we experience them seems self-refuting is because we are construing the mental states from the theoretical framework of folk psychology. We are confined within the inferior framework she wishes to eliminate with no alternative framework yet available.

Sketchy hypothetical accounts of some mental properties, events, and processes in man. Two rival views: mentalism and psychobiology

Problem	Mentalist account	Psychobiological account
What is learning?	Enrichment of the mind	Formation or reinforcement of synaptic connections
What is vision?	A mental process triggered by visual sensory inputs	An activity of the visual system involving its cortical areas in the occipital lobe
What is experienced (felt or judged) stimulus magnitude?	The mind's evaluation of the stimulus	Frenquency of firing of the corresponding neural system (including the sensory areas of the cerebral cortex)
What is thinking?	The highest activity of the mind	The activity of certain plastic neural systems
What is self-consciousness?	Inward looking	The monitoring, by certain plastic neural systems, of activity in other neural systems
What is a drive?	A mental conation	A physiological imbalance
What are dreams?	Processes in a part of the mind	Rudimentary and mainly pictorial thinking (a type of brain process)
What is initiative?	Spontaneous movement of the mind	Self-started forebrain process
Why is Z in a happy mood?	Because her mind is in a state of happiness	Because her brain is brimming with biogenic amines
Why is he in pain?	No explanation	Because he got a cut, and the affected nerves activated his brain stem
Why is he so irritable?	Because his wife's naggings have hurt his ego	Because his wife's naggings have overworked his neuroendocrine system
Why is it so hard to express emotions in words?	No explanation	Because emotion is an activity of the right hemisphere, which is mute
Why is human sexuality rather insensitive to level of hormones in blood?	Because it is more psychological than biological	Because sexual arousal and pleasure are hypothalamic activities more strongly influenced by the cerebral cortex than by the endocrine glands
Why do overprotected children grow into helpless adults?	Because their minds are not prepared to face problems	Because they get smaller adrenal glands and are less motivated to face obstacles
Why can we be in conscious states?	Because we are endowed with a mind, part of which is Consciousness	Because our ancestors evolved neural systems capable of being in conscious states, which have a survival value
Why do we sometimes hallucinate?	Either because our mind is fed the wrong information or because it is sick	Either through the activation of the wrong neural systems or because of sick nervous tissue (e.g. excess or defect of some neurotransmitter)
How does voluntary movement come about?	It is caused by the mind ordering the body to move	A plastic neural system in the forebrain (the "seat" of will) activates a motor neural system in the precentral cortex
How did Z recover from his depression?	No explanation	Z was given an antidepressant drug which prevents the breakdown of norepinephrine
Why did our remote ancestors become humanized?	Because they were given a soul	Because some of them were endowed with exceptionally large and plastic associative areas, which enabled them to think up new ideas and to create new things and new ways of life
How did the incest taboo evolve?	Either by grace or by the decree of a wise ruler who acted on moral grounds	Imbreeding amplifies abnormalities, so those human groups that prohibited incest (for whatever reason) had an edge over those which practised it
How do you account for ghosts, telepathy, etc.?	In terms of immaterial and disembodied minds and the like	We do not explain nonexistents, but are ready to explain belief in them

Table 1 Eliminative Materialist Accounts (from Bunge, 1980, pp.212–213)

> If the eliminativist is correct in his criticisms, and if the old framework is revised and replaced, then by using the new vocabulary the eliminativist's criticisms could be restated with greater sophistication and with no danger of pragmatic contradiction. (For example, the new eliminativist might declare, "I grokify beliefs", where grokification is a neuropsychological state defined within the mature new theory.) It would be foolish to suppose folk psychology must be true because at this stage of science to criticize it implies using it. All this shows is that folk psychology is the only theory available now. (P.S. Churchland, 1986, p.397)

According to eliminative materialists such as the Churchlands (P.M. Churchland, 1984) (P.S. Churchland, 1986) and (Feyerabend, 1963), as brain research progresses, the language of the physiologists will encroach upon the misbegotten notions of mentalism and eventually render them out of fashion. Karl Popper calls their timetable "promissory materialism." The present lack of empirical evidence for the numerical identity of mind and brain remains a trump card in the hands of the mentalist.

> For all the physicalist offers is, as it were, a cheque drawn against his future prospects, and based on the hope that a theory will be developed one day which solves his problems for him; the hope, in short, that something will turn up. (Popper & Eccles, 1977, p.48).

Functionalism

Functionalism, which developed in the 1960s, took an approach different from CSIT or eliminative materialism. Functionalism attempted to account for interactions between mental particulars. The contents of mental states, beliefs, desires and so forth have relational properties amongst themselves. For example if I believe that today is Mother's Day, I may very well want to call Mom. These relational properties seem to obtain compatibly with a variety of different physiological setups. Functionalism tries to characterize types in terms of patterns of relations among mental states, and between mental states and sensory inputs and motor outputs (P.M. Churchland, 1984).

Jerry Fodor (1981) states that functionalism ". . . is a philosophy of mind . . ." that ". . . is neither dualist nor materialist." He call this position, the Neutrality Thesis and adds

that functionalism involves two other theses:

1. ". . . what determines the psychological type to which a mental particular belongs is the causal role of the particular in the mental life of the organism." (Causal Role Thesis)
2. ". . . the psychology of a system depends not on the stuff it is made of (living cells, metal, or spiritual energy) but on how the stuff is put together." (Structural Thesis).

Notice that the Structural Thesis addresses one of the aforementioned difficulties with type CSIT. The earlier argument against type CSIT asserted that different neural structures could fulfill a variety of mental functions. The Structural Thesis expands the scope of the argument to include, e.g., hypothetical life forms of a different composition embodying mental states (P.P. Hanson, 1986). Indeed, the expansion thus admits dolphins, angels, martians, and computers as possible possessors of mental states, a point not lost among theorists in artificial intelligence. It also accords nature the plausible power to put together a thinking, feeling, perceiving creature in more ways than one.

As previously mentioned for CSIT and eliminative materialism, qualia also pose a problem for functionalism, given the "inverted spectrum argument" (Shoemaker, 1982). By making relational properties the definitive feature of a mental state, functionalism fails to account for the qualitative nature of experience. According to the inverted spectrum argument, it is entirely conceivable that the range of color sensations that I experience be "inverted" with respect to your experience of color sensations. That is, when I experienced, e.g., blue sensations, you would experience, e.g., yellow sensations and when I experienced yellow sensations, you would experience blue. Yet, my visual sensation of a cloudless daytime sky might remain, "functionally equivalent", to yours. If this is conceivable, then qualia, at least, cannot be functionally characterized.

Some theorists want to consider a combination of token CSIT with functionalism.

> Since functionalism recognizes that mental particulars may be physical, it is compatible with the idea that mental causation (as we know it, is in fact) is a species of physical causation. In other words, functionalism tolerates the materialist solution to the Mind-Body Problem provided by the central state identity theory. (Fodor, 1981) (emphasis and paraphrase, Hanson, 1987)

The causal relations, among human mental particulars might be, in this instance, interactions among token neurological states. Hanson (1986) cites this alliance as a problem for functionalism's Neutrality Thesis.

> That a certain neurological configuration in Jones at t, is a realization of the belief that 2 + 2 = 4, does not tell us what it is that that neurological configuration has in common with other possible realizations of that belief, in virtue of which it is a realization of that belief, and in virtue of which it has the causal efficacy that it has. (P.P. Hanson, 1986, ch.4, p.21)

Alternative Perspectives: Emergent Materialism

The three major materialist hypotheses of mind all have some shortcomings involving compositional or causal considerations.

An alternative materialist position could be synthesized from recent historical trends. Philip Hanson describes his version of such a synthesis.

> [An] example from a causal-explanatory perspective is of an evolved system such as our bodies, which we can think of as consisting of a number of numerically distinct and causally hierarchical "levels" of organization, each of whose spatial boundaries coincides at the system's interface with its environment, e.g., our skin. Here again we have the numerical distinctness and a causal ordering of these organizational "levels" in conjunction with the coincidence of their spacial extensions, and, arguably, coincidence of their (ultimate) constitution as well. (ch.2, p.34).

The solution that Hanson proposes is an "emergent materialism" compatible with the fallibilist realist school and type-CSIT broadly construed. For example, "subjective qualia can be bodily phenomena; human consciousness can be a brain process, without their being reductively identifiable with certain other bodily phenomena or brain processes, e.g., the ones that give rise to them" (ch.2, p.34).

The emergent materialist or emergent interactionist position is compatible with the fallibilist realist school with respect to compositional and causal questions. Both hold a stratified conception of nature, with ontologically distinct levels of existence. Natural properties with causal powers emerge at appropriately organized levels of structure. Both reject the traditional Humean analysis of causation.

Causation

Hanson's account of mental causation differs from the traditional Humean view in that it admits the role of causal power. Roughly, a particular, X, has the power to A, where A is some effect, just in case X will do or or bring about A, in the appropriate circumstances, in virtue of its intrinsic nature (Harre' and Madden, 1975; P.P. Hanson, 1986). For instance, a magnet has the power to attract iron filings, in the case where the magnet draws iron filings towards itself, in the appropriate circumstances, [i.e. when they are nearby and there are not intervening obstructions] in virtue of its intrinsic nature [i.e. the electrodynamic alignment of its molecules].

Locke's View

The notion of causal power or agency is introduced in John Locke's 1690 Essay Concerning Human Understanding as follows:

> The idea of the beginning of motion we have only from reflection on what passes in ourselves; where we find by experience, that, barely by willing it, barely by a thought of the mind, we can move the parts of our bodies, which were before at rest (Locke, 1894, sec 132).
> The mind (takes) notice how one (thing) comes to mind, and ceases to be, and another begins to exist. which was not before; . . . and (concludes) from what it has so constantly observed to have been, that the like changes will for the future be made in the same things; by like agents, and by the like ways, . . . and so comes by that idea which we call power. (Locke, 1894, sec 213).

In these passages Locke is admitting both the idea of agency, derived from reflection, and the idea of necessity, which is not given in experience but concluded from it (Jones,

1969). Some fifty years after Locke's assertions, David Hume put them to the test with his absolute empiricism and found them wanting.

Hume's View

> We have sought in vain for an idea of power or necessary connexion in all the sources from which we could suppose it to be derived. It appears that, in single instances of the operations of bodies, we never can, by our utmost scrutiny, discover any thing but one event following another, without being able to comprehend any force or power by which the cause operates, or any connexion between it and its supposed effect. The same difficulty occurs in contemplating the operations of mind on body - where we observe or conceive the tie which binds together the notion and volition, or the energy by which the mind produces this effect (Hume, 1896, vol. VII part II).

Hume claimed that a necessary connection of cause and effect is only in the eye of the perceiver and cannot be said to exist in the universe. Causal goings on are contingent relations. "Every fact could always be otherwise . . . That the sun will not rise tomorrow is no less intelligible a proposition and implies no more contradiction than the affirmation, that it will rise" (op. cit. part I).

Yet a consideration of apparent differences in the causal capacities of separate objects invariably leads us to look for intrinsic differences in their properties. "The fact that we do find corresponding differences of intrinsic nature in such cases is . . . ample empirical testimony to the falsity of Hume's picture of causation." (P.P. Hanson, 1986, ch.3, p.5) Supporters of causal powers and natural necessity thus appeal to the intrinsic nature of an object. This is very Lockean, since Locke deemed powers to be grounded in natural properties of the object which resulted from the organization of its constituent parts.

Recent defenders of the Lockean view include Harré and Madden who appeal to the notion of the "powerful particular" (1975). ". . . causation always involves a material particular which produces or generates something. But what may be singled out as the cause may be an event, a state of affairs, or even in certain contexts, a material substance." (p.5) Harré and Madden also attribute intrinsic natures as the grounds for causal powers. Intrinsic

natures can be understood as the sum of natural properties.

Mental Causation

In Hanson's account of mental causation, mental states and properties are natural properties of the human organism, emergent from interactions among their neural constituents which exist at a lower level of structure.

> As emergent properties, mental properties are also type and token distinct from any properties that could occur at the lower structural level from which they emerged. The relation of being composed is not the relation of identity. Nevertheless, mental properties are compositionally material (P.P. Hanson, 1986, ch.10, p.2).

Hanson speaks of the lower level neurological constituents as being causally prior to the higher level emergent phenomena. This implies that the interaction of the neural constituents with each other is the cause of the emergent mental phenomena. Once emerged, mental properties then causally interact with each other. This is causation occurring at the level of structure at which mental properties themselves occur. But more controversially, Hanson also supposes that mental causation can involve causal relations across levels of structure, that emergent mental properties can causally influence, e.g. neural processes. Hanson says that such "downwards" causal influence takes place by means of "demergence". (see figure 3)

Composition

The influence of higher structures (mental) on lower structures (neural) results from their essential linkage to each other. Emergent mental properties come from a certain organization of underlying neural structures from which they are composed. Since this is an ongoing causal relation during the life of the organism, mental patterns change as a result of changes in the neural patterns. This is an example of an emergent relation (see emergence in figure 3). A similar emergent position was espoused by the Gestalt school of psychology. The causal relation of emergence is exemplified by the effects of psychoactive drugs, direct

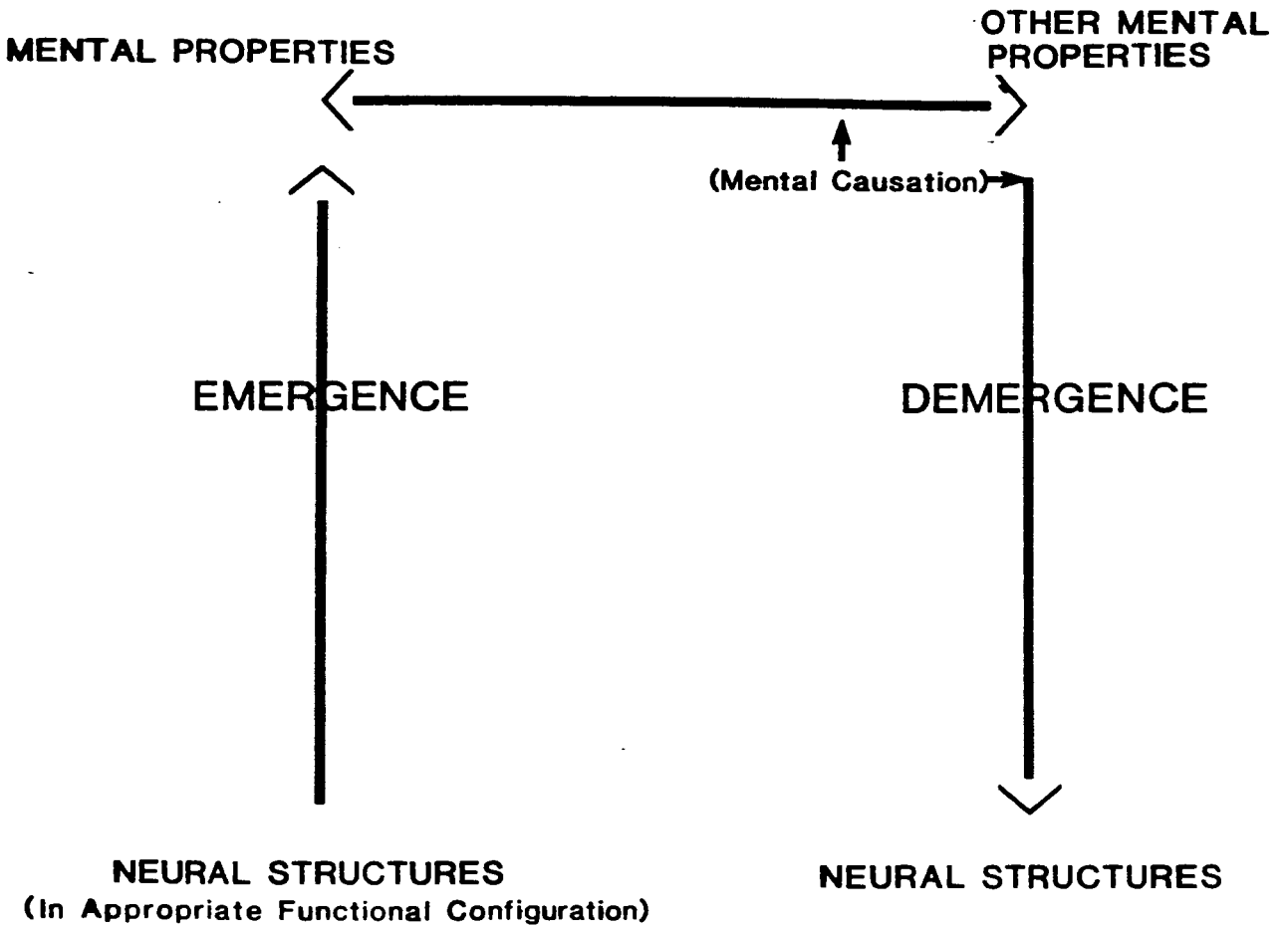


Figure 3 Emergent Materialist Account

stimulation of the brain (Penfield, 1954) or aberrant mental processes due to neural lesions or tumors. It is also the causal relation in which the brain gives rise to any mental state. However, mental patterns also change as a result of other mental processes. The horizontal arrow in figure 3 represents mental causation in the case of mental states affecting other mental states by virtue of the content of the particular mental state. This causal relation is exemplified by the mental meanderings of the human thought process as a result of mental association. For example:

> I look at the rectangular rubber eraser lying beside the notepad on which I am writing. I notice a chunk missing from its corner. I remember my boss Steve, removing it while he was fiddling with it during a conversation last week; must be a nervous guy. But he's nice to work with. I hope Nancy and I can meet the project deadlines this week. Jeez, here I am daydreaming again, better get back to this paper . . . (and so on).

However each of those shifts of mental focus also causes concomitant shifts in the neural structures from which they had originally emerged. This is an example of demergent relation (see demergence in figure 3). Hanson elaborates on demergence as follows:

> Higher levels of structure supervene on lower levels, in the sense that what goes on at the latter determines what goes on at the former. There can be no difference at the higher, supervenient level without a corresponding difference at the lower subvenient levels. But if there are causal interactions occurring at a level resulting in changes at that level, then there must be corresponding changes at lower levels on which this level supervenes and from which it has emerged (P.P. Hanson, 1986, ch.5, p.53ff).

The Gestalt position on emergence does not acknowledge mental events as having causal efficacy. Instead mental events are seen as correlates of lower level neural events and thus are epiphenomenal (Sperry, 1976).

Roger Sperry, a proponent of emergence and mental causation, cites the example of a rolling wheel. The motion and momentum of a constituent molecule is constantly being changed by the motion of the rolling wheel. Changes of the molecule result from causal goings-on at a higher level of structure. "Its motion and momentum are demergent properties relative to the motion and momentum of the wheel" (Hanson, 1986, ch.3, p.54). Sperry refers

to the demergent relation as "downward causation". He elaborates on such relations with respect to mental causation:

> Just as the holistic properties of the organism have causal effects that determine the course and fate of its constituent cells and molecules, so in the same way, the conscious properties of cerebral activity are conceived to have analogous causal effects in brain function that control subset events in the flow pattern of neural excitation . . . The subjective mental phenomena are conceived to influence and to govern the flow of nerve impulse traffic by virtue of their encompassing emergent properties. Individual nerve impulses and other excitatory components of cerebral activity patterns are simply carried along or shunted this way and that by the prevailing overall dynamics of the whole active process (in principle — just as drops of water are carried along by a local eddy in a stream or the way the molecules and atoms of a wheel are carried along when it rolls downhill, regardless of whether the individual molecules and atoms happen to like it or not) (Sperry, 1969, pp.533 & 534).

CHAPTER III

EMPIRICAL CONSIDERATIONS

Research investigating the influence of mental processes on physical processes, that has here been termed demergence, has become increasingly popular in recent years. The work has produced results suggesting evidence of deeper levels of interaction between mind and body than had been previously conceived.

Empirical evidence for demergent causal influences on physiological processes will be organized around interactions among the nervous, endocrine and the immune systems. The would-be demergent causal relation is that of mental phenomena influencing the dynamic flow of nerve impulse traffic. Changes at the mental level force concomitant changes at lower levels of structure as well, e.g. the nerve impulse traffic, by virtue of the compositional relationship that exists between the higher level and lower level properties. So the would-be demergent relation is from mental states to the nervous system (from which these mental states emerged), which mediates the effects of mental states on the endocrine and immune system.

Historical Overview

Cannon and Selye's Contribution

Effects of mental states on the endocrine system as mediated through the nervous system have been a well documented phenomena for over fifty years. Stress reactions of animal endocrine systems were initially explored by Walter Cannon (1932) and Hans Selye (1936). (see figure 4)

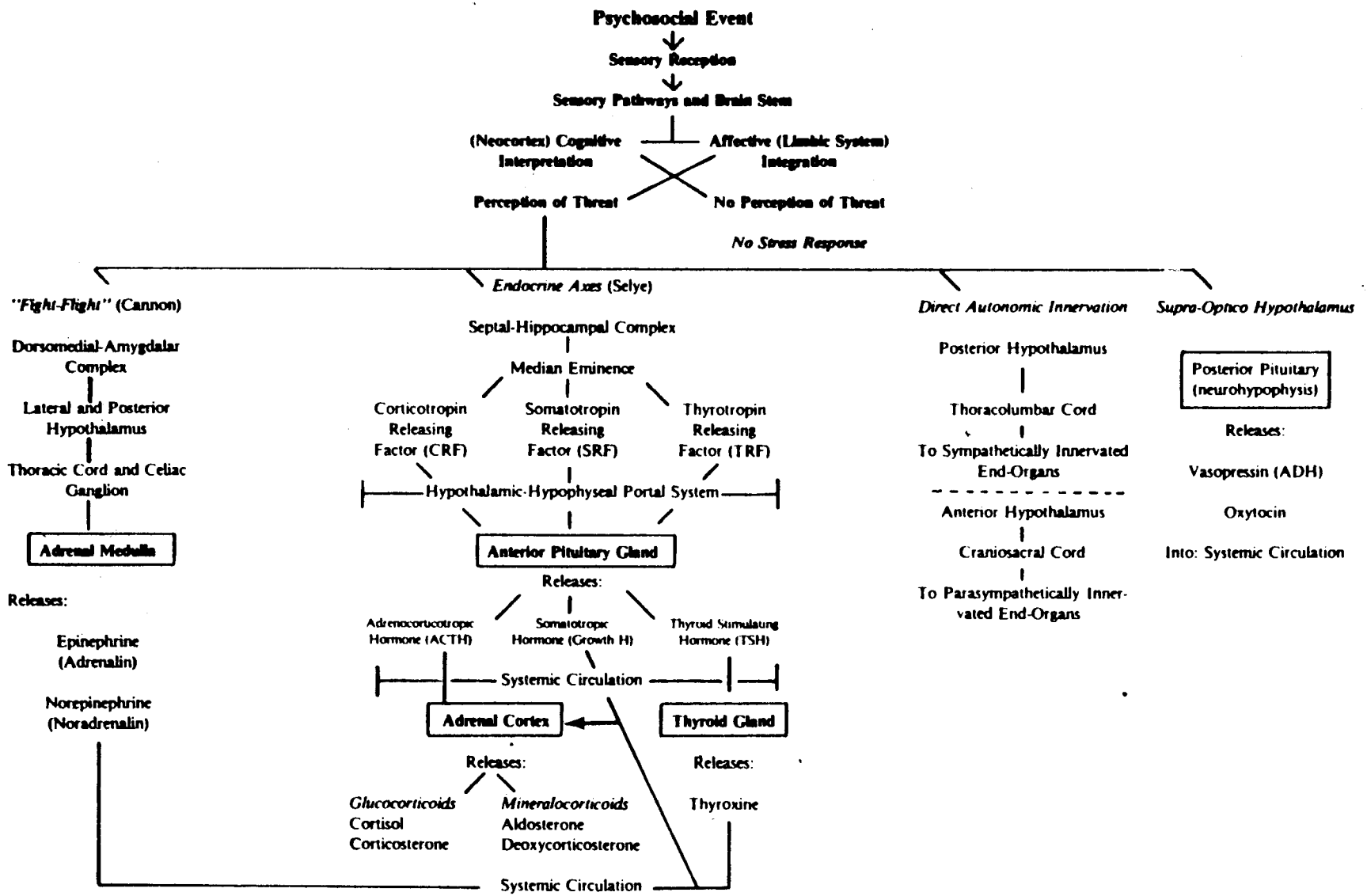


Figure 4 Neuroendocrine Pathways (from Everly and Rosenfeld, 1981, in Feuerstein et al., 1986, p.102)

Cannon's model is primarily neurally mediated, and is the origin of what he called the fight or flight reaction. Once the brain perceives a stressful situation, nerve impulses pass from the cortex to the limbic system and hypothalamus, proceeding down the pathway of the autonomic nervous system to its sympathetic subdivision in the middle of the spinal cord. Nerve impulses from this area activate secretion of the hormones epinephrine and norepinephrine from the interior of the adrenal glands, the medulla. These hormones mobilize the body's resources for emergency action be it fight, flight, or other immediate survival strategies. Breathing speeds up to deliver more oxygen to the muscles, the heart beats faster, blood pressure climbs, (the liver releases stored sugar for quick energy for the muscles) and digestion slows as blood is rerouted from the stomach and intestines to the heart, central nervous system, and muscles. Cannon's pathway is now technically termed the sympathoadrenal-medullary axis (Locke and Colligan, 1986).

Selye's model, the General Adaptation Syndrome (1946), is primarily hormonally mediated. It is also known as the hypothalamic - pituitary - adrenocortical axis (Locke and Colligan, 1986). The pathway originates in the higher brain centers of the cerebral cortex which passes nerve impulses to the hypothalamus. This secretes a peptide hormone called corticotropin-releasing factor (CRF), which activates the pituitary gland. The anterior region of the pituitary secretes another peptide hormone, adrenocorticotropic hormone or ACTH, which circulates to the adrenal glands via the bloodstream. There, ACTH triggers the outer layer of the adrenals, the cortex, to release a barrage of steroid hormones, the corticosteroids. They are a series of five hormones, all derived from cholesterol which perform numerous physiologic effects. Blood chemistry changes; for example, the blood thickens which increases oxygen carrying capacity and clotting ability which inhibits bleeding. The liver releases stored sugar for additional energy supplies to the muscles. The inflammatory response to tissue injury is inhibited (Gangong, 1983).

These types of responses supplement the faster acting autonomic response described by Cannon to insure survival in life threatening situations. Selye's General Adaptation Syndrome described the course of hormonal mobilization in three stages, alarm reaction, resistance, and exhaustion. Resistance was possible through increased adrenocortical activity. On the other hand, prolonged stress could exceed the animal's ability to sustain an adequate hormonal response and adrenal cortex exhaustion could occur, leading to either disease or death (Selye, 1946).

It was once thought that Cannon's and Selye's models were competing interpretations of what was happening in the body under stress. They are now seen to describe complementary physiologic processes. It should be emphasized that the cursory descriptions provided here are gross simplifications of the intricacies and interrelationships of what is actually happening. See figure 4 for an illustration and embellishment of other physiologic pathways of the stress response (also see Borysenko & Borysenko, 1982) not including the immune system.

Definitions of Stress

Stress is not an easily defined concept. As Selye himself has pointed out, "stress is a scientific concept which has suffered from the mixed blessing of being too well known and too little understood" (1980, p.127). He settled for a broader definition calling stress: "the nonspecific response of the body to any demand made upon it." (1973, p.692). More recent researchers opt for what they call an operational definition and conceptualize stress in terms of two components: stressors and stress response.

> Stressors represent stimulus events requiring some form of adaptation or adjustment. Stressors usually evoke a relatively stereotypic set of responses, the stress response. The circular nature of this definition is intentional. It is believed that a complex feedback system exists between stressor and stress response, with each influencing the other. Thus any definition of one requires reference to the other.
> Stressors can be such external physical stimuli as heat, cold, crowding, loud noise, or interpersonal difficulties with a loved one or such internal stimuli . . . as pain or cognitions including thoughts and feelings. (Feurstein, et al., 1986, p.98).

The authors go on to point out that stressors can have positive as well as the more commonly assumed negative valence and that what could be considered a stressor could vary greatly with individuals. Note that the definition includes mental states such as thoughts or feelings as stressors. The stress response is called "a complex reaction pattern that often has physiological, cognitive, and behavioral components" (Feurstein, et al., 1986, p.99).

Kobasa (1979) has studied hardy individuals who could function and even thrive under extremely stressful situations. She characterized them as sharing three traits: challenge, commitment, and control. Those who thrived felt stimulated by stress and change (challenge). They were intensely involved in what they were doing (commitment). And they usually did not feel powerless to affect a situation (control). Indeed a recent and popular book, written for general consumption, extols the "The Joy of Stress" (Peter Hanson, 1986). Thus, it is now seen that stress can have positive consequences for an individual under the appropriate circumstances.

Psychosomatic Medicine

Work on stress by Selye and Cannon stimulated the emergence of the field of psychosomatic medicine. The notion that psychological factors contribute to disease states can be traced in the West as far back as Hippocrates and his theory of health as a balance of the four bodily humours (MacMahon, 1984). Modern psychosomatic medicine had its beginnings in 1939 with the publication of a journal by the same name. In its early years a major contributor to the field was Franz Alexander (1950) who related psychological factors to seven disease entities: peptic ulcer, ulcerative colitis, hypertension, hyperthyroidism, neurodermatitis, rheumatoid arthritis, and asthma. It was thought that a specific psychological conflict provided an underlying basis for each of these illnesses (Plaut and Friedman, 1981).

Dunbar's interpretation (1943) was that a definable personality type was the underlying etiologic factor rather than a specific psychological conflict. Both theories share the notion of

some single underlying factor as the significant contributor.

Engel (1954, 1977) contested the single factor theory with his notion of a multifactorial etiology of disease. He contended that disease has multiple determinants, and in most instances the search for a single cause of illness is overly simplistic. With this perspective in mind, psychosomatic research:

> ". . . deals not with the role of psychosocial factors in causing disease, but in altering the individual susceptibility to disease . . . The relevant question is not whether a given disease is caused by a pathogenic agent or by psychological factors, but rather, to what extent the disease can be related to each of a number of factors in the history, makeup, and environment of the organism (Plaut and Friedman, 1981, p.5).

Behavioral Medicine

Engel's broader perspective of disease etiology eventually spawned the field of behavioral medicine which more explicitly addressed the multifactorial perspective. Thus, the field of "behavioral medicine" was born in a 1977 conference at Yale University (Schwartz and Weiss, 1977). The new model for healing recognized four conditions as intrinsic to therapeutic programs that could be considered behavioral:

> trying to change a behavioral (such as the circumstances surrounding asthma attacks) or physiological response (change in the glucose of a diabetic) that is in itself a health problem; changing the ways health care providers work by improving their methods of caring for the sick (for example, by teaching the value of paying attention to the patient or by touching or listening); trying to improve compliance to a given treatment; and stepping in to change behaviors or responses (such as smoking) that are risk factors (Locke and Colligan, 1986, pp.172ff).

The nine year history of the field shows mixed results. In the academic world interdisciplinary programs in behavioral medicine are well underway at Harvard, Yale, Stanford, the University of Rochester, Duke, the University of Pittsburgh, and the University of California (at San Francisco, Los Angeles, and Irvine) (Dreher, 1986).

In 1980, the Behavioral Medicine Branch was created at the National Cancer Institute in the United States. The aim of the Branch as set forth in the division's annual report of

1981 was to plan and conduct "a program of biobehavioral research related to cancer prevention and treatment." As part of its mission, the branch recognized that "the fundamental search for mediating mechanisms between behavior and disease needs to be pursued at every level" (Warga, 1984, p.42) Yet within two years of its establishment, the Behavioral Medicine Branch, along with four other branches were eliminated from the Institute's programs. A new Deputy Director of the Division of Resources, Centers, and Activities explained that "it was our feeling that in NCI the process of linking findings from the world of basic research to the world of health care services was too haphazard" (ibid, p.43).

The Institute's misgivings about a coherent systemization of the field is well founded. The sheer scope and interdisciplinary nature of behavioral medicine contribute to a plurality of conceptual definitions, theoretical orientations, and attitudes regarding the application of such knowledge. "All of this commonly suggests that we still lack the consistent and convincing body of data that would provide the necessary credibility to the field." (Plaut and Friedman, 1981, p.7).

An example of one of the field's "largely speculative" areas is in the knowledge of mechanisms by which psychological factors contribute to the etiology of any given disease. The inclusion of the immune system in the causal nexus of mind-body interactions is showing promise of clarifying the nature of those mechanisms.

The Immune System

The role of the immune system is to help the organism defend itself against potentially damaging substances. To do so, the system must differentiate self from non-self. A virus, bacteria, or anything that is foreign to the self is identified and eliminated by the immune system. Thus vigilance from external threats is maintained.

Equally important, internal vigilance is also provided, as appropriate cells are distinguished from inappropriate cells or potential malignancies. Defense against potentially damaging substances, which are called antigens, must be sufficient but not excessive so as not to harm healthy tissue. (The antigen defended against may also be recorded in a kind of immunologic memory if a specific defense had been created for that single substance.) Figure 5 illustrates the consequences of either an insufficient or excessive immune response. Autoimmune diseases result from an excessive immune response to an internal antigen. These diseases include rheumatoid arthritis, lupus, and multiple sclerosis.

Most knowledge about the immune system has been accumulated within the past twenty years. Students of the immune system like those of the brain cultivate a sense of humility with respect to their subject matter. Nobel Laureate, Baruj Benacerraf has said, "Immunology is one of the more complex, Talmudic areas of biology. The only topic more complicated is understanding how the brain works." Speaking less metaphorically, when asked about his reaction to the challenge of working on the immune system in his research, psychologist Robert Ader replied, "I'm scared to death." (Locke and Colligan, 1986, p.25)

The immune system has two broad strategies for defending the body: cell-mediated immunity and humoral immunity.

1. Cell-mediated immunity is a defense strategy that uses groups of specialized cells to alert the immune system to the presence of an antigen and organize an attack. Cell mediated reactions specialize in defense against viruses and tumors. It is this type of response surgeons must suppress to avoid rejection of a transplanted organ.
2. Humoral immunity relies on special molecules, such as antibodies, present in bodily fluids, as humors. It's function is to respond quickly against potential infections such as bacteria in the bloodstream. (Locke and Colligan, 1986).

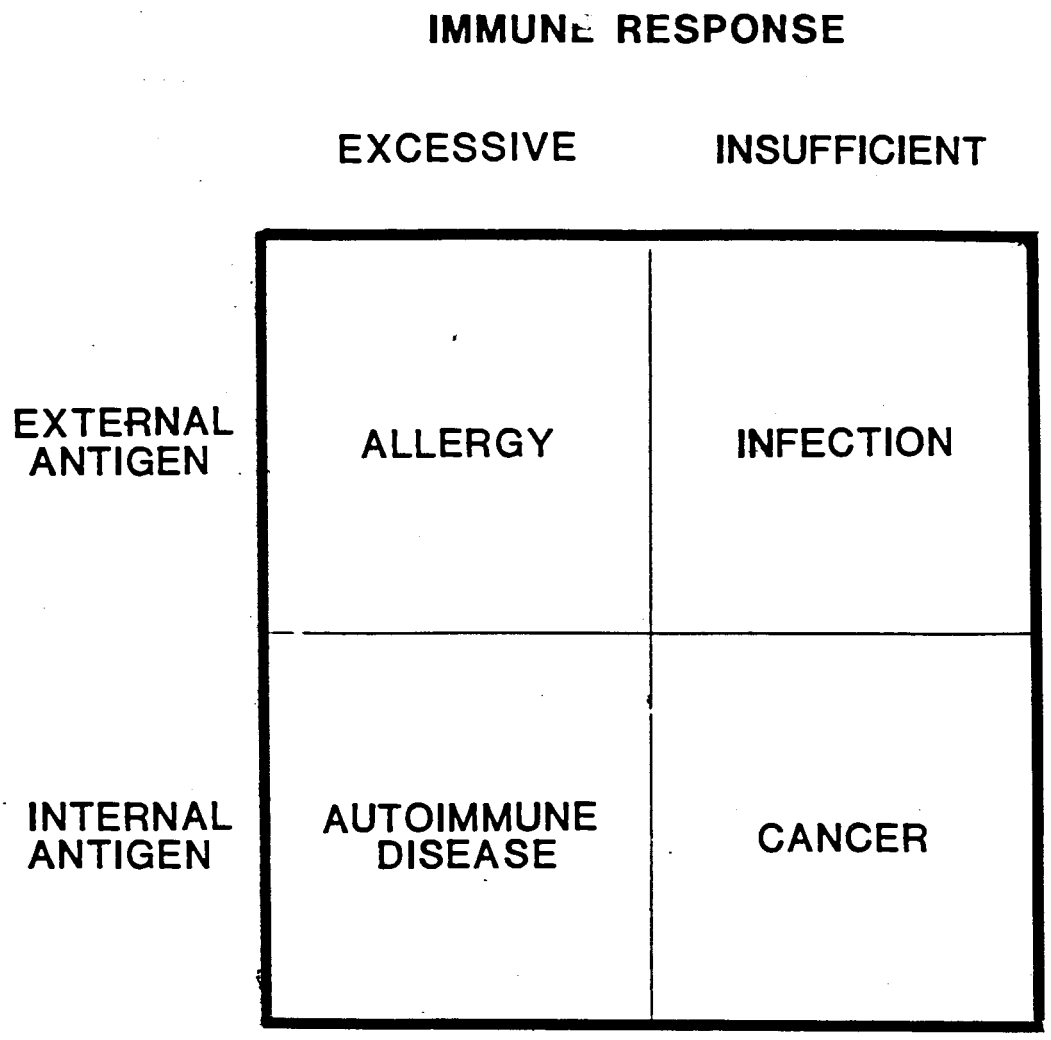


Figure 5 Negative Responses of the Immune System

Both humoral and cell-mediated immunity can employ immunologic memory in their defenses. This insures that if an organism has previously encountered a particular antigen, the immune response will be stronger and faster upon subsequent exposure to the same antigen. This memory function explains why vaccinations work so well in preventing disease. Immunologic memory is a vital part of specific immune responses in which the system recognizes an antigen as foreign and tailors a specific defense against that particular antigen.

The major components of the immune system originate in the bone marrow (see Figure 6). As precursor cells, they enter the blood stream as elements of blood (monocytes, lymphocites). Monocytes can differentiate into macrophages which perform as the garbage collectors of the body, consuming and processing destroyed tissue. This is done through the process of phagocytosis which Barrett (1983) defines as "the engulfment of cells or particulate matter by leukocytes, macrophages, or other cells." Macrophages also assist T-cells in identifying and inactivating antigens.

Lymphocites which migrate to the thymus gland become T-cells. They circulate in the blood on the alert for foreign, potentially dangerous microbes. They provide protection against cancer by destroying abnormal cells before they proliferate. There are a number of different types of T-cells. Helper T-cells enhance or elicit the aggressive action of other immune cells. The destructive capacity of the AIDS virus results from its greatly depleting the number of helper T-cells. Damage to this single link causes the rest of the immune system to unravel because of the complex web of interactions among the system's components. (Laurence, 1985). Suppressor T-cells dampen the activity of other immune cells. Amplifier T-cells increase the activity of the cells. Killer T-cells destroy cancerous and virus-infested cells when properly prepared by a previous encounter with the appropriate antigens.

B cells are thought to originate in the liver or spleen after which they migrate to the lymph nodes. They are the primary agent of humoral immunity. The cells create antibodies

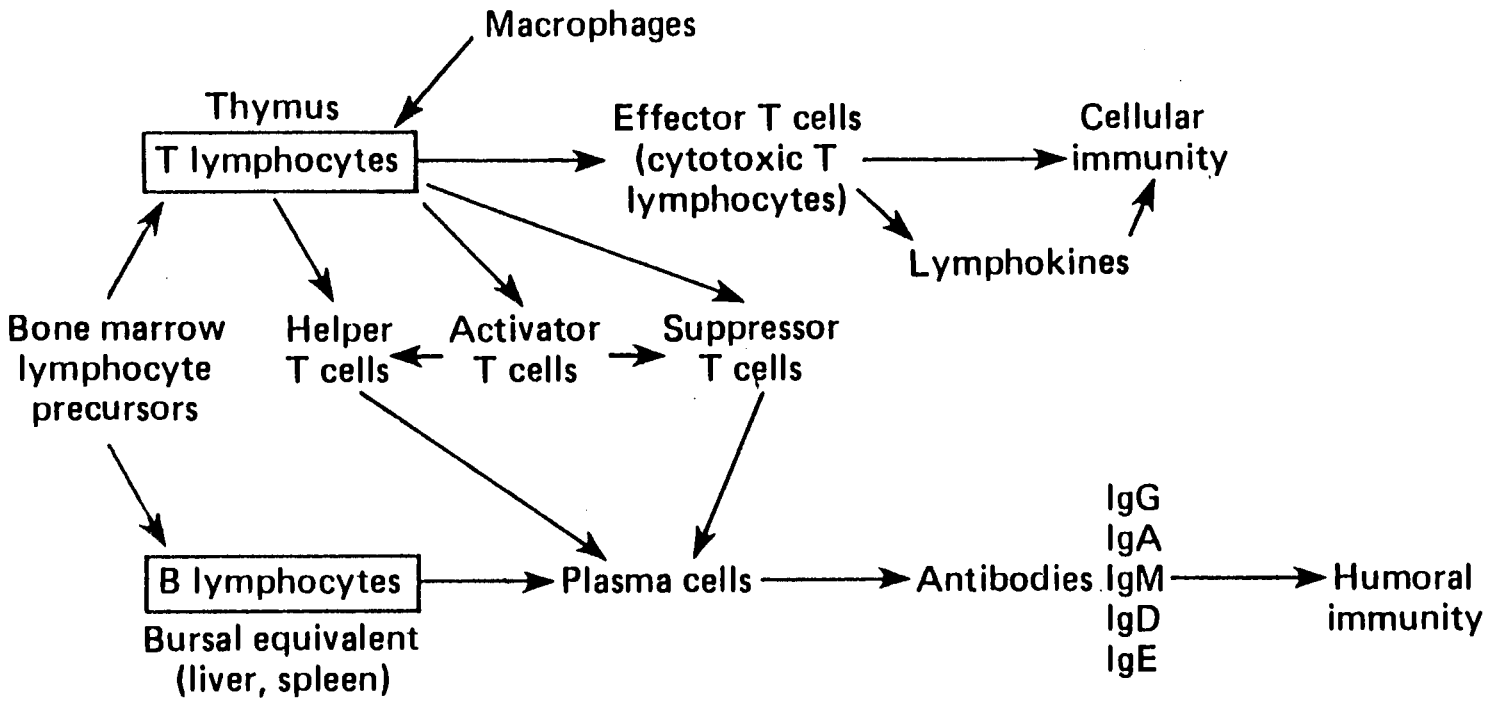


Figure 6 Components of the Immune System

(from Ganong, 1983, p.418)

which mobilize against infection. Antibodies function in a number of ways. Some are created specifically to act against a particular infection. Some neutralize poisons produced by bacteria. Others coat the bacteria to attract macrophages which then engulf and digest the bacteria.

A more recently discovered component are the natural killer (NK) cells. Identified in 1974, they are large lymphocites that do not originate from the thymus, and their lineage is not yet clear (Ader and Cohen, 1985). They appear to be part of the defenses against cancer and virally infected cells.

So as not to stray too far afield from the psychological emphasis of the essay, an over-simplified presentation of the immune system must terminate here. The reader is advised to consult the references cited for a fuller discussion (Kimball, 1983, Barrett, 1983, Glasser, 1976).

Immunological Advances in Medicine

For years, immunologists had viewed the immune system as an entirely independent system within the body. Evidence supported this assumption. For example, immune cells placed in a test tube with viruses or bacteria reacted to the microbes in much the same way as they did within the body. (Locke and Kraus, 1982). Gradually researchers from other disciplines, principally the neurosciences accumulated evidence that suggested otherwise. The evidence was suggestive of some sort of relationship between the central nervous system and the immune system.

In October of 1983, an international and interdisciplinary conference was convened in Belgium in an attempt to clarify the relationship between the two systems. The proceedings were published in 1985 under the title of Neural Modulation of Immunity, (Guillemin, Cohn, and Melnechuk, eds.). A second conference on neuroimmunolmodulation was convened in Nov. 1984 by the National Institute of Health in the United States. Locke and Colligan (1986)

summarized the current state of knowledge regarding the relationship between the two systems. They cite two bodies of evidence, the first being more inferential:

- Robert Ader's and others' conclusion that immune functions are susceptible to influence by the brain based on the experiments in which they were able to make changes in the immune system by conditioning behavior.
- Work by the Soviets, George Solomon, Marvin Stein, Gerard Renoux, and others showing that selective damage to parts of the brain's neocortex and hypothalamus can generate selective changes in the immune system.
- More speculative theories of Norman Geschwind, Peter Sifneos and John Nemiah suggesting that certain structural differences in the brain involving communication affect the course of diseases.

The second body is said to comprise more direct evidence:

- The meticulous nerve–mapping research that uncovered the infiltration of the nervous system into important areas of the immune system: the bone marrow, the thymus, the spleen, the lymph nodes.
- Evidence that the morphine analogs, the endorphins secreted by the brain, have immunosuppressive or immunoenhancing effects.
- Findings showing active lines of communication between the brain and the immune system. (Locke and Colligan, 1986, p.56ff)

Readers are advised to consult the Belgium Proceedings or the annotated bibliography compiled by Locke and Hornig–Rohan (1983) for details regarding the above findings.

The present essay primarily concerns the role of mind in neuroimmunomodulation. The invocation of mind in this context requires controversial conceptual leaps when considered in relation to empirical evidence. The editors of the Belgium Conference proceedings eloquently addressed this problem in their preface:

> The problem becomes ambiguous, but not less important, when we substitute "mind" for "central nervous system." The reason derives from the enormous differences between our understanding of "mind" and the immune system. No one would measure the velocity of an airplane by determining elapsed time with an atomic clock and traversed distance by dead reckoning. Yet we are forced to do something like this when we study the relationship between the immune system (dependent variable) and the "mind" (independent variable). The immune system is understood in sufficient detail to measure the limiting factors in responsiveness with precision, while "mind" is a collection of subjective and objective events and processes: i.e., emotions, stress, cognition (conscious and unconscious), conditioning, volition, etc. This disparity would be sufficient reason to treat the problem circumspectly were not the effects of "mind" on immune reactivity so dramatic and paradoxical that the urge to understand becomes irresistible This, unfortunately, encourages the use of anecdotal and correlative data to support a conclusion. Yet quite often, the most fundamental and generalizable of concepts in biology begins with such a tolerated ambiguity which, in time, becomes delineated with experimentation. In view of the medical and social importance of "mind-related" effects on immune responsiveness, as well as our scientific curiosity concerning them, it is appropriate that we should undertake an analysis of the relationship by attempting to at least delineate the problem. (Guillemin, Cohn, Melnechuk, 1985).

Empirical Data

Conditioning Phenomena of the Immune System and Central Nervous System

The first systematic studies of conditioning of immune responses were conducted by Russian investigators in the 1920s. They were adapted from Pavlov's (1927) classical conditioning paradigm. A stimulus that unconditionally elicits a particular response (eg. food causing salivation), is repeatedly paired with a neutral stimulus that wouldn't ordinarily elicit the same response (eg. bell ring). Eventually the neutral stimulus will become conditioned to elicit the same response without the unconditioned stimuli being present (eg. bell ring causing salivation).

Using Pavlov's techniques, Metal'nkov and Chorine (Ader, 1981a) attempted to condition the increase of polymorphonuclear leukocytes (PMNs) by pairing injections of bacteria, the UCS, with immunologically neutral stimuli. A PMN is a white blood cell with a multilobed nucleus that is very active in phagocytosis (Barrett, 1983). An increase in PMNs is a

characteristic non-specific immune response to an injection of bacteria into the peritoneum of a guinea pig. With the bacterial injection as the UCS, they used a scratching of the skin with a tapioca emulsion as the CS. This CS-UCS pairing was repeated daily for 18-25 days. After a 12-15 day rest period to allow conditions to return to baseline levels, the CS was applied several times in the absence of the UCS.

Within several hours, there was a rapid influx of PMNs that subsided after 1 to 2 days. This response was shown in three animals. A number of other Russian researchers replicated these findings in rabbits and guinea pigs in studies with slight variations in the method. In 1928, Metal'nikov and Chorine were successful in conditioning changes in a specific antibody response to cholera in rabbits. These results however had mixed success in replication studies.

There was skepticism within the scientific community regarding the evidence of conditioned changes in antibody levels. Alterations mediated through the nervous system were considered unlikely since antibody production was known to be an immunologically specific response to each new antigenic stimulus. There were no known mechanisms to account for the findings (Ader and Cohen, 1985). Ader speculates on the reasons why the Russian work was not followed up:

> As much as anything else, the demise of conditioning studies from the Soviet Union can be attributed to the intransigence of the proponents as well as the critics of such work. For many, the observation of conditioning effects was interpreted as evidence for the neural transmission of antigenic stimulation and led to the hypothesis that the central nervous system was capable of stimulating antibody production de novo. This restrictive conceptualization provided the framework for the early studies of conditioning and, unfortunately, rejection of the underlying concept resulted in rejection of the experimental data (Ader and Cohen, 1985, p.382).

Ader's own work in conditioning effects on the immune system were conducted some fifty years later in 1974. His interest in the effects resulted from the serendipitous observation of mortality among rats that were being tested in a taste aversion learning

situation. This conditioning paradigm differs from the traditional model of classical conditioning in that it uses a single trial pairing of UCS-Cs for the conditional response. The phenomenon is known as the Garcia effect (1968) or "bait-shyness" effect and requires the ingestion of a noxious substance. The unpleasant experience becomes associated with other sensory modalities such as taste or smell to produce a lasting aversion to a previously neutral stimulus.

Ader was pairing cyclophosphamide (CY) with the consumption of different volumes of a saccharin drinking solution. CY is a potent emetic and as hypothesized, the resistance to extinction of the conditioned response was directly related to the volume of the saccharin solution. However, some of the rats died and mortality rate tended to vary directly with the volume of solution consumed during the single conditioning trial. Ader later discovered that the drug he was using had another quality besides causing nausea. Cyclophosphamide is a powerful immunosuppressant. The rats' immune systems were compromised rendering them susceptible to any latent pathogens in the laboratory environment (Ader, 1974).

These results prompted Ader to design an experiment to determine if it were possible to condition an immunosuppressive response. Ader and Cohen summarized the procedure as follows:

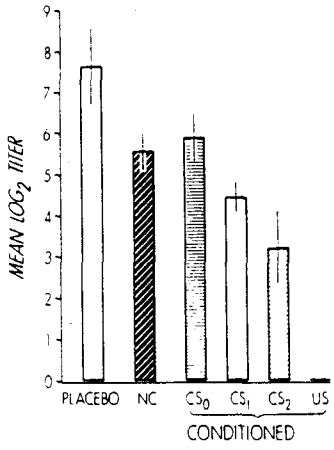
> Individually caged rats were gradually adapted to drinking their total daily allotment of water during a single 15-min period that occurred at the same time each day. On the day of conditioning, conditioned animals were given a 0.1% solution of sodium saccharin in tap water instead of plain water during the 15-min drinking period. Drinking was followed by an intraperitoneal (ip) injection of 50mg/kg CY. In subsequent studies, nonconditioned animals received saccharin and CY in a noncontingent (unpaired) fashion. Placebo animals in this and subsequent studies drank plain water or saccharin and were injected with vehicle.
>
> Three days after conditioning, all animals were injected ip (intraperitoneally) with antigen, sheep red blood cells (SRBC). Thirty min after immunization, each animal in one subgroup of conditioned animals (Group CS) was provided with a single drinking bottle containing the saccharin drinking solution for 15 min and was then injected with saline. To control for the effects of conditioning per se, a second subgroup of conditioned animals (Group CSo) was provided with plain water and injected with saline. To define the unconditioned effects of CY, a third subgroup of conditioned animals (Group NC) were given saccharin-flavored

water and injected with saline; placebo-treated animals (Group P) were given plain water and no injection. In this first experiment, independent subgroups of conditioned animals were reexposed to saccharin on the day of immunization (Day 0) and/or 3 days after being injected with SRBC. For each subgroup of conditioned animals there was a subgroup of nonconditioned animals that received saccharin at the corresponding time(s). Six days after immunization, blood samples were obtained, coded, and titrated for hemagglutinating antibody activity (Ader and Cohen, 1985, p.383).

Figure 7 shows the results of the experiment as well as that of two replication studies using essentially the same procedure. The relationship among the groups was consistent with Ader and Cohen's prediction. Placebo treated animals, having received no immunosuppressive treatment had the highest antibody titers and animals injected with CY at the time of inoculation had the lowest. Nonconditioned animals and those who were not reexposed to the CS on one or two occasions after inoculation of the SRBC showed attenuated antibody responses. The group with two reexposures consistently showed the greater attenuation.

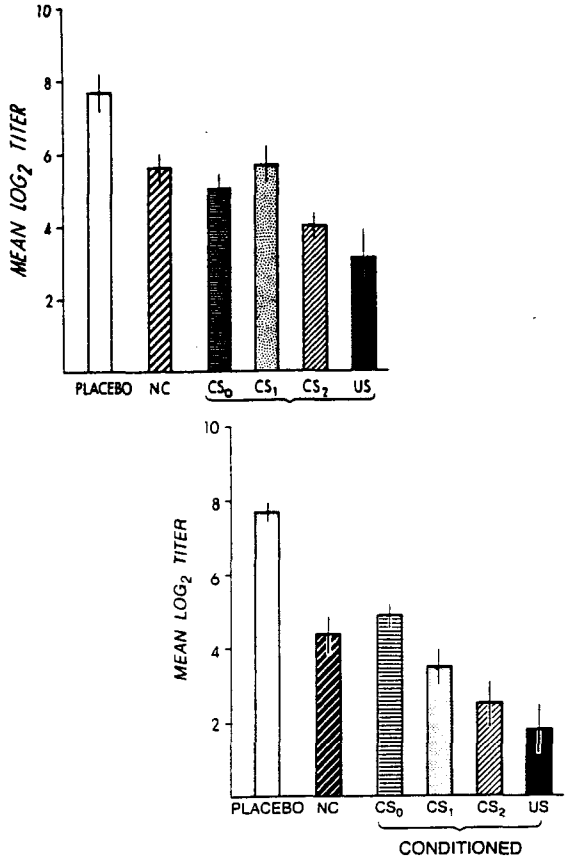
A number of variations on the design did not affect the conditioned alteration in the antibody measurement. A conditioning effect was obtained pairing sucrose and CY instead of using saccharin (Ader and Cohen, 1981). The effect was also observed mixing CY with chocolate milk in order to dispense the drug orally rather than through injection (Ader and Cohen, 1985).

The use of sheep red blood cells in the paradigm induces a humoral (antibody) response that involves interactions between thymus-dependent helper T-cells and antibody-producing bone marrow-derived B cells. Boubjerg, Ader, and Cohen (1982) were successful in obtaining immunosuppression in a cell-mediated reaction which was similar to that previously used while using a different antigen to induce the T-cell response. In this case, rats received a subdural injection of splenic leukocytes from other female rats which triggers a graft versus host immune response. This is the same immune response which must be suppressed in order to allow transplanted tissue or organs to be accepted by the recipient organism.



Hemagglutinating antibody titers (mean ± *SE*) determined 6 days after injection of SRBC. NC = nonconditioned animals provided with saccharin on Day 0 (day of antigen) or Day 3; CS_0 = conditioned animals that did not receive saccharin after antigen treatment; CS_1 = conditioned animals reexposed to saccharin on Day 0 or Day 3; CS_2 = conditioned animals reexposed to saccharin on Days 0 *and* 3; US = conditioned animals injected with CY following antigenic stimulation. (From Ader, R., & Cohen, N. Behaviorally conditioned immunosuppression. *Psychosomatic Medicine*, 1975, 37, 333–340. Reprinted by permission of Elsevier/North-Holland, Inc.)

Effects of conditioning on hemagglutinating antibody titer. (Adapted from Rogers, M. P., Reich, P., Strom, T. B., & Carpenter, C. B. Behaviorally conditioned immunosuppression: Replication of a recent study. *Psychosomatic Medicine*, 1976, *38*, 447–452.)



Effects of conditioning on hemagglutinating antibody titer. (Adapted from Wayner, E. A., Flannery, G. R., & Singer, G. The effects of taste aversion conditioning on the primary antibody response to sheep red blood cells and *Brucella abortus* in the albino rat. *Physiology and Behavior*, 1978, 21, 995–1000. Reprinted by permission.)

Figure 7 Results of Conditioning Research

(from Ader et al., 1975; Rogers et al., 1976; and Wayner et al., 1978; in Gentry, 1984, pp.146–147)

One of the primary issues of controversy in the immunosuppressive conditioning data is that of a possible alternative explanation for the attenuation response. Conferees had discussed at the Belgium meeting, "that supposed evidence of CNS suppression of immune responses might instead be more parsimoniously interpreted as a result of the long familiar inhibition of immunity by hormones liberated in the general adaptation syndrome". This inhibition, especially by adrenocortical steroids is typically a marked response in laboratory rodent studies (Melnechuk, 1985).

Indeed in Selye's (1936) original formulation of the syndrome, he acknowledged atrophy of the thymus and lymph nodes in the third phase, the exhaustion condition. The atrophy was seen to be a direct result of the adrenal corticosteroids. Their inhibitory effects have also been found to influence the function of both macrophages and lymphocytes (Borysenko and Borysenko, 1982).

Ader and Cohen conducted experiments designed to evaluate the possibility that the immunosuppressive conditioning effects were mediated by changes in corticosterone levels. The results failed to support the hypothesis of steroid mediation (Ader and Cohen, 1975, 1985). Lithium chloride (CI) was used instead of CY as the UCS. Both compounds can induce a taste aversion and both unconditionally elicit elevations in corticosterone level. LCI however does not have the intrinsic immunosuppressive qualities that CY does. To determine whether an elevated corticosterone level superimposed upon the immunosuppressive effects of CY could account for the conditioned suppression, subgroups of animals conditioned with CY were injected with LCI or with corticosterone instead of being reexposed to the CS. Those animals reexposed to the CS showed lower antibody titers. Those that received LCI or corticosterone did not differ from nonconditioned animals or conditioned animals that were not reexposed to the CS. Thus there was no evidence of corticosteroids mediating the conditioned immunosuppressive response in the Ader and Cohen work.

Conditioned enhancement of a cell-mediated response was demonstrated by Gorzynski et al. (1982). The study is significant not only because it demonstrates enhanced rather than suppressed responses but because an antigen itself served as the UCS (Ader and Cohen, 1985). The UCS was a skin graft from a genetically different mouse strain than the mice who received the skin grafts. The grafting procedure was repeated three times. Each time the animals would mount an immune response of the type called graft vs host reaction. An increase in the number of precursors of cytotoxic T-cells is part of the reaction and served as the dependent measure. An interval of 40 days between grafts allowed for the immune response to return to baseline levels. On the fourth trial, animals were sham grafted rather than skin grafted. The sham graft consisted of anaesthetizing the animal and taping an area of the skin as if an actual graft had been performed. In each of two experiments, 50-60% of the animals so treated showed an increase in the T-cell measure in response to sham grafting. This difference was statistically significant.

Other work has demonstrated conditioning effects on other components of the immune system. Russell et al. (1984) were able to condition histamine release in guinea pigs using fish and sulphur smells as the CS. Ghanta et al. (1985) demonstrated conditioned enhancement of natural killer cell activity in mice using camphor smell as the CS.

Placebo Effects

Ader (1985) and others (Melnechuk, 1985) have addressed the clinical implications of the conditioning phenomena. Ader contends that the above data elaborate the role of conditioning processes in the study of placebo effects. He argues that there is considerable heuristic value in adopting a conditioning model for manipulating, controlling, and predicting placebo effects in pharmacotherapeutic protocols (Ader, 1985, p.307).

The term "placebo" is derived from the Latin meaning "I shall please". In the broad sense of the term, it refers to the effects of procedures that offer patients reassurance or

expectations of improvement in their clinical status (White, Tursky, Schwartz, 1985). In the narrow sense of the term, placebo refers to an inert preparation or substance given to subjects, within a controlled experiment, in place of a drug or medicinal substance (Locke and Colligan, 1986).

Ader's suggestions of therapeutic conditioning strategies are used from the perspective of the more specific definitions. But he makes a case to use placebos outside the controlled experiment where subjects are either exclusively given the inert placebo or the active drug. Rather he suggests that subjects or patients can be treated with drug and placebo by introducing partial schedules of pharmacological reinforcement. Ader speculates on some possible advantages,

> If it could be shown that a partial reinforcement schedule could approximate the therapeutic effects of a continuous reinforcement schedule, drug dose will have been reduced, some side effects may be reduced, problems of dependence may be lessened or alleviated more easily, and/or the duration of the effects of pharmacotherapy might be extended. The cost of medication would also be reduced (Ader, 1985, p.317).

It is the broader use of the term placebo that specifies the relevance of mental causation to medical science. David Bakan recently articulated his impressions of the problems facing the scientific conceptualization of mental causation from the context of the placebo effect. His perspective is instructive of the difficulties of reconciling philosophic analysis with empirical evidence.

> One of the things that makes the placebo phenomenon problematic is that while there is ample evidence of its existence, there is almost no place into which it fits easily and comprehensibly within established scientific contexts . . . The problem lies in our metaphysics, in our view of the nature of reality. The commonest, ultimate reality consists of material particles and their motions in time, with all other phenomena resulting from the interactions among these particles. Mental phenomena constitute empirical challenges to this metaphysical view. Various versions of dualism, interactionism, double aspectism, dualism with materialistic reductionism, and dualism with mentalistic reductionism (such as solipsism) have all sought to make some metaphysical accommodation to the patently empirical dual reality of the physical and the mental. The fact of the matter is that, to this day, no fully satisfactory metaphysical position has been developed, in spite of the many claims in the philosophical and scientific literature that the metaphysical duality problem has been solved or satisfactorily

circumvented.

> We can easily accommodate ourselves to a situation of metaphysical uncertainty. My own conviction is that we can make progress in science without solving ultimate questions first. Biology has made great progress without solving the problem of what life is. Physicists have learned a great deal about light without having knowledge of the ultimate nature of light. It is quite possible to learn a great deal about the placebo phenomenon without having to answer the question of how mental events can possibly have an effect on physical events. Empirically they do, however much some metaphysical orientations might indicate that such effects are impossible (Bakan, 1985, pp.211 & 212).

Stress and the Immune System

The literature examining the effects of stress on humans is extensive. This includes investigations of the relationship between personality factors, stressful life events, and disease processes in humans (eg. Stone, Cohen, and Adler, 1979). As the field of PNI has emerged, the scope of the dependent variable in the relationship between psychosocial factors and disease processes has expanded. There now exists a growing literature including conditions of the immune system in these considerations. Reviews of this literature include Palmblad, (1981); Plaut and Friedman, (1981); Locke, (1982); Locke and Hornig-Rohan, (1983); and Ader and Cohan, (1984).

Due to the complexity of the interrelationships and the relative novelty of the field of PNI, a clarification of the effects of stress on immune function or the mediation of such effects has not been achieved (Ader and Cohen, 1985). This is also the case with the conditioning literature previously discussed. Fox acknowledges the limited state of the existing knowledge base of PNI.

> The extant data, although convincingly indicating that there is an interaction between the neuroendocrine system (NES) and the immune system (IS), are sparsely distributed tiles of a complex mosaic. We need to know the mechanisms by which each affects the other, although some hints about the NES-IS pathway(s) are emerging. On the other hand, the IS-NES mechanisms and routes of action are, except for a few papers, unknown. (Ader and Cohen, 1985, p.400)

The scope of this essay will not allow a thorough overview of the literature examing the effects of stress on the human immune system. The following is a brief sketch of some of the more suggestive findings. Rather than providing an overview, it illustrates the complexities of the interrelationships involved in stress responses.

Bereavement Studies

Conjugal bereavement is among the most potentially stressful of commonly occuring life events and has been associated with increased mortality (Holmes and Rahe, 1967). Bartrop and colleagues (1977) looked at the effects of bereavement on mitogen stimulation of T-cells. They found that over a period of two months, the response of bereaved persons' T-cells was reduced in comparison to matched controls. Of the two T-cell mitogens that were used, PHA and concanavalin A (con A), only PHA-induced stimulation was significantly effected. No effects of bereavement were found on a number of other immunologic measures nor on any of a number of relevant hormones including corticosteroids.

Schleifer and colleagues (1983) conducted a prospective longitudinal study of spouses of women with advanced breast cancer. Mitogen-induced T-cell stimulation was measured in 15 men before and after the death of their wives. Responses to three T-cell mitogens, PHA, con-A, and PWM, were significantly lower during the first two months after the spouse's death compared with prebereavement measures. Follow up during the remainder of the postbereavement year revealed that mitogen responses had returned to prebereavement levels for the majority of the subjects. Prebereavement mitogen responses did not differ from those of age and sex-related controls.

These findings demonstrate that suppression of mitogen induced T-cell stimulation is a direct consequence of the bereavement event. They also suggest that the effect of stress on immune function may depend on what measures are used and on temporal factors. Schleifer et. al. (1981) emphasized that these findings do not adequately explain the epidemiologic

findings of increased morbidity and mortality following bereavement. "It remains to be determined whether stress-induced immune changes such as decreased mitogen responses are related to the onset or course of physical illnesses following life stress" (Stein et. al., 1985, p.828s).

The experimenters acknowledge that the processes linking the effects of bereavement on the immune system are complex and remain to be determined. Changes in nutrition, activity levels, sleep and drug use which are often found in the widowed could influence immune function. Subjects in the 1983 Schleifer et. al. study, however, did not report any major or persistent changes in the above behaviors (Stein et.al., 1985).

Other Examples

Newberry (1985) distinguishes two separate types of effects of stress on cancer. One is via alterations in exposure to cancer-relevant exogenous agents. That is, stress could effect behaviors such as smoking, food choice, alcohol comsumption, drug intake, or occupational exposure to chemicals so as to effect cancer risk. He calls this the external loop relationship between psychological factors and cancer. The other type of effect is called the internal loop in which "psychosocial factors such as stress effect cancer via endogenously mediated effects on endogenous components of host resistance" (Newberry, 1984, p.18). This could come about from effects on the immune system mediated by neuroendocrine processes.

An interesting study by Locke and Kraus (1982) further illustrates differential effects of temporal measures and psychosocial factors. The study examined self-reported measures of life stress and psychiatric symptoms as related to human natural killer cell activity. Life-change stress and psychiatric symptoms were only related to natural killer cell (NK) activity when the period of self-reported assessment was the past year and not for periods of time less than the course of an entire year.

The highest NK activity was found in subjects that reported high stress and low symptomatology. The lowest NK activity was found among those with high stress and high symptomatology. The experimenters suggest that the psychiatric symptomatology reflects coping ability. This then implies that life stress impairs NK function if the person has low coping skills but may actually enhance NK function if coping strategies are strong.

Newberry (1985) summarizes the effects of stress on the immune system as follows:

1. Stress can depress, enhance, or fail to affect immune function.
2. Which effect occurs seems to depend upon: What aspect of immune function one considers. What type of stress is involved. Controllability/coping, chronicity, and other variables still poorly understood appear to have important effects.
3. The mechanisms of stress modulation of immune function are poorly understood. Adrenal corticoids almost surely play a role, but they are not the only factors. It is likely that catecholamines and endogenous opioids are involved, though less is known about their effects. It is also likely that large numbers of other factors are involved, including other hormones and more direct neural factors, but next to nothing is known yet about these possibilities (Newberry, 1985, p.17)

Conscious Immunomodulation

In the preceding two subsections of this essay, evidence of immunomodulation as mediated by neuroendocrine systems has been considered from two empirical sources, conditioning phenomena and the effects of stress on humans. The third and final source of possible immunomodulation to be considered is through "higher" mental processes, conscious efforts to modify one's own immune system. If the interrelationships among the three physiological systems are as extensive as the present evidence suggests, some degree of conscious regulation should be possible. The preliminary data generated from this hypothesis appear to support its viability as a worthwhile scientific enterprise.

Investigations of effects of conscious mental manipulation of physiological processes, have often employed techniques involving some aspects of imagery, hypnosis, and or relaxation as independent variables. There has been a smattering of such work using immunomodulation as the dependent variable. This subsection will include a brief look at some of those experiments.

Imagery

The study of mental imagery has once more come into vogue as the cognitive sciences have emerged as a credible scientific discipline. The difficulty of defining a mental image is acknowledged throughout the literature. Lyman (1984) offers a working definition of images as "copies" of sensations. This definition is intended to emphasize the phenomenal character of images rather than addressing the issue of imagery requiring prior sensory stimulation. Mandler (1984) notes two aspects of the term "image", a mental representation and the "phenomenal conscious experience of any image which is constructed out of that representation." More recently, Ahsen has defined an image as:

> . . . a centrally aroused sensation, a percept-like arousal in the absence of a real object. However, the image extends from perception of an outside object as its model or interpretation, to the appearance of an object in the mind without its external space–time limitations and usual qualities. Embodying this special profit-in-loss balance, the image in the mind loses some of the qualities of the original object, while gaining some new ones on top of this loss, and finally representing a presence in its own right (Ahsen, 1986, p.48).

A major issue within cognitive science concerns the nature of imagery. According to some theorists, such as Pylyshyn, images in the mind are derived from logical or verbal propositions. There is no intrinsic property in the mind that resembles any picture–like percept. Rather mental images, as pictures in the mind, result from an individual's constructing them from symbolic cognitive processes such as beliefs and desires. Images exist as an epiphenomenon or side effect and thus play no causal role as a naturally existing level of representation of mental states (Pylyshyn, 1984). In this interpretation, mental images

do not warrant status as a distinct level of representation in the human cognitive repertoire. Rather they result from a kind of talent or ability, and are strongly influenced by individual differences.

Other theorists, such as Kosslyn (1980), construe mental imagery as a distinct level of representation common to the species. They acknowledge an interplay between the more abstract propositional level and a quasi-pictorial level that is a percept-like, spatially extended "analogue" representation (Ahsen, 1984). They also contend that this quasi-pictorial image is not merely an epiphenomenal concomitant of more abstract non-pictorial processing but can also play a causal role at the level of a quasi-pictorial image (Gardner, 1985).

Kosslyn does concede that there is a basic propositional level of coding, from which images may well be generated. But rather than engage in the reductionist search for the irreducible level of representation, he prefers to explore the various forms of representation, for their role in accounting for specific empirical findings. As Gardner describes Kosslyn's strategy:

> . . . the issue is not whether images may be derived from more primitive propositional or symbolic representations, but rather whether a quasi-pictorial image has emergent properties permitting its treatment as a distinctive form of representation (1985, p.334).

Further discussion of this debate is beyond the scope of this paper. The reader is advised to consult discussions by Kosslyn (1980), Pylyshyn (1984), and Gardner (1985) for elaboration.

Ahsen takes both groups of theorists to task for ignoring the link between mental imagery and the physical body from which it is generated. He attempts to remedy this omission with his "Triple Code Model" of imagery (1984). He describes an "idea" as a unitary experiential state which can be divided into three modes: image, somatic response, and meaning (hence the acronym, ISM.) Ahsen describes the three modes as follows:

"I" — Image. Empirical studies have found it difficult to distinguish between images and percepts. The image can be defined as a centrally aroused sensation. It possesses all the attributes of a sensation but it is internal at the same time. It represents the outside world and its objects with a degree of sensory realism which enables us to interact with the image as if we were interacting with a real world. At the same time the "as if" image is real in its own special way. It represents its own reality. We can reconstruct the world through it, and also change the world, if we wish to do so.

"S" — Somatic Response. Whether one believes in the Cannon-Bard theory or James-Lange theory the simple fact remains that the seeing of an Image (I) results in Somatic (S) or neurophysiological change which involves skeletal, proprioceptive, sensory experience and so forth. Upon seeing the image of an apple, one experiences also its color, texture, taste and smell. The somatic response is always of a specific type and always accompanies an image unless the response has been suppressed. The original somatic response, however, can be developed again by concentrating on the image.

"M" — Meaning. Every image imparts a definite significance or meaning. Through meaning, the organism interprets its relationship with the visual image or with the world. Logic or proposition is a special form of meaning but this does not comprehend all the "meanings" which the organism is capable of feeling concerning an image. Some meanings may be vague, others partial and incomplete, still others very clear, but they are meanings all the same in the operational sense because they represent stages of involvement with a presented object. While seeing an image, meaning should be experienced without disturbing its nature (Ahsen, 1984, p.34ff).

The three modes can also interact in such a way as to change the order of their operations. ISM is stated to be the most straightforward variation. Evocation of a visual image is followed by a somatic response, and then by a meaning. However, any variation of the three modes (e.g. SIM, MSI, etc.) could occur depending on cultural and individual tendencies.

The ISM model is at a stage of development in which many conceptual and empirical clarifications need to be made. Its purpose within this essay is to illustrate its compatibility with an emergentist account of mental causation in which a mental state influences the concomitant neural processes from which it emerged (demergence). Every mental representation (image) as well as its linguistic component (meaning) includes a physiological concomitant, each of which are capable of influencing each other in a causal relation.

A number of theorists feel emotion plays an important mediating role in the somatic response to a mental image. An emotion could result from an interaction between the mental image and its meaning. Achterberg (1985) reviewed the literature which addressed the role of the right cerebral hemisphere for imagery and emotions. The predominant role of the right hemisphere in processing imagery has been well documented in the split-brain literature (Sperry and Gazzaniga, 1967; Bogen, 1969, Gazzaniga and LeDoux, 1978). Other studies implicate the right hemisphere in the processing of emotions (Safer and Leventhal, 1977; Ley and Bryden, 1979, 1982; Bryden and Ley, 1983). In addition to greater right hemisphere activation, emotions also activate the autonomic nervous system (Mandler, 1984). Previous sections of this essay have addressed the multitude of physiological implications of autonomic arousal.

Research from a phenomenological perspective has examined the relationship between imagery and emotions. Lyman, Bernadin, and Thomas (1980) showed that images were more predominant in situations that were emotionally charged (as compared with situations of neutral or minimal emotion). Lyman (1984) has proposed that emotional experience is an emergent phenonmenon, characterized by a dynamic pattern of imagery and accompanying affect with particular experiential themes. Affect includes the somatic responses of Wundt's classic tri-dimensional theory. Lyman and Waters (1986) have shown that different emotional experiences have going with them different sensations most easily identified through introspection. Emotion, which has both experiential (imagery) and somatic (affect and sensation) componants, may serve as a bridge between mind and body and could play an important role in psychoneuroimmunological reactions.

The following is a consideration of studies which have used imagery, hypnosis and/or relaxation as independent variables and measures of the immune system as dependent variables.

A Clinical Application

A series of studies, conducted over a five year period in the mid 1970s, investigated the role of psychological factors as they related to the course of cancer. The clinical component which explored psychological intervention to enhance survival rates in cancer was led by O. Carl Simonton and his wife, Stephanie Matthews. A more experimental component which examined the nature of psychological factors was led by Jeanne Achterberg and G. Frank Lawlis.

The clinical study involved 225 subjects diagnosed with advanced malignancies of varying types, mostly of the breast, bowel, and lung (Simonton, Matthews-Simonton, and Sparks, 1980). Expected median survival time was 3 to 22 months. A battery of psychological tests was administered including the Minnesota Multiphasic Personality Inventory (MMPI), Fundamental Interpersonal Relationship Orientation-Behavioral (FIRO-B), Levinson's Locus of Control test (Levinson's IPS), a social history, and sex role inventory. A five-to-ten day psychotherapy session was conducted with each subject including individual and group counseling:

> The central psychological process was to have the patient employ muscular relaxation and regular breathing for 10 to 15 minutes three times daily. Each episode was coupled with mental imagery used for the purpose of desensitization, addressing fears, adding flexibility to rigid thinking, and releasing anger and resentments. Other counseling processes were also employed. These included having the patient redecide early childhood decisions and improve emotional outlets through standard assertiveness training; goal setting; and a guided fantasy about disease recurrence and death to clarify underlying beliefs and fears...Imagery drawings were routinely used as a projective tool to evaluate patients' and spouses' beliefs about cancer treatment and their own healing potential. (Simonton, et al. 1980, p.227).

This experimental procedure was conducted as an adjunct to standard cancer therapy for all subjects. The principle methods of treatment including surgery, radiation therapy, and chemotherapy were used to treat the malignancies.

Rates of survival time for the experimental subjects were compared with median survival rates for cancer patients receiving only standard therapy at other treatment facilities. Table 2 is a copy of tables of results including comparison of experimental vs. control groups and breakdowns of survival times for each of the experimental subgroups. Reactions to Simonton's work from the medical community will be discussed in the next subsection of the essay.

Achterberg and Lawlis built upon the work of Simonton et al. by devising a diagnostic tool to better assess the role of imagery in treatment. The instrument used was the Imagery of Cancer scale (or IMAGE-CA) which is said to assess "attitudes as well as symbology that does not appear to be at the conscious fore, about three basic areas: the cancer, its treatment, and any inherent ability to overcome it (ie., immunological properties)" (Achterberg, 1984, p.7).

Two separate analyses of data from the previously discussed Simonton study were conducted using the IMAGE-CA as one of the measures (Achterberg and Lawlis, 1977, 1979; Achterberg, 1985). One hundred twenty six subjects were obtained from the group of cancer patients involved in the Simonton study. The Profile of Mood States (POMS) and IMAGE-CA were administered in addition to the battery of psychological tests previously mentioned. Blood chemistry profiles were made within 24 hours of the test administration.

Canonical analysis, which describes the correlation between two sets of data, was used to examine the relationship between blood chemistry and psychological test variables. Three personality profiles emerged from the series of analyses.

The profiles result from compiling the highest and lowest correlations between the psychological and blood variables. The experimenters termed the first profile, resignation (see table 3), characterized by a higher level of depression and low levels of lymphocytes, an important immunological component The second profile was called nondirected struggle.

Table 2—Comparison of Survival Times

Type of cancer	Median national survival time (months)	Observed median survival time of our patients (months)
Breast	16	35
Bowel	11	21
Lung	6	14

Table 3—Survival in Advanced Breast Cancer Study Group, by Metastatic Sites

Metastatic site	Survival <21 months	Survival 21 to 41 months	Survival >41 months
Bone	3	8	4
Liver	3	5	1
Lung	2	1	3
Brain	1	0	0
Intra-abdominal	1	0	1
Total no. patients	10	14	9

Median survival time, 35 months

Table 4—Survival in Advanced Colon Cancer Study Group, by Metastatic Sites

Metastatic site	Survival <20 months	Survival 20 to 27 months	Survival >27 months
Liver	6	1	2
Intra-abdominal	1	2	1
Lung	0	1	2
Bone	0	2	0
Total no. patients	7	6	5

Median survival time, 21 months

Table 2 Simonton's Research Results

(from Simonton et al. 1980, p.231)

PURPOSEFUL ACTION

(+) POSITIVE IMAGERY
(+) HYSTERIA (MMPI)
(+) CONTROL (MMPI)
(+) ANXIETY (POMS)
(−) EXPRESSED INCLUSION (FIRO)
(−) WANTED INCLUSION (FIRO)
(−) CHANCE (L of C)
(+) RED BLOOD CELLS
(+) WHITE BLOOD CELLS
(−) HEMOGLOBIN

NON-DIRECTED STRUGGLE

(+) PSYCHASTHENIA (MMPI)
(+) F (MMPI)
(−) CHANCE (L of C)
(−) AFFECTION (FIRO)
(+) DEPRESSION (POMS)
(+) PSYCHOPATH. (MMPI)
(−) HYSTERIA (MMPI)
(+) POWERFUL OTHERS (L of C)
(+) RED BLOOD CELLS
(−) HEMOGLOBIN
(+) MEAN CORPUSCULAR VOL.
(+) MEAN CORPUSCULAR COUNT

RESIGNATION

(+) DEPRESSION (MMPI)
(+) TENSION (POMS)
(−) HYSTERIA (MMPI)
(−) SCHIZOPHRENIA (MMPI)
(+) RED BLOOD CELLS
(−) HEMOGLOBIN
(+) MCV
(+) MCC
(−) SEGS
(−) LYMPHOCYTES

Table 3 Personality Profiles

(from Achterberg, 1985, p. 215)

Achterberg describes these patients as "dissatisfied and worried, struggling and anxious; but their conflict was without direction" (1985, p.184). The third profile was called purposeful action. Both blood and psychological factors indicate a directed attempt to fight off disease.

> The blood indicated a compensatory anaemic reaction to haemoglobin deficiency, with a relatively higher white blood cell count that could be interpreted as more antibody availability. Psychologically, these patients were unlikely to decompensate in the face of stress, were self-sufficient, and exhibited a belief in their own ability to control their situation (Achterberg, 1985, p.185).

The second study used the same data as in the canonical analysis study, but employed factor analysis to predict the future status of disease. This type of analysis was used to examine the relationship between blood, psychological factors and state of disease at the time of testing and a two month follow-up (Achterberg and Lawlis, 1977; Achterberg, 1985). Results showed that present disease state was correlated with five factors which emerged from the analysis, three of which were blood variables, and two psychological (see figure 8).

Results of a two-month follow-up showed four factors which were predictive of the disease status. None of the blood work was predictive The most significant factor in prediction was imagery as described by three subscales of the IMAGE-CA and a clinical opinion by the examiner as to the prognosis for the disease condition. These subscales are described as follows:

1. Concreteness vs. symbolism.
2. Overall strength of imagery; emotional investment the patient projects to his drawing.
3. Estimated regularity of the number of times per day the patient thinks of his disease in the described way. (Achterberg and Lawlis, 1984, p.24).

Robert Trestman (1981) conducted a replication and extension of the above using factor analysis of blood chemistry and psychological variables. He administered the IMAGE-CA to 48 adult cancer patients, tested their blood chemistry, and administered a psychological test battery that included the California Psychological Inventory (CPI), the Imaginal Processes

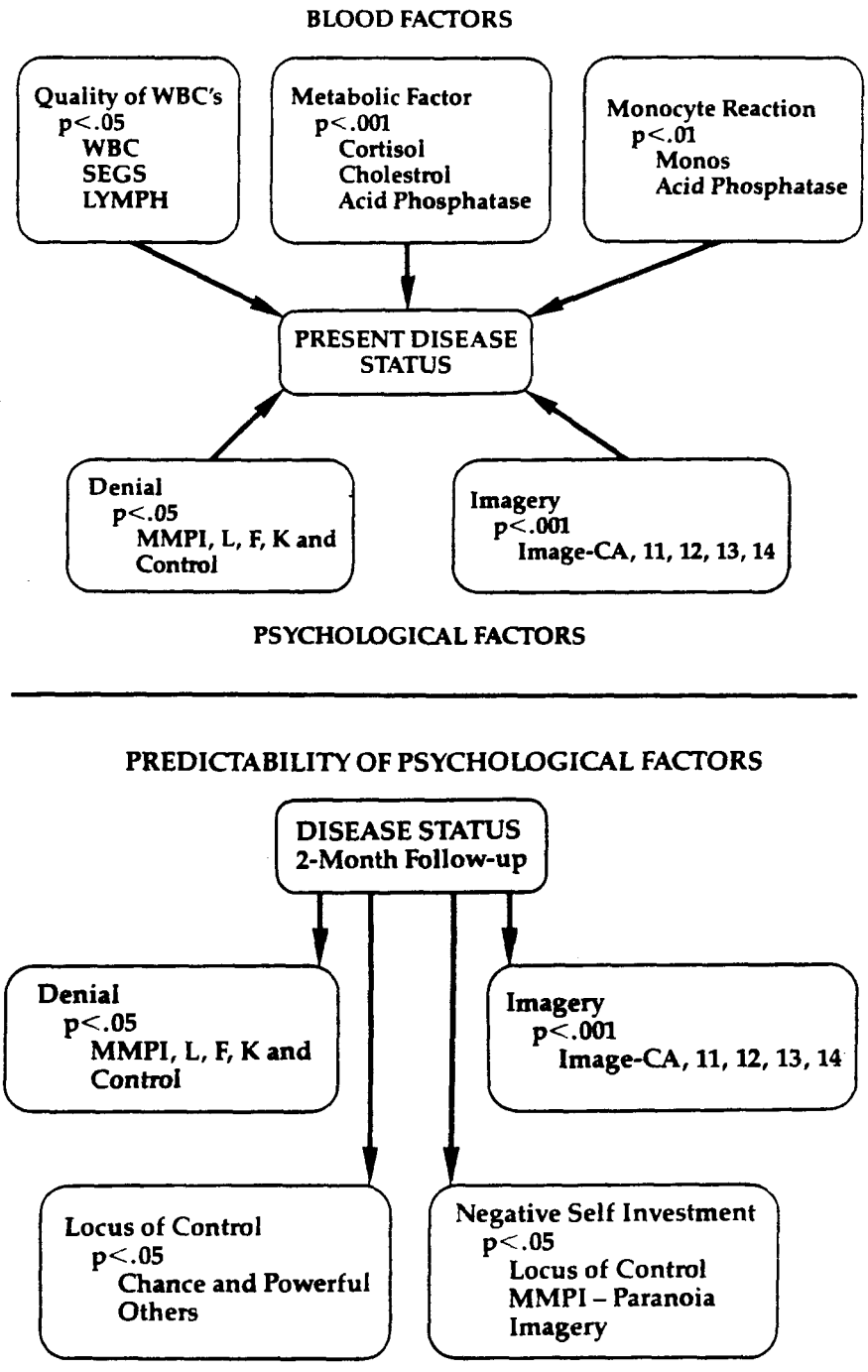


Figure 8 Factor Analysis of Blood Chemistry and Psychological Test Variables

(from Achterberg, 1985, p.186)

Inventory (IPI), the Draw-a-Person Test (DAP), and a Necker cube rotation task (Achterberg and Lawlis, 1984). Results of the analyses were similar to many of the Achterberg and Lawlis findings with some important differences. Only 19 subjects of the 48 had cancer as advanced as all of the subjects in the previous studies. In addition none of the Trestman subjects was involved in formal groups which used imagery in a health-related manner. Achterberg and Lawlis cited the above two differences between the subject samples as possible explanation as as to why Trestman's data "was not found to be predictive of current or follow-up disease status" (1984, p.138). What was found was that the IMAGE-CA was the "instrument most significantly correlated to medical variables (both haematology and blood chemistry) in a broad complex, pattern of relationships" (p.140). Trestman himself concluded:

> The IMAGE-CA taps a dimension separate from those measured by the remaining tests. It would, therefore, seem that one's assumptions and expectations about cancer are neither a simple product of one's style of, and ability to, manage stress nor of one's pattern of imagery use" (Trestman, 1981, p.163).

Relaxation

Peavey, Lawlis, and Goven (1985) examined the effects of stress on immunity using biofeedback-assisted relaxation as the independent variable. The experimenters started with 41 healthy people as subjects. Levels of stress were measured by a battery of psychological tests. Immune function was measured by a white blood cell count and a test called the Quantitative Nitroblue Tetrazolium Test (NBT). This test is a general measure of neutrophil activation capacity and is related to phagocytic capacity.

A statistically significant relationship was found between stress and immunity in the 41 subjects. The sixteen subjects who met the high stress, low immunity criteria participated in the second phase of the study, and were split into an experimental and control group. Both stress and immunity measures were readministered. The experimental group was given instructions on biofeedback; baseline levels of relaxation were obtained using the biofeedback equipment and individual hour-long sessions were held twice a week. Training included daily

home practice with cassette-recorded relaxation exercises. Subjects were trained with muscle tension and hand temperature biofeedback procedures until they reached a criterion previously established as the appropriate level of relaxation. The eight subjects took from three to eight weeks to reach criterion with the average taking five weeks.

When blood tests on these subjects were compared with their pretreatment tests and with the control group, their neutrophils were found to function significantly better following treatment. No differences were found in the white blood cell count. The results indicate a qualitative immune response improvement but not a quantitative one as reflected by greater numbers of immune components. Barbara Peavey conducted the study for her doctoral dissertation. The research was recognized as the "most noteworthy scientific achievement of the year" at the 1984 convention of the Biofeedback Society of America (Achterberg, 1985).

Hypnosis

Research using techniques of hypnosis have also provided evidence for the influence of mental states on the immune system. Barber (1984) and Hall (1982-1983) present literature reviews of studies in which allergic responses, skin diseases, warts, and burns were seen to be influenced through hypnosis. Barber clarifies what is meant by hypnosis in his review as "referring primarily to a situation in which individuals are purposefully guided by carefully chosen words and communications (in short, by suggestions) to "let go" of extraneous concerns and to "feel-remember-think-imagine-experience" ideas or events that they are rarely asked to experience - for instance, to "feel-remember-think-imagine-experience" a blister forming at the "burned" area. (Barber, 1984, p.8).

The research cited in both literature reviews offer only indirect evidence of immunomodulation. Immune system functioning was not directly measured. However its influence was inferred from changes in the state of health in the subjects involved. A recent study of hypnosis was conducted using a direct measure of immunity, a lymphocyte count as

the dependent variable. Hall (1982-1983) with Longo and Dixon used twenty healthy people ages, 22 to 85, as subjects. A prehypnosis blood sample was taken for a baseline lymphocyte count. Subjects were then hypnotized using a relaxation procedure. During hypnosis they were asked to visualize and feel their white blood cells increasing in number and swimming like 'strong" "powerful" sharks with teeth that were attacking and destroying "weak" "confused" germ cells in their body that caused colds and influenza. The subjects were told the sharks would continue defending them even when they weren't thinking about it. These descriptors are similar to those used in the Simonton study. Subjects were then given written and verbal instructions in self-hypnosis and asked to practice twice daily for a week. A second blood sample was taken one hour after the first session. One week later, the hypnosis and visualization session was repeated, after which a third blood sample was drawn. The session and experiment ended with the administration of the Stanford Hypnotic Susceptibility Scale, Form C (Weitzenhoffer and Hilgard, 1962).

Hall cites two findings from the results. When subjects were divided into two age groups by a median split at age 50, the younger group had an overall higher level of immune functioning when in vitro nitrogen analysis was done using the substance, Pokeweek, as an antigen. This was expected because a gradual suppression of the immune system is normal with aging. What was noteworthy was that only the younger group showed a statistically significant (.05) increase when examined from baseline measure to one week post hypnosis. The older group showed an increase at .10 level of significance.

The second finding involves a comparison between a high and low hypnotizable groups. Hypnotizability ranged from 3 to 11 with 7 as the median score on the Stanford Scale. When lymphocite count was examined there was a significant increase from baseline to one hour post hypnosis for only the high hypnotic subjects in the first session. The same group did not show a significant increase for the one week measure.

Relaxation appears to be a condition that facilitates techniques involving both imagery and hypnosis. Paul Bakan (1980) provides evidence that mental imagery flows best when the motor system is not actively competing for the brain's attention, and when the person is in a prone position. Traditional hypnotic induction techniques are characterized by suggestions of relaxation, eye–closure, and drowsiness. Barber, however, does not include a necessary state of relaxation in his aforementioned description of hypnosis. Rather, he contends that it is the subject's level of "absorption" in the hypnotic suggestions which is important (1984, p.12). Indeed relaxation can facilitate this process as in traditional induction techniques. Other effective induction techniques include simply talking to the subjects "about the power of their mind and their ability to imagine" (Barber, 1984, p.12). Milton Erickson's induction techniques of employing stories, parables, and metaphors can also be effective (Zeig, 1980).

It is noteworthy that in examining the characteristics of good hypnotic subjects, Barber states that they are "typically more cooperative and more motivated to do well and to please the hypnotist and (are) better able to imagine or fantasize vividly and thus to experience in a fantasized reality those things that are suggested" (1984, p.29)

To summarize, the preliminary evidence presented in this chapter suggests that techniques involving combinations of imagery, relaxation, and or hypnosis can directly influence immune function. However, the nature of the mental states that have been employed for immunomodulation have only been crudely characterized in this early stage of research. More work is needed to clarify the role of mental states in interactions with the nervous, endocrine, and immune systems.

CHAPTER IV

SUMMARY AND CONCLUSION

In a recent lecture to the Vancouver Institute (1986), Lister Sinclair described "enlightenment" as the principle of making connections; of discerning relationships between that which was not seen to be previously related. The purpose of this essay has been to suggest conceptual links, connections as it were, between ideas that are historical, philosophical and scientific in origin.

Interdisciplinary scientific endeavors have developed and flourished in the last 30 years. Researchers in molecular biology, biochemistry, and the neurosciences have made significant advances in understanding the structure of living organisms. The cognitive sciences have shown promise in clarifying some of the functional aspects of the human condition. An argument has been made in this essay to further extend the interdisciplinary approach in attempts to construct a useful theoretical framework in psychoneuroimmunology. Indeed, the field necessarily constitutes a reconciliation of both structural and functional considerations. It involves returning to the mind-body problem.

The crux of the problem has been to account adequately for what appears to be an interaction between two disparate phenomena, mind and body. This essay cannot hope to provide any explanation for this interaction. Rather, this essay has attempted to point out some of the pitfalls of addressing the mind-body problem from philosophical, metatheoretical, and empirical perspectives. There is yet no satisfactory explanation of mind-body interactions. The concept of mind continues to elude the grasp of a clear definition. Scientists and philosophers are still largely relegated to metaphor. Sir Charles Sherrington was a scientist who had a gift for such description:

> Mind, for anything perception can compass, goes therefore in our spatial world more ghostly than a ghost. Invisible, intangible, it is a thing not even of outline; it is not a "thing". It remains without sensual confirmation, and remains without

it for ever. Stripped to nakedness there remains to it but itself. What then does that amount to? All that counts in life. Desire, zest, truth, love, knowledge, "values", and seeking metaphor to eke out expression, hell's depth and heaven's utmost height. Naked mind . . . Mind, yoked with life, how varied in its reaction! It will sit down and watch life acquiescent, or on the other hand take life and squeeze it like an orange.

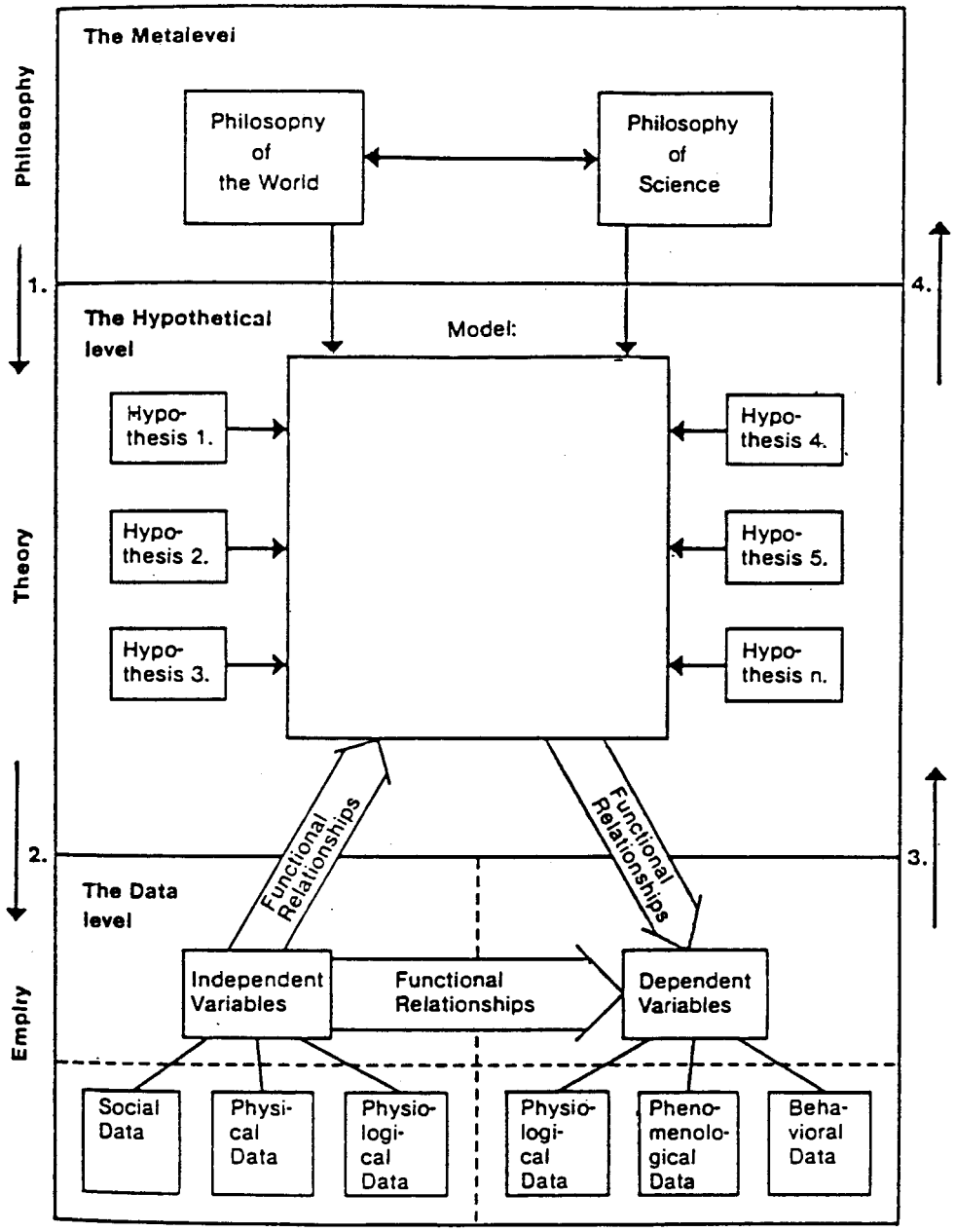
And that other concept, energy; what of its yield? We saw that Time has winnowed its harvest too. How much remains? The perceptible world. All that the space-time continuum contains; gathered harmoniously into one category, a category which nothing which does not act on sense can enter and which all that does so act does enter.

Between these two, naked mind and the perceived world, is there then nothing in common? . . . They have this in common-we have already recognized it-they are both concepts; they both of them are parts of knowledge of one mind. They are thus therefore distinguished, but not sundered. Nature in evolving us makes them two parts of the knowledge of one mind and that one mind our own. We are the tie between them. Perhaps we exist for that (Sherrington, 1951, p.256ff.).

An Historical Perspective

The diagram in figure 2 of the introduction will serve as a useful heuristic in this summary. It is reproduced here as figure 9. Madsen (1985) constructed the diagram from an historical perspective as well as a metatheoretical perspective. The bottom third of the three part sketch is the level of empirical inquiry, the level of observation and data. Nineteenth century science was conducted largely from this level. Most philosophers of the period believed that the concept of science should be exclusively identified with empirical research and its descriptions. This was the case with Auguste Comte and the continental positivists, as well as John Stuart Mill and the British empiricists (Madsen, 1985).

The middle third of the diagram represents the realm of hypothesis and theory. This approach was embraced after the first world war by the logical positivists, such as Bertrand Russell, Ludwig Wittgenstein, Rudolf Carnap and other members of the Vienna circle. Levels one and two, empirical research and theoretical thinking, constitute the "standard view", as discussed in chapter one.



Our metatheory, called "systematology," conceives of a scientific text as consisting of three levels of abstraction: the *metalevel*, containing metatheses (i.e., propositions about the philosophy of the world and the philosophy of science); the *hypothetical level*, containing hypotheses and explanatory models; and the *datalevel*, containing datatheses (i.e., general functional relationships and specific descriptive propositions).

Figure 9 Metatheoretical Framework

(from Madsen, 1985, p.3)

The top section of the diagram represents the philosophical perspective which Kuhn and his predecessors contributed to the scientific enterprise. These philosophers acknowledged the social and historical influences which implicitly direct the course and interpretation of science.

The Essential Tension

One could employ this three level framework to illustrate the movement of science from a larger metatheoretical perspective, by using an example such as Kuhn's notion of the "essential tension":

> Very often the successful scientist (or professional group) must simultaneously display the characteristics of the traditionalist and of the iconoclast . . . it will follow that the ability to support a tension that can occasionally become almost unbearable is one of the prime requisites for the very best sort of scientific research" (Kuhn, 1977, p.226ff.).

This "essential tension" can be discerned in contemporary scientific research from examples involving the effect of mental states on the disease process. The American Cancer Society commissioned two independent investigations of Simonton's work with cancer patients, as discussed in Chapter 3. The investigations were conducted in 1981 by consultants in the Department of Psychiatry from two New York City medical centers, Memorial Sloan-Kettering Cancer Center and Mt. Sinai Hospital. The findings of both were "remarkably consistent and similar", and are summarized as follows:

Positive

1. Use of the Simonton technique encourages a sense of "doing something" about cancer and promotes a sense of reinstituting mastery — even control — over the patient's situation.
2. It promotes relaxation, thus decreasing anxiety, and temporarily leads to an increased sense of well-being.
3. The technique counteracts a psychologic sense of helplessness, and as far as is known

it has no deleterious physical effects.

4. Dr. Simonton does not recommend stopping standard therapies that may be advised (e.g., radiation therapy or chemotherapy).
5. By emphasizing a positive, active attitude, Dr. Simonton may help patients adapt more appropriately to their situation.

Negative

1. There is no evidence of a scientific basis for Simonton's claims of efficacy.
2. There appear to be several conceptual flaws in Dr. Simonton's thinking, particularly the premise that a patient contributes to developing his cancer and has a direct personal role in curing cancer. There is no evidence for either of these views.
3. There is no evidence that reducing stress enhances the body's rejection or containment of cancer.
4. There is no evidence that the use of imagery is efficacious in altering the course of neoplasia.
5. Potential hazards for patients are associated with induction of guilt feelings, over-reliance on the Simonton technique, and abandonment of generally accepted treatments, in spite of Dr. Simonton's advice to continue them.

(Simonton, 1982, p.60)

The consultants, both psychiatrists and psychologists, concluded that . . . "the Simonton technique may increase patient comfort and ability to deal with cancer, (but) there is no scientific evidence that psychological and psychosomatic factors will alter the course of the disease" (p.60).

The second example of an "essential tension" had its origins in a 1985 editorial of the New England Journal of Medicine. The deputy editor stated, . . . "it is time to acknowledge that our belief in disease as a direct reflection of mental state is largely folklore. . . . The

evidence for mental states as a cause and cure of today's scourges is not much better than it was for the afflictions of earlier centuries" (Angell, 1985, p.1571ff).

Two studies were cited to support the editorial. Cassileth et al. (1985) followed 359 advanced cancer patients and concluded that "social and psychological factors individually or in combination do not influence the length of survival or the time to relapse" (p.1551). Case et al. (1985) found no correlation between type A personality and recurrence of acute myocardial infarction.

The editorial and cancer study prompted a flurry of responses from the media and professionals. Most respondents disagreed with the articles, claiming the editorial was "irresponsible". Several researchers, including Achterberg, questioned the design of Casselith's study. ("Editorial, study," 1985). Norman Cousins, in a letter to the editor of Time Magazine, contended that Casselith "makes an erroneous separation between emotional factors and biology. Emotions have biological effects . . . ("Editorial, study," 1985, p.2).

The controversy culminated in a joint letter to the Los Angeles Times from Cassileth and Cousins. They stated that the results of Cassileth's study were "incorrectly interpreted to mean that positive attitudes have no value in a strategy for effective treatment of illness" (Cassileth and Cousins, 1985, p.3). Cassileth's study was of advanced cancer and suggested that the inherent biology of the disease "overrode the potentially mitigating influence of psychosocial factors" (p.3).

Casselith and Cousins summarized their "common understanding and perspective":

> Emotions and health are closely related. It has been known for many years that negative emotions and experiences can have a deleterious effect on health and can complicate medical treatment. Not as well known is the connection between positive attitudes and the possible enhancement of the body's healing system. This relationship is now the subject of study at a number of medical research centers.
>
> It is likely that numerous emotional and physical factors, many of them yet to be delineated, influence health and disease, probably in different ways for different individuals. There is no single, simple factor that causes or cures cancer

and other major illnesses. (Cassileth and Cousins, 1985, p.3)

Back to Metatheory

Madsen's metatheoretical diagram provides a contextual framework for psychoneuroimmunological research which is beginning to address the question of how mental states influence processes in the immune system

The Metalevel of the diagram includes the philosophical position of fallibilist realism as discussed in chapter 2. This position includes the Kuhnian perspective which provides a fallibilist epistemology. The realist position of Bhaskar and Harre extend the Kuhnian view by being ontologically more explicit in attributing causal powers to structures that exist and operate in the world.

The Hypothetical level of the diagram includes the emergent interactionist philosophy of mind as discussed in chapter 2. Hanson's version can be seen as one kind of model, located in the center box of the diagram. A model in this sense is a set of assumptions or postulates which attempts to provide a generalized working construct that can account for empirical data or relationships (Chaplin, 1975). The kinds of hypothesis that would test the model would be those which could be explained by the causal relation of demergence.

A more specific focus involving a model of demergence is a consideration of viable hypotheses with respect to PNI. Research investigating interactive links between the neuroendocrine and immune systems is still in an early phase. A clearly discernable model of PNI is not yet available and may not be for some time due to the complexities of the interactions. However enough preliminary work has been conducted to formulate testable hypotheses based on present findings. George Solomon (1985) has generated fourteen hypotheses on the links between the immune and neuroendocrine systems. Five of the

hypotheses, namely 1, 2, 3, 5 and 14, involve a demergent causal relation of mental states influencing the nervous system. The reader is advised to consult Solomon's article for the literature supporting each hypothesis.

1. Enduring coping style and personality factors (so–called trait characteristics) should influence the susceptibility of an individual's immune system to alteration by exogenous events, including reactions to events.
2. Emotional upset and distress (so–called state characteristics) should alter the incidence, severity, and/or course of diseases that are immunologically resisted (infectious and neoplastic diseases) or are associated with aberrant immunologic function (allergies, autoimmune diseases, AIDS — also immunologically resisted).
3. Severe emotional disturbance and mental dysfunction should be accompanied by immunologic abnormalities
4. Diseases of immunologic aberration should, at times, be accompanied by psychological and/or neurological symptoms.
5. Experimental behavioral manipulation — in terms, for example, of stress, conditioning, and early experiences — should have immunologic consequences.
6. Experimental manipulation of appropriate parts of the central nervous system should have immunologic consequences.
7. Activation of the immune system (for example, [through] immunization) should be accompanied by altered phenomena in the central nervous system.
8. Hormones and other substances regulated or elaborated by the central nervous system should influence immune mechanisms.
9. Immunologically competent cells should have receptor sites for neuroendocrines, neurotransmitters, and neuropeptides, and for substances regulated by them.
10. Feedback mechanisms in immune regulation should act, at least in part, via mediation of the central nervous system.
11. Factors elaborated by the immune system should affect the central nervous system and

substances regulated by it.

12. Biochemical and functional similarities might be expected between the substances modulating the function and reactivity of the central nervous system (neuropeptides) and the substances with comparable effects on the immune system (lymphokines).
13. Thymic hormones regulating immune function should be influenced by the central nervous system.
14. Behavioral interventions (such as psychotherapy, relaxation techniques, imagery, biofeedback, and hypnosis) should be able to enhance or optimize immune function.

(Solomon, 1985, pp.8–15).

The Nature of Health

The broader implications of the issues addressed in this essay speak to a clarification of the nature of health. The fundamental theme of the essay is to acknowledge the direct influence mental states can have on the body. This is not to say that mental states should be seen as something separate from the body, for they are physiological processes as well. However mental states also have emergent properties that are ontologically distinct from their neural origins. These emergent properties have the capacity to assume a significant role in the causal nexus that is the human being existing in the world. This nexus includes the internal milieu of the body as well as the external world where an individual lives and interacts with its own and other species.

It is the human mind, the reservoir of mental states as it were, that contains the greatest amount of adaptability of all the components of the causal nexus. Consequently, therein lies the greatest responsibility. An individual can choose to behave in potentially harmful or healthful ways to his or her body. For example a person could develop a habit of coping with stress by abusing drugs or engaging in moderate exercise. Effects of behaviors

on the body are what Newberry (1985) terms the external loop relationship between mental states and health. The internal loop relationship would include the subject matter of PNI in which mental states effect the body through the causal relation of demergence. The nervous system serves as the intermediary between mental states and other physiological systems of the body.

Central to the condition of health is a concept of balance or equilibrium. Cannon (1932) coined the term, "homeostases" to describe "the various physiologic arrangements which serve to restore the normal state once it has been disturbed" (Cannon, 1932, p.25). Each somatic system, both by itself and in cooperation with other somatic systems, employs self-regulatory mechanisms to maintain an optimal working relationship with the rest of the body.

A major purpose of this essay has been to consider the role of mental states as part of the self-regulatory processes of the body. Recent scientific and philosophical developments have been cited as evidence to support a mind-body interaction, but it is by no means a novel idea. Perhaps Plato said it best in the Republic:

> But in reality justice was such as we were describing, being concerned however, not with the outward man, but with the inward, which is the true self and the true concern of man; for the just man does not permit the several elements within him to interfere with one another, or any of them to do the work of others—he sets in order his own inner life, and is his own master and his own law, in unison with himself; and when he has bound together the three principles within him, which may be compared to the higher, lower and middle notes of the scale, and the intermediate intervals—when he has bound all these together, and is no longer many, but has become one entirely temperate and perfectly adjusted nature, then he proceeds to act, if he has to act, whether in a matter of property, or in the treatment of the body, or in some other affair of politics or private business; always thinking and calling that which preserves and co-operates with this harmonious condition, just and good actions, and the knowledge which presides over it, wisdom, and that which at any time impairs this condition, he will call unjust action, and the opinion which presides over it, ignorance (Needleman, 1982, p.131ff, Republic, 444d-3 adapted from Jowett translation).

The passage was selected by Needleman who describes the paragraph as containing the essence of Plato.

> The Republic . . . is about man considered as three–storied structure, a tripartite being. All the sufferings and evils of human life arise because these three parts are out of relationship to each other. The aim of human life is, first, to bring these parts back together and then to manifest that harmony in one's life with one's fellow man (Needleman, 1982, p.132).

The three principles of an individual are roughly, an intellectual function, the function of the striving spirit or emotions, and an instinctive function akin to appetites and desires. It is important to recognize all three functions having physiological concomitants. The challenge for cognitive scientists, psychoneuroimmunologists, and other such interdisciplinary collaborators is to translate these lofty maxims into scientific theory.

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