Preconditions for Transdisciplinary Health Sciences

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Transdisciplinary models in the health sciences are of crucial importance. A reductionist, materialist approach to the science underlying health care has provided great benefits, but self, social interconnectedness, and the spiritual also contribute to the maintenance of health and cure of disease. In this paper, I will discuss general preconditions to developing transdisiplinary models in the health sciences. I will then discuss transdisciplinary models that I have developed in one mental health (clinical depression) and one physical health (menopause) area. The question explored in the paper is this: What habits of mind, presuppositions, or theory, lead to a transition from a materialist, reductionist view of the science underlying health care, to a perspective in which transdisciplinary, hence holistic, science makes sense and appears real?

Categories Are Not Really Mutually Exclusive

The first precondition to an openness to transdisciplinary models is going beyond thinking in terms of mutually exclusive categories, for example objective science vs. subjective experience. Rather than asking how mutually exclusive domains can be bridged, one step in relating apparent contradictions, dichotomies, or nonoverlapping concepts, is to find examples in which elements of one can in fact be found in its apparent opposite. When examined in detail, exceptions can often be found. In part, this is because ideas such as "science deals only with the material" are often regarded as though they were clearly-defined concepts bound by the laws of logic, especially the law of contradiction, but clearly often are not. Sometimes they are generalities; sometimes they function as frank stereotypes or overly rigid categories. In part, this is because scientists deal with theoretical models rather than bald facts. Models are frameworks within which thinking occurs. Models cannot capture the complexity of reality; they are necessarily selective. Models are simplifications of reality, in which the variables most important to understanding a phenomenon are included; all other variables are excluded or overlooked. However, we may forget that variables are simply being overlooked or mistake the model for reality. An apparent contradiction to a model may simply be a fact which is overlooked or ignored by that model.

Science Is Not Really Exclusively Materialistic

One step in bridging apparent contradictions, dichotomies, or nonoverlapping concepts, is to find examples in which elements of one can in fact be found in its apparent opposite. One important stereotype to consider is the very idea that science is by its nature reductionist and materialist, and that only physical entities are the objects of scientific inquiry. A second precondition to transdisciplinary models is to recognize that nonmaterial concepts of all sorts are typical in scientific inquiry.

Scientists studying humans repeatedly use concepts like will, motivation, and choice as what in science are called "independent variables." Independent variables are by definition causes, while effects are called "dependent variables." Independent variables cause, explain, lead to, or determine that which follows. Subjective concepts seem to be ubiquitous, perhaps inescapable, when humans are studied. One of the roots of psychology as a discipline was the development of psychophysics in the late nineteenth century. Psychophysics developed when physiologists and physicians found that they could not explain the results of their experiments without invoking psychological concepts. Psychoanalysis began when an experimental physiologist and neurologist named Sigmund Freud found he could not explain the symptoms of certain of his neurology patients in physical terms (as was being tried, for example, by Charcot) and therefore looked for psychological concepts that would be helpful. Granit, in his book "The Purposive Brain" (Granit, 1979), asserts that when the limits of mechanistic explanation are reached, psychological explanations (e.g., interests or states of mind) are typically invoked. He also points out that all animals exhibit purposive behavior, but that "purpose" has a different meaning in humans in that it includes cognitive and symbolic definitions.

As science has actually been done, rather than in ideologies of science or hopes for future science, physiology and psychology have played independent, interacting important roles in what we can call "the person" (i.e., the individual personality or actual self of a human being—Random House dictionary). If we refer to subjective variables as sources of activity or centers of experience, our language may go beyond scientific language but we are not contradicting scientific language. We can argue about the ontological status of "will," "choice," and other variables--that is, whether they are explanatory concepts or reality--but the point is that these variables fit within the same discourse as does materialistic science and we can ponder this question. Indeed, while spiritual experience is not required by this language, it is not contradicted by it either.

"Behavior" and "social interconnectedness" are also nonmaterial but part of scientific inquiry. Consider "hormones." Hormones are material, chemical messengers that coordinate bodily functions. They work by altering the rate at which cells do their jobs. Hormones help to maintain homeostasis, that is, physical integrity and sameness even as physiological and environmental conditions change. For example, hormones help to maintain stable salt and fluid levels in the body. They also serve flexibility. For example, hormones are intimately involved in the human "stress response," which is a temporary change in physiology that increases the body's ability to respond to threat. They help to orchestrate development over the life span. For example, they initiate physical changes at puberty. Many powerful cause-and-effect relationships involving hormones are known. However, hormones do not act alone, and understanding them requires understanding how they interrelate with both many physiological systems in the body and also with social factors and with behavior. Hormones are intimately interrelated with behavior and appropriate to the social context, and behavior can serve as an "independent variable" along with hormonal changes. This is illustrated in Pfaff's (1999) review of the biology of reproductive hormones and Nelson's text (Nelson, 1995) on behavioral endocrinology. A female rat must arch her back in a special way ("lordosis") or a male cannot copulate with her. A female whose ovaries have been removed, so that she does not have the hormone estrogen in her body, will not engage in lordosis; this is a powerful cause-and-effect relationship. However, if the male does not engage in particular behaviors, for example stroking the female, she also will not engage in lordosis no matter how much estrogen she has. Further, while estrogen increases the female's tendency to engage in behaviors that will result in copulation, these behaviors vary with the social context. The female, first, will engage in increased levels of general activity which bring her in contact with a male. The female and male then engage in specific courting behaviors. Finally, they copulate. Even in the rat, females can choose to reject a male rather than copulate even when estrogen levels are high.

Behavior and the social context can control physiology. For example, many physiological mechanisms exist to cool down an animal that is overly warm—blood vessels dilate, the animal sweats. However, the animal can also cool down by walking to a shady spot.

Behavior and social interconnectedness may be expressed as observable, objective acts but can't be understood simply by describing these objective acts. Biologists have found that behavior in many animals can specified by specific, objective chains of motor acts. For example, rat maternal behavior consists of behaviors like retrieving pups that wander off. However, this is not the case for nonhuman primates or humans, where specific chains of motor acts vary but all express an underlying motive or purpose (Nelson, 1995). Courting behaviors, for example, do not follow a rigid course of motor acts. Further, even in animals where specific chains of motor acts can be described, understanding the conditions under which these acts are used is a separate issue. For example, understanding conditions under which a sequence of behavior will be initiated may involve psychological and social concepts like drives or emotions and social structure. Sequences of social behavior--for example, with which behaviors an animal responds to the behavior of another animal—is often not predictable.

With regard to humans, social interconnectedness is intrinsic to scientific inquiry. A child raised in isolation would not become a normal human being. Both behavioral and social inputs are important to normal brain functioning; the physiology of the brain, which neurons connect to which, is dependent upon social and behavior experience. "Norms" are social ideas that constrain behavior—you can't understand the behavior of an individual without knowing the norms of the group within which he or she lives, as well as his/her individual interpretation and reactions to the norms. Some theorists have grappled with the difficult problem of characterizing "social climate," the "feel" of a place. Development is in part biological, but cultures vary in, for example, what it means to be an adult or a mature adult. Thus, for example, when you marry is in part due to physiological maturity but also due to your culture. "Family therapy" is posited on the idea that the behavior of an individual can only be understand with reference to the role he or she plays in the family. For example, certain pathological behaviors in children serve to help parents to unite with each other or distract them from other problems or act out an issue of general importance to the family.

Spirituality has been overlooked in scientific inquiry except in specific cases. It has, for example, been studied as a way of coping, and specific religious experiences have been objects of research. However, spirituality is not one of the dimensions that have commonly been considered important to include as part of the reality characterizing human experience. Contrast that, for example, with Chinese medicine, where spirit, mind, body, emotions, and environment are all regarded as aspects of the reality that the practitioner evaluates and intervenes in. If subjectivity and other nonmaterial concepts are part of Western scientific discourse, why not spirituality? Including spirituality is problematical in part because spiritual experience is regarded as diverse in Western science and culture. Institutional religions are diverse and spirituality is regarded as a matter of individual conscience or belief rather than as an aspect of reality. The role of spiritual reality is beyond the scope of this section, except to say that spirituality, like other nonmaterial concepts, is not inconsistent with science.

To summarize—the idea that science deals only with the material is a stereotype not born out by the facts. Psychological states, social interconnectedness, behavior, and spirituality are all important. Indeed, Greg Derry (personal communication) has pointed out that physics typically invokes concepts that are not themselves material. Forces such as gravity are known by their effects on material objects. We see the effects of gravity when a ball we let go of drops, when tides shift, when a planet and its sun rotate around each other without centrifugal force carrying off the planet. However, while physicists disagree about its ontological status, a force like gravity, as opposed to its observable effects, is not itself a material object.

Understanding What Is Distinctively Human Is An Important Scientific Question

A third precondition for transdisciplinary models is thinking in terms of structure and levels of organization. Science is often identified with studying links between cause and effect. However, while identifying these links is important to science, the reality is that cause-and-effect links are embedded in larger wholes which may not themselves be causal. Individual physiological, psychological and other facts and explanations are part of larger, organized, functional wholes. Understanding these functional wholes in humans requires understanding our similarities to other living beings, and it also requires understanding distinctively human-grade organization and functioning.

There is much about the nature of larger wholes that is simply not understood. For example, when the chemical structure of DNA was identified, this was heralded by many as solving the puzzle of inheritance: DNA is a chemical in the form of a double helix, triplets of certain chemicals code for specific amino acids which are then joined together to form proteins. When it turned out that the vast majority of genes do not code for this cause-and-effect sequence, these genes were dubbed "junk genes." It is known that some genes are regulators, turning clusters of other genes on and off, and it is known that this process is affected by other chemicals. However, the basic nature of this dance of genes is not understood. For example, when cells in bone duplicate, the outcome can either be more undifferentiated cells or mature bone cells. Different genes switch on to guide duplication for the two different outcomes. While some of the details of these mechanisms (i.e., which genes are involved) are known, what remains a mystery is this: what controls switching on a number of genes simultaneously to produce one or the other of these alternate plans? Stein, Stein, van Wijnen, and Lian (1996), for example, have found that chromosomes fold so as to bring the genes needed for one plan or the other into proximity with each other, but how this folding occurs is a mystery. That is, causal links are embedded in a larger, unknown context.

Similarly, cause-and-effect links in the brain have been identified but are part of larger functional wholes whose nature is not well understood. We don't simply have billions of brain cells. We have brain cells organized into functional units of all sorts. These functional units serve adaptation (i.e., interconnection with the environment), and are part of complicated systems involving feedback and balance among many organ systems in the body. At least in humans, there are also self-generated neural processes (i.e., problem-solving, fantasy, etc.) that influence subjective experience and practical outcomes. Functional units can determine the nature of research on cause-and-effect relationships. Granit (1979), for example, suggests that we look for links between neurons in the cerebellum when we are studying physical movement because we already have an idea that this is the function of the cerebellum. Pfaff (1999) suggests that hormones are one mechanism by which neurons are integrated into higher order functional units. Brain functioning is affected by many processes, including inputs from the environment, self-generated inputs (i.e., ideas, memories, etc.), and many processes which are as yet not understood.

One important question to consider is what is distinctive about human-grade neural organization. For Pfaff, one important difference is that a greater number of variables are involved in producing outcomes in humans, and these variables interact in more complex ways. There are a greater number of inputs, including sensory inputs, social and cultural variables, and others. Granit emphasizes that humans have more complex interrelationships between different levels of brain structure. It is not the case that cortical processes found in humans simply control mechanisms common to a wide range of species. Rather, the multiple brain structures form novel integrations. That is, certain brain mechanisms are common to humans and other animals, but their function and meaning may be altered by their integration with cortical tissue. For example, a frog can perceive directionality of movement with nerve cells that adjoin the retina; the cortex is not necessary. In higher mammals, the retina can no longer process this information without the cortex; what we mean by "directionality of movement" is a different, more complex concept.

Understanding what is a distinctively human level of organization, and how this affects the meaning or function of other levels of organization, is an important question but one rarely addressed in science. How are we similar to other animals? What mechanisms do we share with them, both physiological and behavioral? How are we different? What distinctive characteristics do we have? How is the expression or function of more "primitive" mechanisms, the overall gestalt of which they are a part, altered? We know little about the larger whole that is human organization, but this is a crucial question--the role of all of the cause-and-effect relationships that science can identify is understood only by knowing their role in the larger whole of which they are a part. We do know as scientists that the use of symbols and the shared culture are distinctively human means of adaptation to the environment. Humans live in a world of images, narratives, and values. They are intrinsically interrelated—the human brain itself does not develop physiologically and functionally in a normal manner without social experiences. Further, to understand scientifically that which is distinctively human requires understanding human development, the unfolding of the distinctive, unusual human life course (Bogin, 1999). These scientific questions provide common ground with more general questions of what is distinctively human, wherein lies our sense of meaning and purpose, and the nature and role of the self.

The Physical Environment Is Important

A fourth precondition to transdisiplinary models is to include the environment along with body-soul-mind-community. To understand adaptation, the structure of our brains and bodies, and other issues, requires considering our orientation, place, or the effects on us, of the natural and physical environment. Biologists who study animal behavior assume, as a premise, an environmental fit between animal and environment. Darwin found that the shape of a bird's beak fit the food the bird collected with that beak. Circadian rhythms, sensitivity to electromagnetic fields, and other factors have been studied. Zucker (1988), for example, found that levels of luteinizing hormone (LH), a hormone that initiates physical changes needed for reproduction in ground squirrels, rose during the correct time of year even when the ovaries of squirrels had been surgically removed; although LH and estrogen form a negative feedback loop, LH levels were also controlled by some circadian factor rather than by estrogen levels.

What relevance does this study of animals have to humans? We know that the basic anatomy of the human body is influenced by our orientation with respect to gravity. We know that nutrition and physical activity influence physical development and one's sense of well-being. We know that we emotionally respond to place. However, the physical environment is often overlooked except if it is problematic, as when pollution causes disease. Attention to diet and physical activity are often regarded as add-ons (e.g., to achieve weight loss or better cardiovascular health), rather than their absence being regarded as deficiencies of normal components of healthy living. Gaining a greater understanding our relationship to physical and natural space, our relationship to the ecosystem, and how these might contribute to our subjective experience and physical state, is important.

Transcending Images Are Important

A fifth precondition is the importance of creating transcending images. A transcending image is a theoretical framework, orientation, or set of images, that provide one model within which everyone can talk. This does not mean eliminating different approaches or disciplines—you still have psychologists, anthropologists, biologists, philosophers, and others, pursuing their separate interests. However, the transcending image provides a natural bridge between disciplines, and a sense that all are looking at different aspects of one larger phenomenon rather than distinct, nonoverlapping phenomena.

Menopause

All human females stop menstruating during midlife. Menopause is technically the last menstrual period, but is understood by scientists to develop over many years. Ovaries contain follicles which consist of an immature egg surrounded by a ball of cells. The ball of cells manufactures hormones, especially estrogen, that coordinate the menstrual cycle. Each menstrual cycle, a few follicles, eight to ten, become active but all but one quickly die off. The one remaining releases an egg for fertilization while the ball of cells manufactures hormones. At menopause, few follicles remain. There can therefore be no release of an egg or manufacture of the large amounts of estrogen previously manufactured. The woman is therefore absolutely not able to become pregnant. At puberty, the average girl has between 300,000-500,000 follicles. The few that become active during the menstrual cycle are a far smaller number. The reason that there are almost no follicles remaining at menopause is that a large number of follicles simply die, on the order of 1,000 a month, throughout a female's lifespan.

The biomedical scientific explanation of menopause is reductionist, materialist, and mechanistic. In this view, menopause is best understood by the biology of senescence. As we age, our parts wear out and stop doing the jobs for which they were intended. In the same way that our hair turns grey and we loss muscle endurance, as woman age they use up and run out of follicles; that is, the ovaries no longer work. The World Health Organization, for example, defines menopause as "cessation of menstruation associated with loss [not a "change" or "completion"] of ovarian function." Similarly, the transition to menopause is understood as reflecting a system that is in the process of breaking down and therefore not working properly. For example, during the transition to menopause, women typically develop irregular periods. This is often described as resulting from aging follicles that no longer work properly (e.g., are no longer able to respond to chemical messengers that would otherwise control their function). In addition to no longer being fertile, the fact that her ovaries no longer manufacture estrogen is seen as being of more general importance. Some estrogen is manufactured elsewhere in the body, but the amounts are far lower. This is posited to result in an estrogen deficiency which causes a broad range of medical problems including chronic illnesses like heart and brain (Alzheimer's) disease. That is, embedded in the biomedical model are theories of human development. Children grow and develop until they mature; adults are in a stable, fully developed state of maximum functioning; aging consists of the decline of body systems. Further, for a woman, being able to reproduce is central to her physiological nature and psychological well-being. At menopause, when a woman can no longer bear a child, she begins to age more quickly. Further, the developmental stage of midlife is defined by a physiological change rather than psychological states and social position.

This model has had practical consequences. Many midlife women have been prescribed estrogen supplements to restore high estrogen levels. In 1995, for example, 58 million prescriptions for estrogen were written; in 1999, 90 million (Hersh, Stefanick, & Stafford, 2004). This medication is not neutral; it has a variety of health risks, suspected or known, such as stroke or increasing cancer risk. The medication has been beneficial for certain women, as when hot flashes or other discomforts associated with menopause were severe. However, it has been widely prescribed for a variety of purposes. In the 1960s and 1970s, estrogen supplements were said to maintain a woman's femininity. Medication use decreased when it turned out that estrogens increased the risk of uterine cancer. This problem was corrected by adding a second hormone to the prescription, and, beginning in the 1980s, prescribing estrogen for disease prevention was emphasized. A broad variety of chronic diseases, including heart, bone, and brain disease, were said to worsen beginning at menopause and estrogen supplementation could prevent this development. There was a tendency to attribute problems experienced by midlife women to menopause. A woman who was depressed or suffering from insomnia might be assumed to be experiencing a menopause-related condition without a careful diagnosis. Indeed, bone loss can result from many medical conditions, many of which can be screened for with a simple blood test, but bone loss was often assumed to result from menopause without further evaluation. Further, other changes were simply assumed to be caused by physiological changes due to menopause. Urinary incontinence, for example, was assumed to be due to menopause until recent research cast doubt on this. The message to midlife women has been that menopause is unpleasant, unhealthy, and that which defines their life stage.

The strength of this model has thus led to ignoring or overlooking contradictory data. For example, clinical depression was at one time assumed to be caused by menopause. When research evidence contradicted this, a new theory arose that while clinical depression was not related to menopause, "mood swings" are. The idea that prescription estrogen prevents chronic illness was adopted on the basis of nonexperimental evidence. When experimental evidence, especially a research project called the Women's Health Initiative, found that hormone therapy did not prevent heart disease and, in fact, did more harm than good overall, this led to a sharp decrease in medication use. However, now a new theory asserts that estrogens are beneficial if begun immediately after menopause. In this view, the Women's Health Initiative did not find benefits because too many of the experimental subjects were long past the age of menopause so that the damage had already been done; the underlying idea that menopause creates medical problems is unmodified.

A transcending image of menopause reconsiders the underlying theory of development implicit in the biomedical model, and creates a model which is consistent with scientific evidence. Further, while beyond the scope of this paper, theories of the psychology and sociocultural aspects of menopause also exist, and the transcending image provides language within which these theories can be considered along with the biological. The transcending image that I have developed, the Lifespan Biological Model of menopause, views endocrine changes as one aspect of larger life stages that include psychological, social, and physical aspects; understanding of this larger whole illuminates the meaning of endocrine changes. This is analogous to, for example, adolescence, where endocrine changes are centrally involved, but the transition to becoming a reproductive adult also involves psychological changes and social definitions, and the effects of the same hormone varies in humans and nonhuman primates with their varying life structures.

The Lifespan Biological model (Derry, 2002, 2006) combines a subfield of biology called life history theory with developmental psychology. Life history theory characterizes species by their species-typical stages of development. It is "[a] field of biology concerned with the strategy an organism uses to allocate its energy toward growth, maintenance, reproduction, raising offspring to independence, and avoiding death. For a mammal, it is the strategy of when to be born, when to be weaned, how many and what type of pre-reproductive stages of development to pass through, when to reproduce, and when to die" (Bogin, 1999, p. 404). To more fully understand human experience we must also draw on lifespan developmental psychology, that is, the study of human physical, mental, and social changes over the life span, as they result from the interaction of organism and environment. Developmentalists study physical capabilities, personality, the intrapsychic world, emotions, intellect, social behavior, social structure, culture, and the physical environment. Symbolic thought, the characteristics of the social environment, and human flexibility and purpose are taken into account.

The basic thesis is this: Female humans have a life stage of post-reproductive, competent, relatively healthy adulthood. It is unusual for a mammal to have such a life stage, but there is nothing unusual about humans having unusual life stages. The human life course (i.e., the stages of development throughout childhood and adolescence and adulthood) is unique when compared with other mammals.

The evidence suggests that menopause is a universal, even unique, human attribute. While disagreement remains, many biologists, physical anthropologists, and others with a life history perspective assert that menopause is a universal life stage unique to humans Nonhuman primates (i.e., monkeys and apes) sometimes do have a period during old age during which they do not reproduce, which is sometimes cited as evidence for their having a stage analogous to menopause. Pavelka and Fedigan (1991) point out, however, that the phenomenon in nonhuman primates differs from that in humans in many crucial ways. First, these nonhuman primates are typically very old, near the end of the known life span of their species and at a time when many body systems are in an advanced state of decline. Only humans stop reproducing approximately halfway through the known life span and prior to the senescence of other body systems. Further, menopause is universal in humans but not in monkeys and apes. Many species of nonhuman primates have been studied and within each species some individuals do stop reproducing when they are old but others remain fertile. Finally, menopause in humans is characterized by the depletion of ovarian follicles, while nonhuman primates typically do not deplete follicles. Old nonfertile primates continue to have menstrual cycles, and some who live to the end of the known lifespan of their species ovulate within days of their death.

Human females do not simply use up their follicles. They run out of follicles because they are genetically programmed to do so. Different cell types in the body live for different amounts of time. Red blood cells, for example, live for a matter of months while brain cells must last a lifetime. Each cell type responds to different genetic instructions as to its normal life span and when it should die. The rate at which follicles self-destruct is under tight genetic control. Follicles self-destruct throughout the lifespan, including childhood when levels of reproductive hormones are low. While many biologists assume that human egg cells simply wear out after 50 years, perhaps, alternatively, follicles are genetically programmed to live at most 50 years as part of the programming of the human female body plan.

Life stages are characterized by sociocultural and psychological as well as physical changes. What we observe when we look at humans is that they live in groups that are characterized by a high degree of interdependence. Humans cooperate in practical tasks ranging from childcare to hunting. Human babies are unusual among mammals in being physically adapted to being cared for by people other than the mother (e.g., they are weaned when they are too immature to care for themselves). Humans also live in a world of symbolic meaning with regard to their personal and social experiences. Humans form relationships based on symbolic and cultural meanings. Even defining who is related to whom, or what one's responsibilities to different kin are, is only in part a matter of genetics and varies from one group to another. Someone must make and enforce decisions that maintain social meaning and cohesion. Sex, age, and family position (e.g., being head of a multigenerational household) are among the categories by which social power is allotted.

We cannot know what life was like for prehistoric humans. However, we do know that among modern hunter/gatherers, females in their 50s and 60s and older are commonly found. They are not regarded as anomalies or oddities. They are physically healthy and typically have recognized social roles in which they serve important functions for their social groups. In some groups they gather crucial food for young children. They are repositories of cultural memory. In addition, the post-reproductive period is often portrayed as one in which social power is high. Women play a variety of leadership roles, such as deciding who will marry whom or defining kinship relationships as well as assigning practical tasks. In some groups they have important spiritual positions. Consistent with the speculation that the post reproductive period may be associated with high social power, many psychological theorists assert that personality development during the 40s and 50s involves a shift toward increased psychological autonomy, concern for the common good, and differentiation between personal and social realities.

Clinical Depression

Mental health professionals define psychological depression as a mental disorder or disease distinct from normal emotions like sadness. Different subdiagnoses exist, but the most basic diagnosis, "major depressive episode," requires experiencing either depressed mood or loss of interest or pleasure in most daily activities, along with an additional three symptoms from a longer list that includes insomnia, trouble concentrating, and other physical and psychological problems. These symptoms must be present for at least two weeks, be severe enough to interfere with functioning, and meet other diagnostic criteria.

Beginning in the late 1950s and early1960s, the hypothesis developed that depression is a brain disease; because of incorrect amounts of certain neurotransmitters in the brain, especially norepinephrine or serotonin, the connections between individual neurons are abnormal and this produces the symptoms of depression (see Lacasse& Leo, 2005; Leo & Lacasse, 2008, for a discussion). The cause of this is often attributed to material causes like genes or the aftereffects of stress, trauma, or other experiences that "break" the system. Repeated episodes of depression may become progressively more severe and less responsive to environmental triggers because of physiological processes like "kindling." We have a reductionist, materialist, mechanical approach that ignores the primacy of the psychological and social in what is intrinsically a psychological experience. It reflects a radical reductionist approach in which brain physiology directly causes psychological states. Many theories of depression aside from the biomedical one exist, such as psychoanalytic or cognitive-behavioral. Within the biomedical paradigm, all of these theories would be regarded as either incorrect or as reflecting or initiating pathological nervous system changes.

This perspective had important practical effects for the treatment of patients. Treatment with antidepressant medications has often been recommended as a treatment of choice even if psychotherapy is also included. The National Committee for Quality

Assurance is an organization that creates treatment standards for health organizations; their guidelines for depression only create standards for treatment with medications. A 2007 government study found that antidepressants are the most-prescribed drug in the United States (cited in Leo & Lacasse, 2008). The general public is not unfamiliar with the ideas that depression is a brain disease or a medical disorder that involves brain chemicals which are out of balance, and that antidepressants correct this imbalance. However, the ideas that what distinguishes depression as a problematic condition from a normal experience is abnormal brain chemistry, and that depression is a disease, are at best hypotheses rather than facts. The idea that depression might be a family of conditions, rather than one condition, requiring individualized assessment, is more likely to be overlooked. While antidepressants help some patients, a complete evaluation to determine what treatment may be best can be lacking, for example when stressful environmental events or coping mechanisms are ignored in favor of symptom control with medication.

The strength of this paradigm has led to ignoring or underemphasizing conflicting data. For example, it is known that cognitive/behavioral therapies for depression create physiological changes indistinguishable from that of antidepressants (e.g., Brody, Saxena, Mandelken, et al., 2001). Cognitive/behavioral approaches are better than medication at preventing relapse. Antidepressants are most effective when patients have no additional diagnoses, when psychotherapy is likely to also be needed. However, the most important consequence of the strength of this paradigm has been the difficulty in refuting it. Evidence does not been found to support the idea that neurotransmitter amounts cause depression. In response, additional biochemical theories have been created with increasing complexity rather than discounting the original idea. For example (e.g., Maletic, Robinson, Oakes, Iyengar, Ball & Russell, 2007), perhaps several neurobiological abnormalities exist, involving key brain structures in the cortex and hippocampus along with a number of regulatory chemicals. The hypothesis that an underlying nervous system abnormality explains depression in mechanistic terms is retained. Antidepressants are still regarded as correcting pathological changes in brain states by reestablishing normal amounts of chemicals, even if these changes are regarded as consequences rather than causes of depression. Worse, the efficacy of antidepressants has been called into question. Medication trials are most likely to be published and form professional opinion when positive results are found. Kirsch, Moore, Scoboria, and Kirsch, Deacon, Huedo-Medina, et al. (2008) obtained copies of all studies submitted to the Food and Drug Administration for approval of certain antidepressants, which included nonpublished as well as published studies, and found that many unpublished studies had neutral or negative results and that the efficacy of antidepressants was marginal when these studies were included in analyses.

A transcending image of a scientific view of depression considers nervous system changes, social factors, psychological factors, and the spirit. Individual neurons exist as part of larger brain structures that have adaptive purposes and reflect distinctively human functioning. My transcending image of depression begins with the observation that nonhuman primates appear to become depressed. Baby monkeys separated from their mothers have a facial expression which is recognizable as unhappy, withdraw socially and become inactive, respond to antidepressant medications. Depressed humans avoid eye contact; depressed monkeys curl into a ball. However, depression is not the initial response of a baby monkey to separation from its mother. First, it engages in "protest," angry attempts to call to or otherwise regain the mother. If the baby is in a social group in which it is adopted, it does not become depressed. Only after the failure of its attempts to regain either the mother or a substitute caretaker does the monkey become depressed. The typical behavior pattern that results has been called "conservation/withdrawal." The first premise of the transcending image is thus that depression is a mechanism common to humans and nonhuman primates that is called into play when a loss has occurred and there is failure at repairing the loss—that is, depression is a response to hopelessness rather than loss.

Humans, like monkeys, can become depressed when an attachment bond is broken. However, even in monkeys there is more to it. Substitute caretakers ameliorate depression, and a monkey left in a familiar environment is less distressed than one in an unfamiliar environment. We know that for humans a broad range of conditions are associated with depression. Social stresses such as worry about a family member appear most likely to precipitate depression when associated with hopelessness rather than due to sheer intensity. Anomie has been linked to likelihood of suicide. Times of personal transition or change can be associated with depression, as can loss of meaning, most famously in William James and his father. A second premise of the transcending image is that hopelessness can result from a variety of breakdowns in what is central to creating order or meaning. Attachment bonds are one important component of a cohesive order, especially for infants for whom the mother is central emotionally and practically. However, for humans, adaptation, and therefore order, involves the shared culture and symbolic function. That is, we have a sense of self integrated with a social context. We can therefore find vulnerability to depression arising from a broad range of breakdowns in social order and personal meaning. Depression is an experience of distress that can arise when there is an interruption in ongoing activity and the expectation exists that order cannot be restored. Vulnerability to depression is associated with breakdowns in meaning or order. However, whether the person's response will be depression will vary with that person's coping mechanisms and with many other factors. Thus, cognitive/behavioral and other approaches to psychotherapy that restore meaning or a pathway to action are effective treatments for depression. Physiological explanations are not inconsistent with this model. In physiological terms, we could say that a schema within the brain important to meaning or order or coping has broken down or doesn't exist or that existing schemas are overloaded, so that the functioning of the brain may be altered. That is, changes in the functioning of brain structures may exist. In some cases, these changes might become habitual or unrelated to environmental occurrences. However, changes reflect the brain in action as a purposive, functioning organ. In depression, a mechanism common to nonhuman primates and humans exists but in humans the overall physiological context differs (i.e., cortex) and therefore the overall meaning and function of these systems differs. Again, spirituality is not implied by the model but is not inconsistent with it. In some cultures, as in Mexico, depression is regarded as the person's soul having been taken from him. A spiritual loss of meaning can be associated with depression.

Conclusions

With regard to the question of the relationship of science to first-person, subjective experience, the question is not whether science can explain consciousness or values. Subjectivity is inescapably present as an independent variable or source of effects when science studies humans. The emphasis in biological science on adaptation leads us back to the symbolic function and interconnectedness since these are the primary human modes of adaptation. With regard to the multiplicity of neurons and whether there is something irreducible to physiological brain states: Subjectivity is primary in part because neurons are organized into levels of organization that are not describable in self-contained, physiological terms, but in practice require subjective experience and descriptions of the social and physical environment to understand the brain in motion as a functioning organ. With regard to whether we are relational beings or intrinsically part of a community, human functioning, again, exists within a social context and a context of symbolic meaning. In order to develop health sciences that are scientifically accurate and helpful, the reality of human subjectivity organized into a self that is integrated into a social context is required.

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