Toward a Biopsychosocial Ecology of the Human Microbiome and Health:

Charting a Direction for Psychosomatic Medicine

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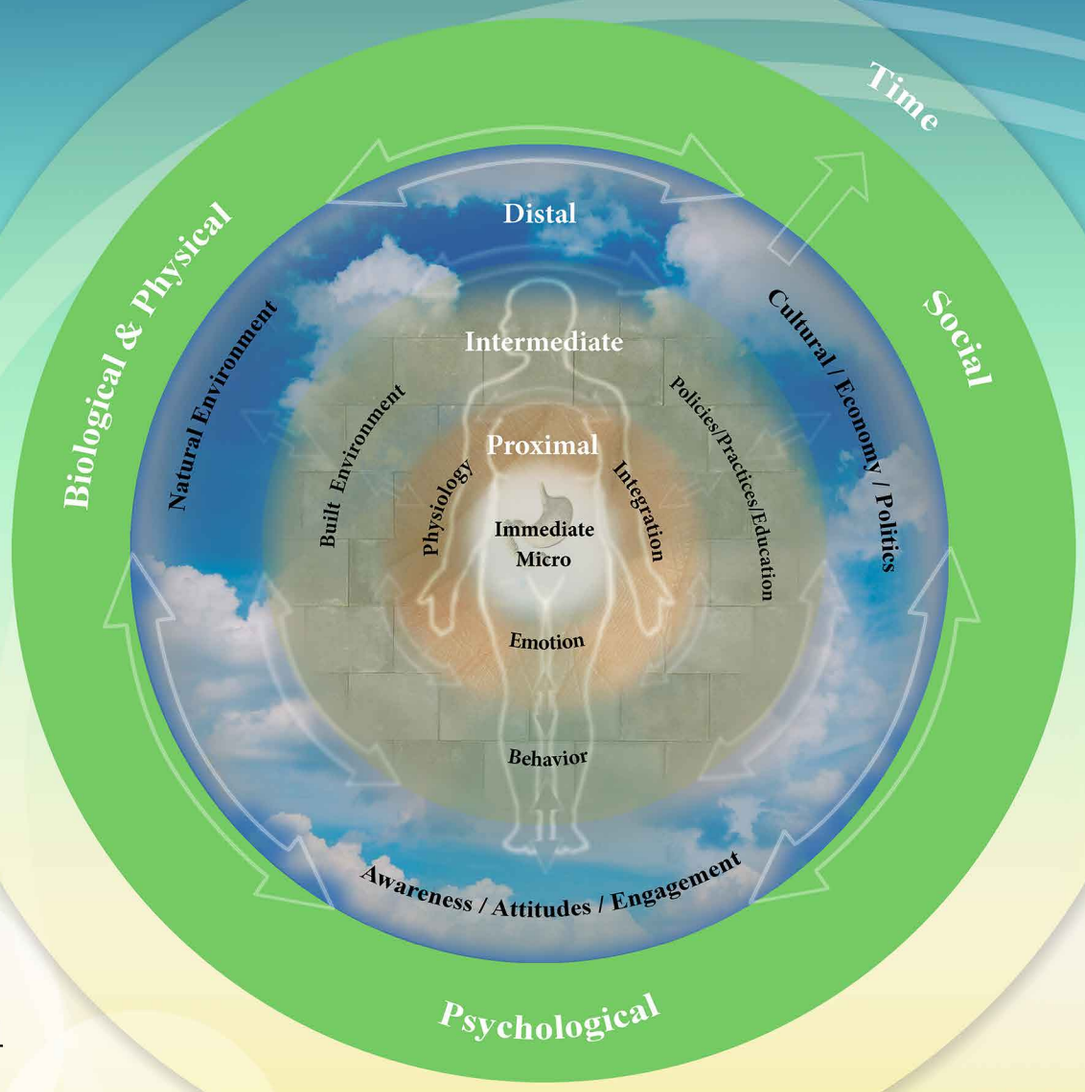
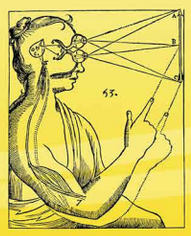


PSYCHOLOGICAL

SOCIAL

BIOLOGICAL



ECOLOGICAL
Sustainable behavioral, environmental, and social systems will become central to medicine and public health for their potential to economically augment or exceed the ability of currently available approaches to address chronic and infectious disease, particularly through prevention.

TRANSLATIONAL
Novel applications of existing knowledge will be facilitated with broad context in mind. New discoveries will be optimized when influences are broadly considered - from conceptualization through interpretation of results - that impact basic and applied research processes and that place the meaning of outcomes in context.

TRANSDISCIPLINARY
Individual & public health will be optimized when thinking, research, and policy are free from disciplinary boundaries and providers have integrative training and resources from broad perspectives.

PATIENT CENTERED

TECHNOLOGICAL
An ecological paradigm of many interacting factors will encourage use of known system theories, mathematical modeling, and simulation/computational technology to understand observed phenomena and to breed discovery, while novel methods are continually developed.

PRECISE
Advances in measurement, informatics, and bioengineering will allow for individualized nano, molecular, and micro-level assessment and treatment of an integrated human-microbial biome as the immediate unit of analysis. Precision will be increasingly possible and reliable as more data are integrated, accounting for interacting influences from the immediate to distal levels of scale.

Abstract

Forty years ago, George Engel's (1977) advocacy for a new biopsychosocial (BPS) model initiated the evolution in Western medicine from a largely reductionist paradigm toward wide acceptance of biological, psychological, and social influences on health. Today, the rapidly growing literature on the human microbiome, and the gut microbiota in particular with its vast implications for health, suggests that medicine is again poised for significant evolution, or perhaps revolution. The development of applicable knowledge within this new area will likewise require a broad and inclusive paradigm, given the apparent sensitivity of the microbiota to perturbations across a cascade of BPS influences.

We propose a BPS ecological framework of the human microbiome and health that characterizes environmental and human factors as members of a global, dynamic set of interacting systems spanning BPS domains, levels of scale, and time - from the most immediate-level molecular, genetic, and neural processes to the most distal ecosystems. For example, in recent decades, shifts in biodiversity of the human gut and the rise of inflammatory and related diseases in industrialized societies parallel the proliferation of antibiotic use and resistance, as well as critical shifts in biodiversity observed at various scales globally. This likely reflects a dynamic interplay of biological, psychological/behavioral, and social systems at all levels of scale that ultimately interact with the gut microbiota, host systems, and their synergies. In turn, the host is integral to determining these systems.

The BPS ecological framework is aspirational, as was Engel's original BPS model, to more fully embody the reach of psychosomatic medicine through better reflecting the totality of interacting systems that determine health. Accordingly, it encourages replicable, generalizable research and practices through its broad consideration of the complex and dynamic systems that may otherwise be overlooked, studied within disciplinary silos, or understood out of context. A BPS ecological approach also bridges basic laboratory and clinical science, and transcends disciplines in ways that facilitate discovery. From a public health perspective, this paradigm may ultimately promote sustainable psychological, social, and bio-environmental systems that broadly support microbial-human health.

Relevant Citations:

Maier, K. J. & al'Absi, M. (2017, March). Toward a biopsychosocial ecology of the human microbiome and health: Charting a direction for psychosomatic medicine. Poster presented at the Annual Scientific Conference of the American Psychosomatic Society, Seville, Spain.
Maier, K. J. & al'Absi, M. (2017). Toward a biopsychosocial ecology of the human microbiome and brain-gut axis. Manuscript under revision. Psychosomatic Medicine.
Maier, K. J. (2016, April). Toward a biopsychosocial ecological model of health. Poster presented at the 37th Annual Meeting and Scientific Sessions of the Society of Behavioral Medicine, Washington, DC. http://www.sbm.org/UserFiles/file/am16-rapid-comm-v1_hires.pdf.

"Nowhere can one see more clearly illustrated what may be called the sensibility of such an organic complex, expressed by the fact that whatever affects any species belonging to it, must have its influence of some sort upon the whole assemblage. He will thus be made to see the impossibility of studying completely any form out of relation to the other forms; the necessity for taking a comprehensive survey of the whole as a condition to a satisfactory understanding of any part."

(Ecologist Stephen A. Forbes, 1887)

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