

GENES, BEHAVIOR, AND THE SOCIAL ENVIRONMENT: MOVING BEYOND THE NATURE/NURTURE DEBATE

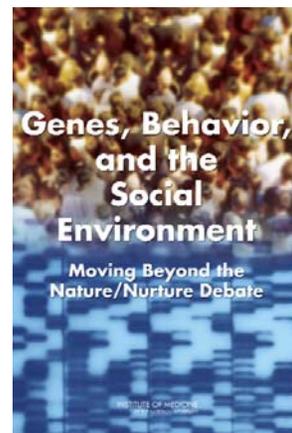
We have made great strides over the past century in reducing rates of disease and enhancing people's general health. Public health measures such as sanitation, improved hygiene, and vaccines; reduced hazards in the workplace; new drugs and clinical procedures; and, more recently, a growing understanding of the human genome have each played a role in extending the duration and raising the quality of human life.

But research conducted over the past few decades shows us that this progress, much of which was based on investigating one causative factor at a time—often, through a single discipline or by a narrow range of practitioners—can only go so far. Recent knowledge, including much of what has so far been gleaned from the sequencing of the human genome, is pushing scientists to look beyond single agents of health and disease. By breaking out of their disciplinary “silos” and embracing a broader systems view, based on the understanding that health outcomes are the result of multiple determinants—social, behavioral, and genetic—that work in concert through complex interactions, the best health outcomes from research may be yet to come.

To help achieve such a transition, three entities of the National Institutes of Health (NIH)—the Office of Behavioral and Social Sciences Research, the National Human Genome Research Institute, and the National Institute of General Medical Sciences—requested that the Institute of Medicine (IOM) undertake a study to help determine relevant approaches and strategies. The Committee on Assessing Interactions Among Social, Behavioral, and Genetic Factors in Health pursued a variety of objectives. It identified a number of well-described gene-environment interactions, reviewed the state of the science in researching such interactions, and recommended priorities not only on research itself but also on its workforce, resource, and infrastructural needs. Moreover, having been asked in particular to identify gaps in the knowledge and any barriers that hamper the integration of social, behavioral, and genetic research, the Committee concluded that a number of far-reaching changes are required if significant strides are to be made in the future.

A CRITICAL NEED FOR TRANSDISCIPLINARY RESEARCH

At the top of the list were recommendations for a more fruitful way of researching gene-environment interactions. Such research requires not merely the involvement of scientific investigators from a variety of different fields in



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“interdisciplinary” collaborations, whereby each participant hopes to take home something useful for his or her particular field, but a shift to *transdisciplinary* research. As noted in a previous IOM report (*Who Will Keep the Public Healthy? Educating Health Professionals for the 21st Century*, 2003), transdisciplinary research “implies the conception of research questions that transcend the individual departments or specialized knowledge bases because they are intended to solve research questions that are, by definition, beyond the purview of the individual disciplines.”

This type of research, when applied to gene-environment interactions, needs to explore wide-ranging levels of organization, including not only the cellular and physiological levels but also the social and behavioral levels that influence them. Bringing together individuals from the necessary areas of inquiry who can work together productively, however, is not easy. For example, most researchers with expertise in examining the social environment know little about mechanisms of gene expression, and vice versa. Each discipline has its own language, methodologies, and assumptions, which members of the team must each come to appreciate if their work is to be mutually informing. Because this literacy requires from participants a level of engagement across fields of inquiry beyond what is typically involved in most interdisciplinary work, the Committee has recommended that NIH use its funding mechanisms to support investigators who seek the cross-cutting skills necessary to participate in transdisciplinary endeavors.

REMOVING BARRIERS

As a prerequisite, funders must first recognize some institutional barriers—the system of rewards traditionally used by most universities, for example, as well as the processes by which entities like NIH award grants—which, if unmodified, could limit the availability of transdisciplinary researchers. Universities need to develop procedures for ensuring that members of teams from different departments, disciplines, and even schools receive appropriate credit and advancement, while the NIH should create Requests for Applications (RFAs) that genuinely encourage the collaboration of social, behavioral, and genetic scientists. Similarly, a culture that values transdisciplinary research needs to be created among reviewers so that applications can be fairly reviewed. Thus the Committee has recommended that NIH and universities address:

- Hiring, promotion, and tenure policies that acknowledge the contributions of collaborators on transdisciplinary teams;
- Peer review that includes reviewers who have experience with inter- or transdisciplinary research and are educated about the complexity and challenges involved in such research;
- Mechanisms for peer review of research grants that ensure the appropriate evaluation of transdisciplinary research projects; and
- Credit for collaborators in teams, such as NIH acknowledgement of co-investigators and university sharing of incentive funds.

OBTAINING USEFUL DATA

The Committee noted that one practical arena, among others, for the creation of new RFAs could involve the use of animal models to study gene-environment interactions and pathways of human disease.

Animal research studies are an important complement to clinical and community-based research because animal models can be used to conduct investigations in which different aspects of social, behavioral, and genetic variables can be controlled, standardized, or manipulated to a significantly larger extent than is possible in human studies. These models also allow for the invasive examination of organ-, tissue-, and region-specific mechanisms at the physiological, cellular, and molecular levels. Animals with short reproductive cycles and life spans can be especially valuable for experimental purposes.

Similarly, if the study of gene-environment interactions, whether in animal or human populations, is to provide significant information across multiple disciplines, improved data sets are needed. Data sets that already include biological and genetic measures could be augmented to include social and behavioral variables. Moreover, new data sets with the necessary variables could also be created. They may involve, for example, specific topics—such as obesity, diabetes, and smoking—that have high potential for showing genetic contribution, social variability, and behavioral influence.

PRACTICAL CONSIDERATIONS

Ethical and legal issues need to be considered in virtually all types of research, but they are especially important in transdisciplinary research that addresses the interactions of social, behavioral, and genetic factors in determining health outcomes. For example, scientific findings can be oversimplified and even exaggerated upon entering the public arena, sometimes because of the complexity of the concepts or because of economic and social pressures to emphasize the significance of findings in easily understandable terms or in particular ways.

The Committee therefore urged researchers to be mindful of public and policymakers' concerns, to develop mechanisms for informing these constituencies, to avoid overstating their scientific findings, and to give careful consideration to the appropriate level of community involvement and the level of community oversight needed for such studies.

The Committee also offered recommendations in other areas, including infrastructural needs (involving, for example, the training needs of transdisciplinary researchers), research design and analysis, and such issues as protection of human subjects' privacy and mechanisms for ethically obtaining their informed consent.

AN EFFORT WORTH PURSUING

Through transdisciplinary research, we can achieve a far greater understanding of how the interactions of social, behavioral, and genetic factors affect health and illness. This knowledge, in turn, will enable major improvements in the well-being of individuals and populations. But such happy outcomes will not be accomplished without effort. Many intermediate steps are required, including the training of investigators in transdisciplinary research, expansion and development of data sets that include social, behavioral, physiological, and genetic variables (measured over the life course), creation of new research strategies, and careful attention to the research's ethical, legal, and social implications.

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FOR MORE INFORMATION...

Copies of *Genes, Behavior, and the Social Environment: Moving Beyond the Nature/Nurture Debate* are available from the National Academies Press, 500 Fifth Street, N.W., Lockbox 285, Washington, DC 20055; (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area); Internet, <http://www.nap.edu>. The full text of this report is available at <http://www.nap.edu>.

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