Beyond Discipline: Creating a Culture for Interdisciplinary Research

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Abstract—Interdisciplinary research is not a common research paradigm. To venture from their customary disciplinary tenets and methods and risk new methodological approaches, or to compromise in order to accommodate the differences in the way disciplines approach research, requires the commitment of investigators. This paper discusses the interdisciplinary research paradigm, its culture, and how it differs from traditional research methods, and provides examples of successful and unsuccessful interdisciplinary research projects.

No man is a discipline.
—B. Fischoff (1981)

Introduction

Gleick (1987) describes how, in 1974, a man seen prowling the streets of Los Alamos, New Mexico, at night, worried the small town's police. Some physicists at the National Laboratory also wondered about their newest colleague, J. Robert Oppenheimer, who was then experimenting with twenty-six hour days. This bordered on strange behavior in the view of the young men and women at the laboratory.

Just as Oppenheimer was out-of-synchronization with the culture at Los Alamos, interdisciplinary research and those who conduct it work against the strong tradition of disciplinary based research. The traditional view of research is evident in the organization of one of its major sources of funds, the National Institute of Health, which is organized in divisions based on specific diseases or organs. While NIH has reorganized to accommodate the transdisciplinary nature of some diseases, such as AIDS, interdisciplinary research is basically out-of-synchronization with traditional funding sources. Similarly, most professional journals discourage papers that cross disciplinary boundaries. Writing to a specific audience, rather than about a topic that may have multiple audiences, is explicitly encouraged.

For years, the world of learning has been divided into disciplines characterized by rigid specialization, both in thinking and in method of inquiry. Ironically, as educators and scientists sought to protect their disciplinary boundaries, the newly emerging problems that needed solutions became more global, complex, and ill-defined. For example, air and water pollution know no geographical boundaries; the spread of AIDS and drug abuse

have become worldwide public health problems of massive proportions and require the expertise of numerous disciplines. As Beasley (1991) points out, the chronic conditions that challenge us today—from hypertension to learning disabilities—do not respond to the simple formula, "identify the cause and eliminate it," that worked for infectious diseases. Until recently, the great threats to our health were fairly specific—viruses, bacteria and traumatic injuries. Today, however, health is compromised on many levels at once. Societal and health problems challenge traditional methods of prevention and control, and chaos in social and biological systems makes it difficult to predict behavior. Yet, as Rose (1986) points out, we continue to apply disciplined research approaches to undisciplined problems.

Distinguished scientists (e.g., René Dubos, Claude Bernard, Walter Cannon, Charles Richet, and Hans Selye) have advocated and practiced interdisciplinary inquiry. These scientists asked broad research questions that could be answered only through interdisciplinary collaboration. The interdisciplinary research paradigm should be viable, and not only when a specific scientist rises to champion it; interdisciplinary research should have a culture that can be developed and transmitted to future investigators in order to ensure its continuity and staying power. The present paper discusses the interdisciplinary paradigm, its culture, how it differs from traditional and multidisciplinary methods, and the characteristics of successful and unsuccessful interdisciplinary projects.
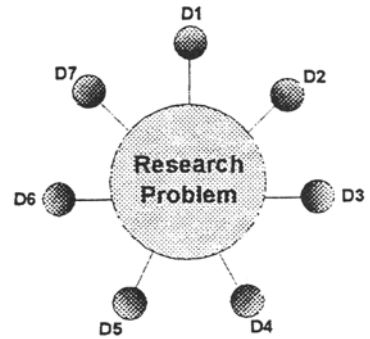
The Interdisciplinary Paradigm

Webster defines interdisciplinary as involving two or more academic, scientific, or artistic disciplines. Multidisciplinary is defined as many, multiple, or more than two disciplines. Traditional is defined as an inherited, established, or customary pattern of thought, action, or behavior. Figure 1 contrasts the structures of traditional, multidisciplinary, and interdisciplinary research, the most common paradigms for working on a research problem—at one extreme, a single investigator working on a problem (traditional), at the other extreme, several investigators working together on the same problem (interdisciplinary). Collaboration within or between disciplines can take several forms: 1) informal consultation among investigators; 2) solicitation of observations and advice from experts from other disciplines; or 3) two or more investigators working closely together designing the problem, determining the methodology to study it, analyzing the data, and writing up the final report.

The major difference between these three approaches is the degree of commitment the investigator wishes to make that goes beyond his/her disciplinary expertise. Investigators who do interdisciplinary research must be willing to leave a fixed disciplinary platform in order to consider the influence of other factors, methods, and explanations for a problem. Willingness to venture out of one's discipline relates to the degree of comfort or security an investigator feels when participating in the critique and examination of principles, theories, and methods among colleagues from different disciplines. A truly interdisciplinary research effort involves some compromises, and not all investigators are comfortable with making modifications or compromises. Compromises or modifications in research methods and techniques—for example, the collection of both qualitative and quantitative data—are often necessary to bridge knowledge gaps related to a problem. One objective of interdisciplinary research is to study a problem comprehensively.
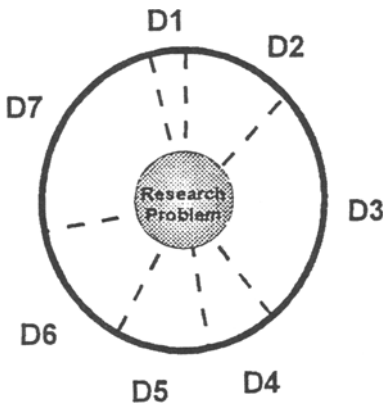
All types of research involve a process that includes formulating the problem, developing methods for data gathering, data analysis, interpretation, and write-up. In interdisciplinary research, the rigorous interaction of different disciplinary representatives helps to
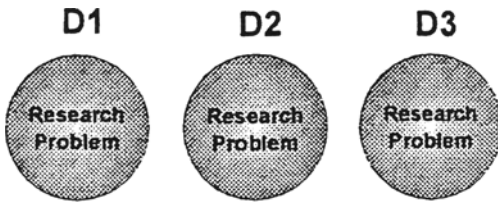
Traditional Approach

Multidisciplinary Approach

Interdisciplinary Approach

FIG 1.   Comparisons of traditional, interdisciplinary, and multidisciplinary research paradigms.

sharpen research methods, data analysis, and interpretation. Serendipitous findings are no more likely to occur in an interdisciplinary than in a traditional research project, but the meaning of these findings may take on greater importance when discussed by investigators from different perspectives.

   Frequently, the interdisciplinary research paradigm is mandated or contrived in response to a request for a proposal from a government agency or private foundation. Often, these RFP's require that principal investigators involve other organizations, agencies, institutions, and disciplines. Usually, such interdisciplinary efforts are time-limited and tied to the availability of funding. Hence, investigators may approach a problem from an interdisciplinary standpoint as a convenience in order to obtain grant funds to study a problem. The basic problem is that interdisciplinary research is often ad hoc; it has no culture to sustain it. Not every researcher or research problem is a candidate for the interdisciplinary paradigm, and universities and research institutes do little to create a culture to nurture the interdisciplinary research paradigm.

Interdisciplinary research is a process. Researchers are invited or volunteer to work on a specific project. The cohesiveness of the team and the coordination of the project evolve over time. As an interdisciplinary team grows and matures, the insights, hunches, risk-taking, and experimentation that embellish scientific inquiry increase. Every successful interdisciplinary effort must have a strong leader; in the words of Cassell, " . . . good ringmasters are essential. Keeping all the tigers in the cage and sitting on their pedestals (each at the proper height) is no easy task." The team leader functions as a "bridge scientist" or a people mediator (Anbar 1986).

Interdisciplinary leadership is taxing. The team leader must not be exclusively auto-cratic or laissez-faire in style. Neither of these extremes encourages creativity or teamsmanship. The leader must, however, have credibility as a research scientist so that his/her views will be respected. The leader must be a skilled modulator of personalities and theoretical perspectives and must seek, as a major goal, to achieve the melding of differ-ences into a workable, positive project. The leader must be perceptive and insightful about drawing out peoples' strengths and about know how to use group dynamics to blend these different strengths into a team. Researchers tend to be prima donnas who want to be heard and recognized individually, but every player is essential to the whole. The essence of interdisciplinary research is the integration of disciplinary contributions into a team prod-uct. The product itself is an innovative blend of perspectives and analyses. Interdiscipli-nary research not only joins the cracks between disciplines, it provides bridges across intellectual and societal chasms (Chubin, Porter & Rossini 1986).

Creating a Culture for Interdisciplinary Research

Two research subcultures predominate in universities today. Some researchers identify a problem they would like to investigate, develop a proposal, and search for a funding source. The more prevalent subculture involves researchers who wait for funding sources to identify problems and then develop research proposals to obtain funding with which to investigate them. Available funds determine the research questions that investigators pur-sue. The pressure to publish and do research in order to achieve promotion in universities, and the lack of state funds for laboratory and other resources, has forced faculty members to underwrite their research. This means that the importance of a topic for research is directly related to the availability of funds to carry it out. The amount of funds available also directly influences the size and length of the research effort, that is, how many investigators can obtain salary support and how many years of support staff can be salaried from this source. As a result of the dependence on external funds and the fluctuation in what is being funded at any given time, the research culture in universities encourages short-term projects that strive for sufficient results to warrant renewal or a new grant. University administration rewards faculty members who are successful in obtaining exter-nal funds; consideration of the relevance or application of the topic being researched is usually secondary to that of the amount and source of funding obtained.

This picture is relevant to the development and maintenance of interdisciplinary re-search. The prevalent university research culture discourages interdisciplinary research for several reasons. The reward system in universities is designed to recognize the research and scholarly contributions of individuals, not of teams. Most departments in a university do not like to give faculty members joint appointments because, when time commitments are shared between two or more units, it is difficult at the time of tenure and promotion evaluation to determine individual contributions in each unit. This discourages faculty

members who have multiple interests from working with colleagues in other departments. There are research institutes or study centers on campuses that gather researchers who have expertise in specific topics together in one location. However, these units are generally not well integrated into mainstream campus activities.

Interdisciplinary research occurs in universities when a specific funding opportunity encourages it or when a leader organizes a group of colleagues whom he/she knows are interested in a specific topic; e.g., gerontology, violence, materials science, international business. Interdisciplinary ties or working relationships are generally not encouraged in a university unless they generate income. Indeed, graduate degree programs that are interdisciplinary are often discouraged by university officials who ask, "what will the job market be like for a person graduating with this kind of interdisciplinary degree?" Graduates with specialist degrees are more marketable than are generalists, and marketability drives the types of graduate degrees that universities offer. On the other hand, the types of research questions facing society require the collaboration of researchers from many disciplines, e.g., genetic research, AIDS, pollution, aging, cancer, heart disease, and so on.

If we are to make progress in seeking solutions or breakthroughs in some of our pressing problems, we need to do more than let interdisciplinary research occur by chance. Interdisciplinary research needs to be accepted as a legitimate paradigm; it must be encouraged, nurtured, and rewarded in universities. A culture needs to be fostered so that interdisciplinary questions can be asked, and researchers must be encouraged to jointly pursue the answers. Collegiality needs to be encouraged to help refine research problems and assemble appropriate teams of experts to work on these problems. Figure 2 illustrates the ideal culture for nurturing interdisciplinary research. The figure emphasizes the need for resources, personnel, and rewards in order to create an interest in interdisciplinary research. At present, this kind of culture and the values associated with it are rare in universities.

An ideal culture for interdisciplinary research provides the necessary resources, rewards, and administrative encouragement for scientists to cross boundaries in order to work collaboratively. Perhaps most important in an ideal culture is a belief system that no single discipline has all of the answers to any problem and that no problem is too complex to investigate. An ideal culture for interdisciplinary research creates the curiosity among researchers to study gaps in our knowledge and to examine the interactions between phenomena. Thus, an ideal culture for interdisciplinary research stimulates inquiry into "how" questions about phenomena. An ideal culture for interdisciplinary research values both linear and nonlinear predictions.

A Different Approach to Research Questions

Usually, researchers are interested in the reasons "why" phenomena behave as they do, and they manipulate variables to see whether certain combinations of variables will behave in a predicted manner. Asking "how" phenomena behave broadens the spirit of inquiry. Investigators who are interested in "how" phenomena behave must be open to new or unexpected ways of behaving. They are confronted by a challenge to understand the unexpected as well as the expected.

For example, stress research has concentrated on the presence of negative conditions as a source of stress and has largely ignored stress reactions that result from a lack of positive conditions. Kanner and his colleagues (1978) found that both the absence of positive conditions and the presence of negative conditions are substantial, but independent,
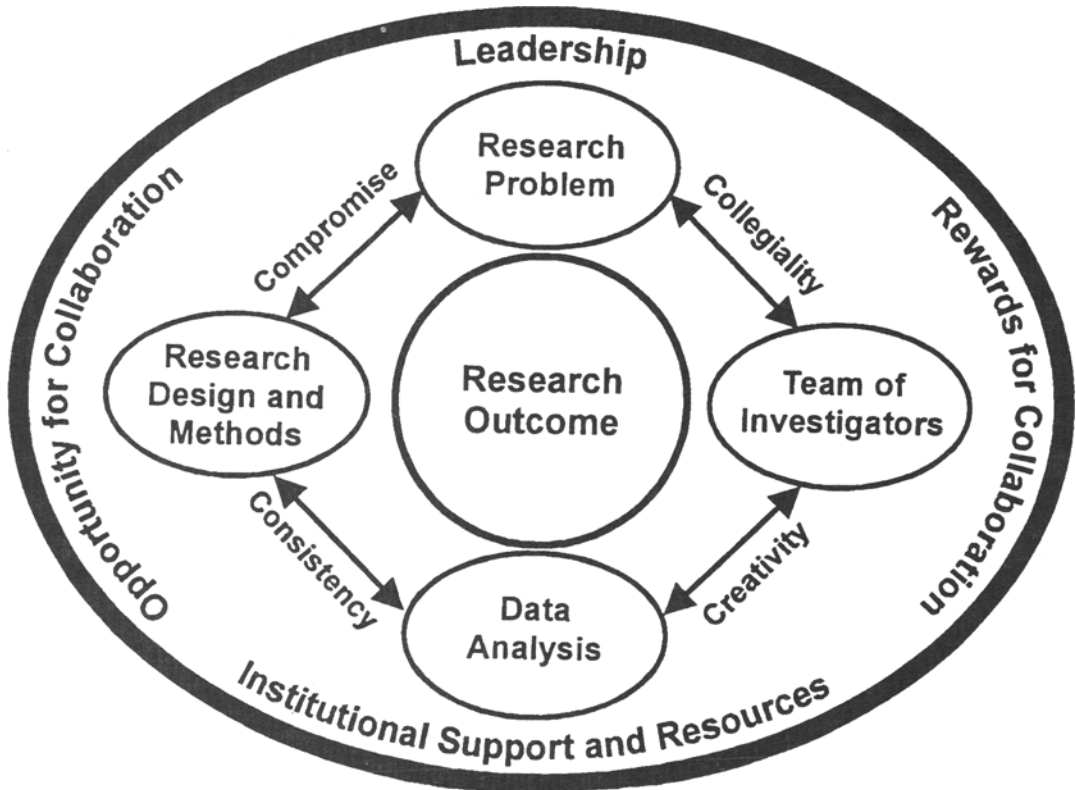
FIG 2. A paradigm for interdisciplinary research.

sources of stress. A lack of positive conditions was found to be the more powerful predic-tor of stress outcomes. These authors point out that researchers of stress have been inter-ested in particular topics and have not systematically explored the interrelationships of sources of stress. The relationship of stress to the presence or absence of positive condi-tions, which remains unexplored, could provide important information on the role of stress in peoples' lives.

Kaplan (1992) points out that the evolution of Type A personality and heart disease is well documented. The protective corresponding Type B construct has not been well stud-ied. Kaplan asks "How does the social environment influence Type B behavior?" "What is socially and psychologically protective?" Kaplan notes that these questions require an examination of healthy adaptation which, in turn, necessitates an ecological model that considers factors at the intra- and interpersonal levels, institutional levels, and cultural levels. We cannot understand the protective aspects of the Type B personality by stating that Type B persons do not have Type A characteristics. An understanding of the Type B construct requires the asking of much broader questions than those related to personality.

Young (1983) noted that illness has been proposed to be dysfunctional to the family system. She suggests that illness may have a temporal aspect that influences whether or not it is dysfunctional to the family. Indeed, families may respond favorably to illness when

resources are available. Young suggests that the family-illness interaction be examined within the context of adaptation. Families comprise a system that interacts with itself and with externally based systems. This interaction is a process and can be affected positively or negatively, depending upon the availability and use of social support. As rehabilitation therapists know from clinical experience, persons have more difficulty in rehabilitating from their illness when they are resource poor. Understanding the place and function of the ill members within the family and their available coping repertoire makes for better illness management.

It is widely believed that social norms govern the timing of major life events, and that events experienced "off time" are considerably more stressful than events experienced "on time." A social clock dictates the expected age range of marriage, having a family, and so on. People who engage in life transitions "off time" are often subject to negative sanctions and social stress. Nevertheless, Rook and her colleagues (1989) found, contrary to common belief, that individuals whose life transitions deviated from expected timetables did not experience greater stress and that, instead of less social support, more social resources were available to "off-timers." These investigators speculate that the social clock theory was not affirmed because the timing of life events, and when individuals choose to engage in them, may have more to do with the desirability or value of an event in their lives than with what others have established as the time for that event. The relevance of the theory of "off time" probably has diminished since society, today, is moving toward a "fluid life cycle," where social comparisons are less important than they once were.

All of these projects share several characteristics: 1) the researchers were less interested in prediction and linear hypotheses than in looking at phenomena in new ways; indeed, their inquiries were paradoxical to most of the published literature on the topics they studied; 2) they perceived the relevance and contribution of other disciplines to an understanding of the phenomena under study—some advocated an approach where the interactions between variables should be studied, others advocated the consideration of environmental factors; and 3) they saw the importance of studying human behavior from a life cycle or developmental approach in which people are "moving targets" while they are being studied. It is important to study people over time, during periods of stability and tranquility and periods of instability and chaos.

A Model Structure for Interdisciplinary Programs

While asking creative questions is a cornerstone of interdisciplinary research, other basic ingredients are essential to a model structure for organizing and carrying out interdisciplinary programs. Figure 3 illustrates the interrelationships between the focus or level of study, the variables to be studied, the disciplines involved, and the phases of research. The disciplines involved help to decide the focus of the study and the variables to be studied, and each discipline brings its expertise to bear at each phase of the research project. The difference between this model and a single disciplinary or a multidisciplinary model is that it melds the input of different disciplines into both the design and the execution of a unified project. This takes the even-handed skill of a project leader, who provides the necessary vision for bringing the multifaceted aspects of the project together into a cohesive protocol.

The prevention of cardiovascular disease through intervention programs provides an excellent example of interdisciplinary research. The North Karelia Project demonstrates how four theoretical approaches were integrated into a unified model designed to change

Disciplines

Variables

Focus or Level of Study

Developing Methods	Data Gathering	Data Analysis	Data Interpreta- tion	Follow-up					D5
Individual									
Family/ Group									
Organization									
Community									

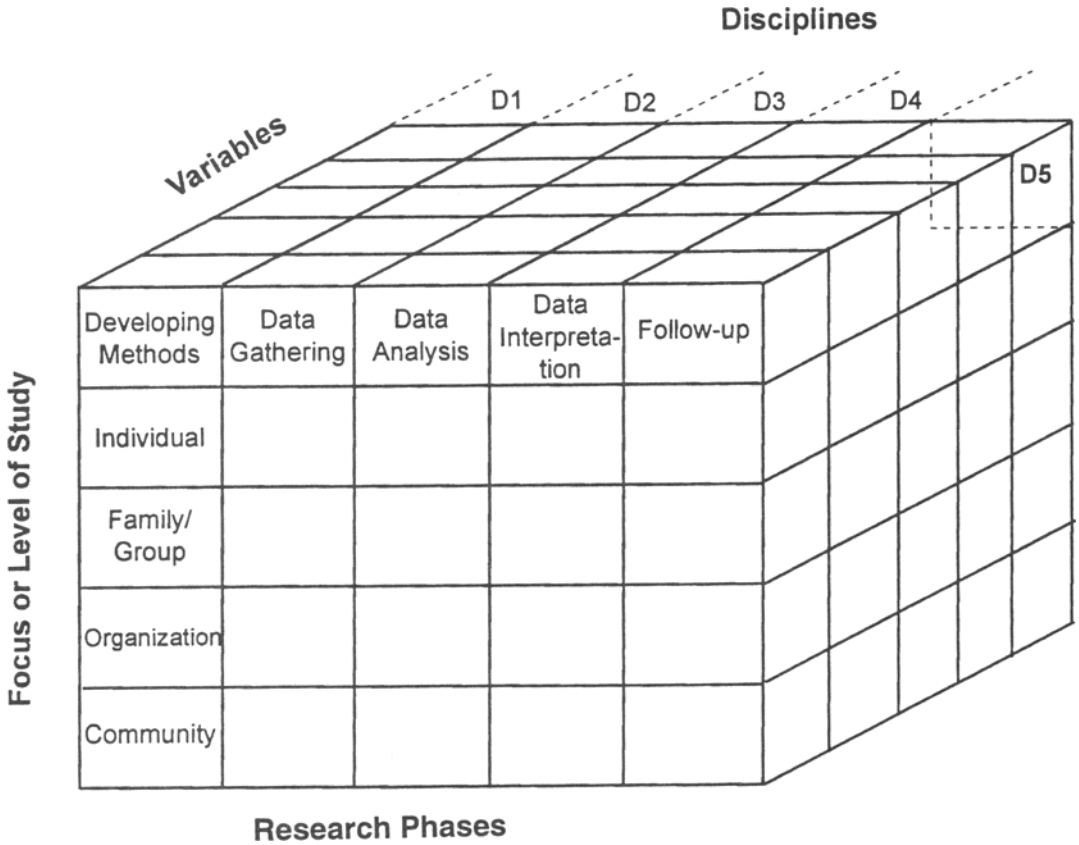D1   D2   D3   D4

Research Phases

FIG 3.   Model illustrating facets of an interdisciplinary program.

cardiovascular risk factors in a community and, subsequently, to reduce morbidity and mortality. The focus or level of study was the community; the variables were serum lipids, diet, smoking, and hypertension. The four theoretical approaches were *behavior change,* which suggests that new behaviors originate from exposure to powerful models and are maintained through internal and social reinforcements; *communication-behavior change,* in which new behaviors are introduced through interpersonal communication and mass communication; *innovation-diffusion,* in which health behaviors are introduced through the social networks of a community; and *community organization,* which requires change in community structures in order to accomplish social and cultural change. These various approaches were combined into a single model, with intervention strategies aimed at: increasing knowledge about cardiovascular risk factors, persuasion, teaching practical skills, and providing the necessary social and environmental support for behavior change and maintenance. Behavior change was aimed at reducing cardiovascular risk factors, and consequently, the rate of cardiovascular disease.

The North Karelia Project has reported five- and ten-year results. At five years, reductions were observed in the prevalence of smoking, serum cholesterol level, and blood pressure by 17.4 percent for men and 11.5 percent for women. At ten years the net

reductions in risk factor levels for men, aged 30 to 59 years, were: smoking, 28 percent, serum cholesterol, 3 percent, systolic blood pressure, 3 percent, and diastolic blood pressure, 1 percent. For women, aged 30 to 59 years, the risk reductions were: smoking, 14 percent, serum cholesterol, 1 percent, systolic blood pressure, 5 percent, and diastolic blood pressure, 2 percent. Over a ten year period, coronary heart disease mortality declined by 24 percent for men, aged 30–59. The significance of the results for women were uncertain.

Findings from this, and other community-based cardiovascular intervention projects, strongly support the concept that interdisciplinary community intervention programs can affect the levels and prevalence of major cardiovascular disease risk factors.

Interdisciplinary Projects That Failed

There are more examples of published successes than there are of published failures of interdisciplinary research. This may mean that failure is more difficult to admit to and to publish than is success. But, one published failure in the mental health field is very well known. Cummings and Cummings (1957) assembled a team of mental health professionals and health educators to attempt to change the attitudes of the citizens of a small Canadian community toward mental illness. The professionals assumed that the citizens would have a much narrower conception of normal behavior than they themselves did. The researchers met with a great deal of hostility from the citizens. The people of the community had fixed ideas about the causes of mental illness and a greater tolerance for deviance than did the research team. As the research team began its educational campaign, the citizens became anxious and agitated and asked the researchers to leave the community. One lesson that was learned from this failed experiment is that it is desirable to involve local people in the planning and execution of activities that will affect them. The project may have been too comprehensive and intensive and may have overwhelmed the small town. The experiment clearly points out the limitations of research intervention. Researchers may be so intent on making sure an intervention has an effect that they over-implement the intervention.

Bailey and Berg (1994) implemented an innovative treatment program in a civil addict treatment facility. The reformative model attempted to reduce conflict between staff and residents through group interaction and role reversal. The rather complex research design was aborted following a high number of drop-outs from the groups and a heightened conflict in resident-staff relations. The researchers analyzed the reasons for their failed experiment. There were many, including: philosophical disagreement between the correctional administrator and the correctional innovator, a lack of agreement on basic research issues, lack of clarification of primary goals of the project, confusion about project expectations among staff and residents, and lack of agreement regarding the delegation of authority. Perhaps the greatest barrier was the inability to gain consensus on the parameters of the projects. Since no boundaries were established at the beginning of the project, to assist staff and residents in their interactions, boundary issues arose when boundaries were violated.

Lessons For Interdisciplinary Projects

While the reasons interdisciplinary projects succeed or fail do not differ greatly from other research approaches, two key issues are especially important in interdisciplinary projects. First, boundaries regarding their roles, expectations, and authority must be very

clear to the various participants and to the project leader. Fuzzy boundaries lead to conflict and to poor quality control over the data being collected. The leadership, organizational, and interpersonal structures of an interdisciplinary project must be clear before the project can proceed. Second, it is important to involve the probable subjects or their representatives in helping to plan the project. Too great a communication gap between the researchers and the research subjects will result in drop-outs because of unclear expectations. Subjects should be clear from the onset about what they will gain from their participation.

While these points apply to all types of research, they are most critical for interdisciplinary research. Research involves manipulation; interdisciplinary research involves several types of researchers who are using different types of methods to obtain data. Often, subjects can feel abused or violated. It is important that the goals and methods of the project be explicit for all the researchers as well as for the subjects. The demand on subjects' time, psyches, and bodily functions constitutes a built-in risk factor for failure in interdisciplinary projects.

Research methodology is a matter of choice. Greater status and prestige is associated with traditional or classical than with interdisciplinary, experimental methods and with one or two, rather than with multiple scientists working together. Interdisciplinary research, which is more often discovered than taught, needs to be recognized as a legitimate methodology that is worthy of funding and teaching. Interdisciplinary research has its problems, but they are not insurmountable. Efforts to encourage the interdisciplinary approach have been inadequate; each interdisciplinary project seems to be unique in its successes and shortcomings. To a large extent, government and private funding institutions shape the types of problems we study and the length of time we study them. Establishing expectations about what interdisciplinary research should be and helping it to achieve greater use, success, and credibility would be a major positive step.

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