SCIENCE AND MEDICINE IN DIALOGUE

Thinking through Particulars and Universals

Roger Bibace, James D. Laird,
Kenneth L. Noller, and Jaan Valsiner

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SERIES PREFACE

The fields of health psychology experienced tremendous growth in the last two decades. This growth reflects an increasing recognition of the many social and psychological factors affecting health and illness and the realization that physical health can no longer be addressed solely from a biomedical perspective.

The books in this series focus primarily on how social, psychological, and behavioral factors influence physical health. These volumes will serve as important resources for layreaders as well as students and scholars in psychology medicine, sociology, nursing, public health, social work, and related areas.

Series Editor, Barbara J. Tinsley
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UNIVERSALS AND PARTICULARS IN THE PRACTICES OF PSYCHOLOGY AND MEDICINE: ENTERING A DIALOGUE

Roger Bibace, James D. Laird, Kenneth L. Noller, and Jaan Valsiner

The casual observer of the fields of psychology and medicine would find few commonalties. The first deals with the mind and its processes, while the second is concerned primarily with the body. Yet, it only requires slightly more intense observation to find myriad areas in which the two overlap. Psychological processes often rely on physical input, and medical problems always have a noncorporeal component. Despite these facts, few published works have attempted to explore these commonalties.

We began our process of exploration by convening two workshops composed of members of both disciplines, including both experimentalists and clinicians from each field. We gave the presenters little guidance beyond telling them that we were interested in the interactions between "The Universal" and "The Particular." While the presentation titles suggested that we were likely to fail to find common ground, the discussions that followed each paper began to identify our mutual areas of interest and our common problems.

We also discovered that we shared at least two goals. The first is that both disciplines seek a basic understanding about how human beings exist in their ordinary biological and psychological worlds. The second is the attempt to describe and treat disruptions of each person's healthy state of being. These goals would seem to divide rather than unite the scientific and applied factions. On the one side is the world of experimental psychology and the basic medical sciences. On the other are clinical psychology and the clinical practice of medicine. What we found,

however, is that both the scientists and the clinicians were interested in the same concepts: While scientists are interested in uncovering universal truths, they must use data from individuals. Likewise, while clinicians are primarily motivated to treat the particular individuals who are seeking care, they must rely on universal truths to initiate treatment.

This book is also an experiment on a different level. Not only were we—the four co-editors—attempting to uncover areas of mutual interest between the two disciplines, we were also hoping to uncover the basis for the conflicts that have arisen in our fields. In both psychology and medical practice, schisms have emerged that need to be bridged if we are to develop the most effective science and practice. Most generally, the problem appears to be how to relate universal principles and particular cases. This remains a perennial problem for all science and its applications.

CONSTRUCTING KNOWLEDGE: BEYOND THE OPPOSITIONS GIVEN

It is not difficult to sense the tension between the adherents to the "generalized knowing" and "particularist practices" ideas in our book. Clearly, the chapters reveal that the distance between these positions has not narrowed. One group has "solved" the problem by arguing that universal principles are at best crude approximations and perhaps are no more than illusions. The richness of context-sensitive phenomena—both in psychology and in medicine—is viewed as a means toward a better understanding of reality. At the extreme, this group urges us to focus only on single cases, studied in intensive, "qualitative" ways that permit us to know a great deal about a single person. While this approach results in rich descriptions of the most minute details of the specific case, all generalizing power is lost. Losing that means the end of science and professional self-extinction.

Yet there is a different way to view specific cases, that is, to look for universality within a single, systemically organized case. This is a focus of both basic science and medicine in its practice. In both cases, the object of inquiry—be it a far-away planet in astrophysics (a single case) or the particular Mr. Smith who feels that he has a health problem—is singular and unique. In both cases, the knowledge base that allows the scientist or practitioner to make sense of how the planet or person is functioning is that of a generalized kind. That knowledge comes from the study of other cases, under different conditions, yet in ways that

allow for transfer of previously acquired knowledge to the new, not yet understood case.

The other, "quantitative" group seems relatively unconcerned by the problem of universals versus particulars and proceeds to generate general principles that characterize groups of people. These general principles are assumed never to fit any single individual precisely. Yet, from the quantitative perspective, individuality is inevitable, with each individual representing a potentially unique intersection of a potentially infinite array of dimensions.

Both perspectives may be limited when any of the knowledge obtained from groups is to be put to the service of intervention in the case of a particular individual. The transfer of sample-based generalized (averaged) evidence from epidemiology to concrete actions in medicine is a risky undertaking. The "average" condition or treatment may work, but it also is open to errors, due to the lack of knowledge about this particular person whose health is at risk. Correspondingly, too great a focus on the individual may lead a practitioner to ignore evidence-based medicine in favor of the individual's intuitions. Rigid reliance upon either population-based information or individual variation may lead to treatment errors. Both are "right" and "wrong" at the same time. Successful treatment of any patient depends on the clinician's ability to coordinate relevant information from both.

KNOWLEDGE ABOUT HUMAN BEINGS: THE PRIVATE AND THE PUBLIC

The contrast between the general and the particular is linked with another contrast—that between PUBLIC and PRIVATE. The former corresponds to the universal and the latter to the PARTICULAR. All private information is the particular side of whatever may be seen in public in a different way. Thus, politicians' public speeches reveal next to nothing about their personal, particular worlds.

The ways in which the private and public domains are coordinated differs greatly among societies and within the same society over its history. Private/public boundaries changed drastically in the twentieth century, all over the world. First radio, then television, and more recently the internet have made all information "global."

This fact leads to new challenges for both medicine and psychology. We live in a society where the distinctions between what is private and what is public are increasingly blurred. For example, virtually all Web users have received an e-mail that offers a service that can "find out

anything about anyone." Of course, such grand promises are advertising gimmicks, yet the amount of information about any person that is available on-line is enormous. Passwords and firewalls only partly control access to our privacy.

A good example of the extent to which societal attempts to protect personal information can be deleterious to medical practice is the "Health Information Portability and Accountability Act" (HIPAA) that recently became law in the United States. The original purpose of the Act was to ensure that an individual would have access to her/his medical records if they ever moved. However, after the politicians and their staff finished adding their personal touches, HIPAA became several thousand pages of restrictions, rules, regulations, and interpretations. It is now very difficult to obtain medical information from another institution or physician, just the opposite of the original intention of the law.

Different contributions to this book touch upon the tension between the individual's rights to privacy and social institutions' self-proclaimed rights to invade that privacy. The situation is further complicated by the need of society to demand individual information for some benevolent interventions for the sake of the lives of people in the society as a whole. The most obvious example concerns infectious diseases. However, these (macrosocial) dilemmas remain largely beyond the scope of the present book.

Another dilemma—the invasion by the researcher of the privacy of the research participant[1]—is one of the central themes in this book. The issue is the basic question, "How should human beings create knowledge about other human beings?" In science, humans are used in experiments for the sake of scientific understanding. In medicine, the goal is to identify concrete and practical solutions for health problems. We need to transcend the "dialogue" between psychology and medicine and analyze the common process in which they are jointly involved.

PARTICULAR SOCIETIES AND THE UNIVERSALITY OF MEDICINE

The organization of medical practice in any country is always tied to its history and societal structure. A good illustration of this is the different ways countries have chosen to provide medical care. In some areas there is a socially guaranteed access to medical services (e.g., Cuba, Sweden), in others there is a centralized government-run "national health system" (e.g., U.K.), and finally there is medicine operating as a private business (U.S.). Each system has its unique strengths and weaknesses.

Each tries to tie Hippocratic ideology with day-to-day practicality. And once again there is the contrast between the universals of medical know-how and the particulars of its application in the social contexts of society. However, all of the different forms of medical services borrow from the same universal medical knowledge base.

We can use the practice of medicine in the United States at the present time to illustrate the social–personal tug of war that is placed on both the science of medicine and the practice of medicine. The U.S. populace, through its politicians, has supported research in virtually all fields of medicine for decades. The multibillion dollar annual budget of the National Institutes of Health is the best proof that the United States has a commitment to extending the boundaries of medical science. On the other hand, millions of individuals do not have access to the fruits of these investigations. Medical care is expensive, and only those who are fortunate enough to have adequate health insurance receive excellent health care.

The peculiarities of the U.S. medical system are situated within the social history of the United States. de Tocqueville (1848/1966) was one of the first to point out how the history of the United States is responsible for a society where extreme individualism is held together with equally extreme collectivism. That unique history is a kind of historical "natural experiment" in the social psychology of macrocommunities. It has resulted in an economically successful society that functions through a unique system of democratic governance—a transformed model of British community governance (see Mead, 1930). There has been a strong dose of missionary spirit in U.S. society that has helped economic development at home, but this has also led to U.S. attempts to export its ideology worldwide. The U.S. social system has not been adopted by other countries in any successful way, however, and the only case of its explicit exportation (to Liberia) has not resulted in a prosperous and peaceful society.

PSYCHOLOGY'S STRUGGLE: THE ROLE OF THE RESEARCHER

Contemporary psychology is a result of the history of the discipline. It can be roughly divided into "mainstream" and "other" groupings—at least in the context of the United States where political pressures prescribe a fight for "the right" way of being, thinking, and making sense. It is an interesting observation that the specific contents of such a "right way" changes relatively quickly, yet at any instant there cannot be more

than one "right way" operating within the same competitive, social enterprise. Minority views are tolerated (and at times even highlighted), yet not beyond the point at which they would supercede the "right way."

Surely different enterprises can flourish in parallel (each with their own "right way"). An outsider who looks at psychology in the United States as a whole would be left with an impression of eclectic parallelism. While parallelism may be present on a national level, it is unusual within local enterprises. That is not merely a result of the social organization of the enterprise. Rather, its roots go to the privacy of the members of such institutions. For example, an American psychoanalyst who works in New York, Japan, and India has given an example from the boundary of societies:

> One Indian colleague, Veena, recounted that she is a member of two private psychoanalytic seminars with radically different orientations as well as leaders, one being quite traditional, the other highly innovative. Veena feels perfectly comfortable in both groups, with no conflict whatsoever, and learns a great deal in each. No American psychoanalyst I know of, woman or man, would ever consider being a member of these two particular seminars simultaneously, because they would experience them as far too dissonant and too disruptive of consistent inner professional identity. Since each group's members would probably disapprove of her being in the other group, Veena keeps her participation in the other group secret in a highly private self, typical of Indians and other Asians. (Roland, 1996, p. 27)

This example may test the limits of the cognitive dissonance theory, at least when applied to an active learner in a divided group context. As a strategy of overcoming unnecessary intergroup rivalry within one's private self, however, the example demonstrates the potential for researchers to transcend the usual intergroup frictions within a discipline.

CONTRIBUTIONS BY SOCIAL PSYCHOLOGY

Social psychology has a long tradition of disbelieving verbal reports as data (Nisbett & Wilson, 1977). This idea came to the forefront at almost the same time that cognitive psychology was rehabilitating the use of verbal reports as data (Ericsson & Simon, 1993). In fact, the last century of social psychology and many of the other branches of experimental psychology has been devoted to demonstrating how limited and

error-filled is our understanding of ourselves. The real issue, of course, is not in a political stance—"verbal reports by subjects are correct" versus "verbal reports are faulty"—but a careful consideration of why a person makes one or another statement about oneself, how these statements are coproduced by the researcher who sets up the conditions for the investigation, and how the researcher decides to create data from all of the evidence. In the long run, the researcher assembles the scientific picture of the objective phenomena, often using language that is far beyond the comprehension of the participant.

Here we face another tension in the research process: the use of the specialized (universal) language of science versus the particular languages—or idiolects—of the participants. Scientific language necessarily goes beyond the language used in everyday life. Yet, if the researcher has the final word, then that word also can be deceptive. In fact, experimental techniques are meant to bring out conditions where the researcher had made a generalized—yet deceptive—claim. In the case of adequate uses of experimental methods in social psychology (Milgram, 1974; Zimbardo, 1969), the value of experiments in correcting the researcher's delusions is well documented. The driving force behind the development of various aspects of the prevailing methodology is to figure out ways to minimize the impact of the researcher's values and expectations on the outcome. The standard assumption is that one can never entirely remove that bias, but one can minimize it, or sometimes measure it, or, by converging methods, find a way to see the reality that is only dimly reflected in the actual observations.

Deception, or the researcher leading the participant's thinking in a direction so that some other phenomenon can be studied, is a necessary part of science. It is not only the participant who can be misled, often it is also the research assistant who sets up the study whose understanding of what is being investigated is selectively directed. It is precisely the desire to minimize the experimenter's impact on the observations that is behind the use of blind and double-blind studies. It also leads to attempts to standardize the experimenter's behavior as much as possible, so that the participant is not led by the experimenters' nonconscious influences. Such standardization is fraught with problems. Often the interviewer/researcher begins to sound and act like an automaton. Normal personal interactions are lost. The research participant may answer a question, but there is no way to know if it was understood, as it is often believed that each study participant should hear exactly the same words, no more and no less.

DISTANCING FOR THE SAKE OF GAINING A PERSPECTIVE

Among the methods adopted to minimize the impact of the observer, one of the most common is to ask questions in writing rather than in person. It is assumed that the questioners will inevitably influence the answers they receive, without either the questioners or the answerers knowing that the influence has occurred. Of course, pursuant to the guiding assumption that the observer's influence can only be minimized, not removed, the further assumption is that questions themselves influence the answer, even when written. (Of course, in one sense, if they did not produce some sort of relevant answer, they would not be questions.) Norbert Schwartz and others study how question features influence answers by systematically varying the questions (see also chapter 17). While questionnaires may be no more (and perhaps less) biased than interviews, they are imperfect and at least involve a different set of potential biases. If we understand the effects of different formats, we might be able to ask questions in a number of different ways and better converge on the "truth." This book contains several chapters that examine the benefits and shortcomings of both questionnaires and interviews.

FROM RESPONSES TO DATA

In any research, the originally collected specimens of evidence are processed further to become data. Usually, participants' responses must be categorized. The first task is to identify the categories of response. This can be done in advance, and then the response categories can be provided to the participant, as in a multiple choice questionnaire format. Conversely, it can be done after the data are collected by coding responses into categories. Doing it beforehand has the advantage that the participant is the one who decides which of the experimenter's categories best fit his or her response. The disadvantage is, of course, that the experimenter may fail to include one or more important response alternatives in the category system. This problem may be overcome to some extent by providing an "Other" category. The greatest advantage of establishing categories after the data are gathered is that everything the participants say may be included, including responses the experimenter would never have considered.

Potential bias is again introduced when the researcher begins to interpret the responses, whether from interviews or questionnaires. In most experiments that deal with more than a handful of participants, there is

no way to use all of the participants' responses in a pure, uninterpreted way. While the use of a complete transcript of every interaction, without categories or any attempt to characterize the responses, will eliminate interpretation bias, it is impractical. Therefore, it comes down either to providing the categories and letting the participant decide what is best or establishing the categories later and having the experimenter make each response fit into a category.

HOW ARE GENERALIZATIONS MADE?

Generalization is the process through which a universal principle is developed from a set of existing evidence (data). Traditionally, this can be accomplished either by qualitative or quantitative methods. Both methods have strengths, and both have weaknesses. Often, the method is chosen because of the tradition of that field or branch of science to which the researcher belongs. The quantitative method moves from responses to classification. For these researchers, the "law of large numbers" reigns. Generalizations here move from samples to populations. The issues of representativeness of samples, randomness of sampling, and sample size are all important.

The qualitative route to generalization does not rely on the notion of a sample (nor of population). Each system under study is treated as a microcosm of its own and is studied as a complete system. Hypotheses are tested on the basis of a single case, but with varying conditions. Here the "law of small numbers" ($N = 1$) prevails. The classic experiments in the history of psychology—such as those of B. F. Skinner, M. Sherif, S. Milgram, and others—did not need at least 29 standardized replication efforts (note: the "magic number" of subjects needed is often said to be 30). Instead, in the many studies conducted by the classic researchers, the experimental procedures were varied as to their particulars in order to test the boundaries of the general principle. If the general principle is adequate (valid), then it will be replicated in every single case that is selected and studied. If there is no replication, then the general principle itself requires modification.

OVERVIEW OF THE BOOK

The structure of this book oscillates between the general and the particular. In Part I we address the issues of how human thinking—in everyday life and in medicine—reaches relevant decisions. Much is at stake in those decisions, and it remains a remarkable testimony for human

adaptation that the heuristic means—models for thinking—are robust and available for very speedy decision making. These "fast and frugal" heuristics (chapter 1 by Gigerenzer and Kurzenhäuser) are examples of universal human cognitive mechanisms. Yet it is important to remember that the way an individual makes a decision may vary greatly depending on the context of the need for the decision. For example, the factors involved in deciding how much to bet in a casino are quite different from deciding how to treat a critically ill person. The actual mental processes of decision making are socially guided, as Salovey (chapter 2) shows. The specific ways in which messages are framed make a profound difference in the outcome that is reached. The specific life situation of the individual also changes the decision process. Furthermore, a specific social discourse mode—talking about risks—can lead to either general escalation or de-escalation of the societal concerns about health issues and feed an individual's actual feelings about their own health-related actions (Heyman, chapter 3) and, in Part II, perceptions (Heyman, chapter 4 and Hoffrage et al., chapter 5).

In the context of medical practice, all the cognitive and social conditions for human thinking are subordinated to the goals of the health care system—the recovery or maintenance of health. Clinicians remain central in the decision processes despite the advances in medical science. Only the clinician has the knowledge about the individual that is necessary to treat an illness. Chapters by Noller and Bibace (chapter 6) and Chelmow (chapter 9) provide the readers with an overview of the current state of affairs in the American medical system, where—together with great technological advancements—the possibilities for medical errors are enhanced. The critical issue is how to prevent such errors. In this endeavor, psychology can make a contribution. The No-Fault Learning Program (chapter 7 by Bibace and Noller, and chapter 8 by Bibace, Leeman, and Noller) demonstrates how a focus on an individual clinician's decision making can help to reduce both errors of omission and commission.

Part III of our book is dedicated to case studies in human health-related conduct. The very act of seeking medical assistance is a socially guided practice that—as Bäärnhielm shows in chapter 10—is overdetermined by meanings. Such overdetermination is situated in the ordinary social discourses—and Amorim and Rossetti-Ferreira demonstrate how intricately a child's ordinary illness experience in a day-care setting is socially constructed (chapter 11). A more dramatic story unfolds in the case of a child fighting leukemia (Silva, in chapter 12).

In Part IV, the reader is shown that the interface between universals and particulars can lead to the development of new methodologies. It is

demonstrated how all four of the psychologists' favorite measurement scales—nominal, ordinal, interval, and ratio—form an ascending sequence of quantitative sophistication (Laird, in chapter 13). Much real-life decision making takes place without full information and under conditions of rapid change. Toomela (chapter 14) promotes a systemic perspective for looking at decision making without full information.

Contributions to Part V outline the different meanings of the notion of participation. It begins from the initial consent to participate and follows the process over years and even decades. Chapter 16 by Kerllenevich et al. illustrates the intricacies of the process. The research participant has principled autonomy, and no instruction can reduce it. Furthermore, that autonomy extends to the level of each particular question that a clinician or researcher asks. Informed consent can cover a wide range of interpretations (chapter 17). Similarly, all psychological questionnaires—such as personality inventories like the MMPI or NEOPI—are vulnerable to high inter-individual variability, even in seemingly simple items (Valsiner et al., chapter 18).

We have attempted to examine the widely disparate concepts of the universal and the particular in the context of modern society. We have uncovered both friction and accord, but mostly we have found that we have changed our "feelings" about them. We no longer see the universal as one globe on the end of a barbell and the particular on the other, neither do we see the concepts as a continuum. Rather, these concepts are more like the colors of a rainbow. At no point is there only red, or blue, or yellow. Each layer of color extends from one end of the spectrum to the other. Neither is there only universal nor only particular anywhere in science or medicine. Each is inexorably intertwined with the other. To examine one is to examine both. No universal truth is discovered without the data from individuals, and no particular person is healed without knowledge of the universal (Leeman et al., 2003).

We hope you enjoy our "experiment."

NOTE

1. The use of language is interesting here. Both psychology and medicine have changed the way they refer to the persons—or animals—that are being studied. For years these persons were subjects. Now they are research participants.

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Part I

BETWEEN GENERALITIES AND PARTICULARS: AVAILABILITY OF COGNITIVE HEURISTICS

Chapter 1

FAST AND FRUGAL HEURISTICS IN MEDICAL DECISION MAKING

Gerd Gigerenzer and Stephanie Kurzenhäuser

How do doctors solve the challenging task to make treatment decisions under time pressure? Consider the following situation: A man is rushed to the hospital with serious chest pains. The doctors suspect acute ischemic heart disease and need to make a decision, and they need to make it quickly: Should the patient be assigned to the coronary care unit or to a regular nursing bed for monitoring? The decision to admit a patient to a coronary care unit has serious medical and financial consequences. How do doctors make such decisions, and how *should* they?

One way to do it is to rely on experience and intuition. For instance, in a rural Michigan hospital, doctors sent some 90 percent of the patients to the coronary care unit. This behavior can be understood as defensive decision making—physicians fear malpractice suits if they do not send a patient into the care unit, and he subsequently has a heart attack, but less so if they send a patient into the unit unnecessarily, and he dies of an infection. This indiscriminate use of the coronary care unit causes unnecessary costs (too many people in the coronary care unit, which results in high per-day costs), decreases the quality of care, and adds additional health risks (such as serious secondary infections) to patients who should not be in the unit. Only 25 percent of the patients admitted to the coronary care unit did actually have a myocardial infarction (Green & Mehr, 1997; Green & Smith, 1988). Similar rates were found at larger hospitals (ranging from 12% to 42%).

Researchers at the University of Michigan Hospital tried to solve this overcrowding problem by training the physicians to use a decision-support tool based on logistic regression, rather than relying on their intuitive judgment (Green & Mehr, 1997).

Physicians were trained to use the Heart Disease Predictive Instrument (Pozen, D'Agostino, Selker, Sytkowski, & Hood, 1984), which is a

Figure 1.1
The Heart Disease Predictive Instrument (HDPI), a decision-support tool, in the form of a pocket-sized, plastic-laminated card. The reverse side of the card gives the following definitions:

Chest Pain = Chief Complaint
EKG (ST, T wave Δ's)

History	ST&T Ø	ST⇔	T⇑⇓	ST⇔	ST⇔&T⇑⇓	ST⇑⇓&T⇑⇓
No MI& No NTG	19%	35%	42%	54%	62%	78%
MI or NTG	27%	46%	53%	64%	73%	85%
MI and NTG	37%	58%	65%	75%	80%	90%

Chest Pain, NOT Chief Complaint
EKG (ST, T wave Δ's)

History	ST&T Ø	ST⇔	T⇑⇓	ST⇔	ST⇔&T⇑⇓	ST⇑⇓&T⇑⇓
No MI& No NTG	10%	21%	26%	36%	45%	64%
MI or NTG	16%	29%	36%	48%	56%	74%
MI and NTG	22%	40%	47%	59%	67%	82%

No Chest Pain
EKG (ST, T wave Δ's)

History	ST&T Ø	ST⇔	T⇑⇓	ST⇔	ST⇔&T⇑⇓	ST⇑⇓&T⇑⇓
No MI& No NTG	4%	9%	12%	17%	23%	39%
MI or NTG	6%	14%	17%	25%	32%	51%
MI and NTG	10%	20%	25%	35%	43%	62%

Chest pain: Patient reports chest or left arm pressure or pain.

Chief complaint: Patient reports chest/left arm discomfort is most important symptom.

NTG: Patient reports a history of PRN use of nitroglycerin for relief of chest pain. Not necessary to have used NTG for this episode.

MI: Patient reports a history of definite myocardial infarction.

ST⇐⇒: Initial EKG shows ST segment "barring," "straightening," or "flattening" in a least two leads excluding aVR.

ST⇑⇓: Initial EKG shows ST segment elevation or depression of at least 1 mm in at least two leads excluding avR.

T⇑⇓: Initial EKG shows T waves that are "hyperacute" (at least 50% of R-wave amplitude) or inverted at least 1 mm in at least two leads excluding aVR.

Ø: None of the above ST segment or T-wave Δ's are present.

Source: (Green & Mehr, 1997).

decision-support tool that tries to weigh and combine the relevant information. The Heart Disease Predictive Instrument (HDPI) as used in the Michigan Hospital consists of a chart with some 50 probabilities (Figure 1.1). The physician has to check the presence or absence of combinations of seven symptoms and insert the relevant probabilities into a pocket calculator, which determines the probability that a patient has acute heart disease. The probability score is generated from a logistic regression formula that combines and weighs the dichotomous information on the seven symptoms. These symptoms were chosen out of 59 clinical features about which information is available to emergency room physicians (Pozen et al., 1984). However, physicians are generally not happy using this and similar systems (Corey & Merenstein, 1987; Pearson, Goldman, Garcia, Cook, & Lee, 1994). Physicians typically do not understand logistic regression, and even if they do, they are uncomfortable with being dependent on a probability chart. The dilemma the doctors in the Michigan hospital now faced was as follows: Should patients in life-and-death situations be classified by intuitions that are natural but in this case suboptimal or by complex calculations that are alien but possibly more accurate? This dilemma arises in many contexts, from financial advising to personnel recruiting: Should we rely on experts' intuition or on a fancy statistical model?

There is, however, a third alternative: smart heuristics. They correspond to natural intuitions, but they can have the accuracy of fancy statistical models. It was an unexpected observation that initially led the hospital researchers to try a heuristic model. The researchers had employed an ABAB reversal design. That is, they had let the physicians make the decision first by intuition (condition A), then given them the HDPI (condition B), then withdrew the instrument and left the physicians to their intuition once more (condition A), and so on. The researchers had expected that the quality of decision making would be relatively low in condition A and high in condition B, and would oscillate. Quality first increased from A to B, as expected, but then surprisingly stayed at this level, even when the instrument was withdrawn. Figure 1.3 shows that physicians initially had a false-positive rate of over 90 percent (condition A), which improved after they first encountered the HDPI to less than 60 percent (first condition B) and subsequently stayed at this level (all further conditions A and B). It was out of the question that the physicians could have memorized the probabilities on the chart or calculated the logistic regression in their heads. So why did the decision-support system only help the first time? The suspicion was that the probabilities and the logistic computations may have mattered little, and that physicians might

have simply learned the important variables. This interpretation opened up the possibility of deliberately constructing a decision heuristic that uses only a minimum of information and computation. Green and Mehr (1997) constructed a simple decision heuristic by using three building blocks of heuristics: ordered search, a fast stopping rule, and one reason decision making (Gigerenzer, Todd, & the ABC Research Group, 1999). Before we turn to the decision heuristic of Green and Mehr, let us first consider its building blocks in more detail.

FAST AND FRUGAL HEURISTICS

There are several classes of heuristics (the term "heuristic" is of Greek origin, meaning "serving to find out or discover"). Green and Mehr (1997) based the construction of their decision heuristic on fast and frugal heuristics (Gigerenzer & Selten, 2001). These heuristics do not try to compute the maximum or minimum of some function, nor, for the most part, do they calculate probabilities. They are fast, because they do not involve much computation, and frugal because they only search for part of the information. They rely on simple building blocks for searching for information, stopping search, and finally making a decision (Gigerenzer & Goldstein, 1996; Gigerenzer, Todd, & the ABC Research Group, 1999).

Building Blocks for Guiding Search

Alternatives and cues are sought in a particular order. For instance, search for cues can be simply random or in order of cue validity.

Building Blocks for Stopping Search

Search for alternatives or cues must be stopped at some point. Fast and frugal heuristics employ stopping rules that do not try to compute an optimal cost–benefit trade-off. Rather, heuristic principles for stopping involve simple criteria that are easily ascertained, such as halting information search as soon as the first cue or reason that favors one decision alternative is found.

Building Blocks for Decision Making

Once search has been stopped, a decision or inference must be made. Many models of judgment and decision making ignore the search and stopping rules and focus exclusively on decision: Are predictor values

combined linearly as in multiple regression, in a Bayesian way, or in some other fashion? Instead, fast and frugal heuristics use simple principles for decisions (such as one-reason decision making, see below) that avoid expensive computations and extensive knowledge by working hand in hand with equally simple search and stopping rules.

FAST AND FRUGAL DECISION TREE

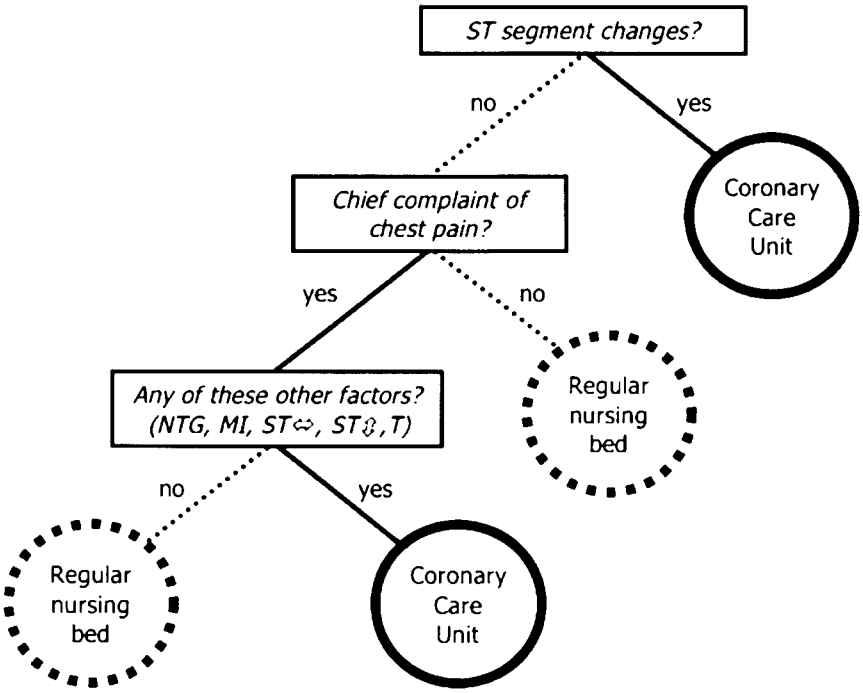
Using these building blocks, Green and Mehr (1997) constructed a simple decision heuristic for the coronary care unit allocation problem. The resulting heuristic is shown in Figure 1.2 in the form of a fast and frugal decision tree. It ignores all 50 probabilities and asks only a few yes-or-no questions. If a patient has a certain anomaly in his electrocardiogram (the so-called ST segment change), he is immediately admitted to the coronary care unit. No other information is searched for. If that is not the case, a second variable is considered: whether the patient's primary complaint is chest pain. If this is not the case, he is immediately classified as low risk and assigned to a regular nursing bed. No further information is considered. If the answer is yes, then a third and final question is asked to classify the patient.

This decision tree employs fast and frugal rules of search, stopping, and decision. First, it ranks the predictors according to a simple criterion (predictor with the highest sensitivity first, predictor with the highest specificity second, and so on). Search follows this order, similar to the Take The Best heuristic (Gigerenzer & Goldstein, 1996, 1999). Second, search can stop after each predictor; the rest is ignored. Third, the strategy does not combine—weight and add—the predictors; for instance, a change in the ST Segment sends the patient immediately into the coronary care unit, whether or not his chief complaint is chest pain, and independent of what other factors the patient has. In general terms, predictors that are lower in the tree cannot compensate for one higher up in the tree. Only one predictor determines each decision. This decision rule is an instance of *one-reason decision making.* The entire heart disease tree is a realization of a *fast and frugal tree,* which is defined as a decision tree with a small number of binary predictors that allows for a decision *at each branch* of the tree.

HOW ACCURATE IS THE FAST AND FRUGAL TREE?

The simple tree, just like the Heart Disease Predictive Instrument, can be evaluated by multiple performance criteria. Accuracy is one criterion,

Figure 1.2
Fast and frugal decision tree for coronary care unit allocation. For explanations, see Figure 1.1.



Source: Based on Green & Mehr, 1997.

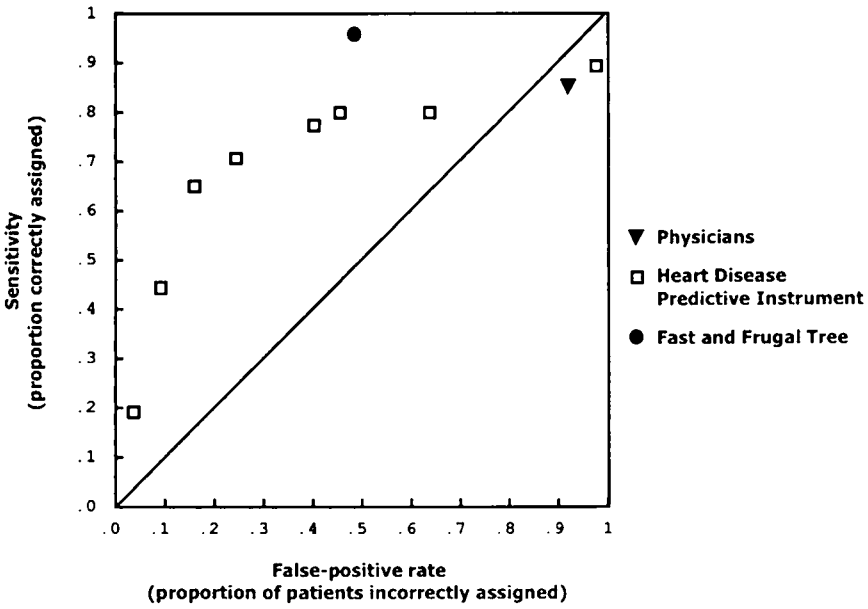
which includes two aspects: The decision strategy should have (a) a high sensitivity, that is, it should send most of the patients who will actually have a serious heart problem into the coronary care room; and (b) high specificity, that is, it should send few patients into the care unit unnecessarily. Being able to make a decision fast is a second criterion, which is essential in situations where slow decision making can cost a life. A third criterion is frugality, that is, the ability to make a good decision with only limited information. The second and third criteria are not independent, and the fast and frugal tree is, by design, superior in both of these aspects to the HDPI decision-support system, as may be physicians' intuition. A fourth criterion is the transparency of a decision system. An accurate system is worth little when it is not accepted. Unlike logistic regression, the steps of the fast and frugal tree are transparent and easy to teach. But how accurate is one-reason decision making? Would you want to be classified by a few yes-or-no questions in a situation with

such high stakes? Or would you rather be evaluated by the HDPI, or perhaps by physicians' intuition?

Figure 1.3 shows the performance of the three forms of decision making. On the *Y* axis is the proportion of patients correctly assigned to the coronary care unit, as measured by a subsequent heart attack. On the *X* axis is the proportion of patients incorrectly assigned. The diagonal line represents chance performance. A perfect strategy would be represented by a point in the upper left-hand corner, but nothing like that exists in an uncertain world.

As one can see from the triangle, the physicians' initial performance turns out to be at the chance level, even slightly below. The HDPI did

Figure 1.3
Coronary care unit decisions by physicians, the Heart Disease Predictive Instrument (HDPI), and the fast and frugal tree. Accuracy is measured by the proportion of patients correctly assigned to the coronary care unit and the proportion of patients incorrectly sent to the unit. Correct assignment is measured by the occurrence of myocardial infarction. Physicians' initial performance is represented by the right point, and their performance after they encountered the HDPI for the first time is represented by the left data point, which shows a smaller false-positive rate. An ideal diagnostic instrument would be represented by a point in the upper left-hand corner, but in the real world, no such performance exists.



Source: Based on Green & Mehr, 1997.

much better than the physicians' intuition. Its performance is shown by the open squares, which represent various trade-offs between the two possible errors.

How did the fast and frugal tree perform? The counterintuitive result is that the fast and frugal tree was more accurate in classifying actual heart attack patients than both the physicians' intuition and the HDPI. It correctly assigned the largest proportion of patients who subsequently had a myocardial infarction into the coronary care unit. At the same time, it had a comparatively low false-alarm rate. Note that the expert system had more information than the smart heuristic and could make use of sophisticated statistical calculations. Nevertheless, in this complex situation, less is more.

The potentials of fast and frugal decision making are currently being discussed in the medical literature, and some medical researchers see in it a powerful alternative to the prescriptions of classical decision theory for patient care (Elwyn, Edwards, Eccles, & Rovner, 2001). The crucial question is, when does simplicity pay and when does it not?

WHEN LESS IS MORE

How can it be that a heuristic that ignores information and forgoes computation can be not only faster, more frugal, and transparent but also more accurate? A comparison between the logistic regression (HDPI) and the fast and frugal tree can help to understand the secret of less is more.

Consider the error-free case in which a decision strategy can classify all objects correctly, that is, where a point in the upper left-hand corner of Figure 1.3 exists. In an error-free world, what is the relation between a fast and frugal tree and a logistic regression? The answer is: If an error-free fast and frugal tree exists in an environment, then an error-free logistic regression always exists as well (Forster, Martignon, Masanori, Vitouch, & Gigerenzer, 2002; Martignon, Vitouch, Takezawa, & Forster, 2003). But can one prove the converse, that for each logistic regression there exists a fast and frugal tree that is error-free, or equally accurate? This is not the case. Thus, although this analysis shows that in the error-free case, some fast and frugal trees can be as accurate as logistic regression, it cannot explain *why* they are more accurate. For this, we need to look at more realistic situations in which error-free decision making is impossible.