CHAPTER 19

Systems Theory

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A system is a bounded set of interrelated components. Systems theory is somewhat of a paradox within sociological theory. It is venerable, yet continues to arise in new forms such as complexity theory or second-order sociocybernetics. It was considered by many to be the backbone of 1950s macrotheory, but remains largely unknown or an enigma to the newest cohort of sociologists. A number of theorists who are not traditionally labeled as systems theorists use the term "system" quite extensively in their work (Coleman, 1964, 1990; Giddens, 1979). It is somewhat ironic that an approach that on the one hand is so current and so well-accepted on a superficial level (how many words are more familiar than "system" or even "social system"), is so scorned and misunderstood on a deeper level (Lillienfeld, 1978). There are a number of possible reasons for this paradox. It may be that its mere aging, and the fact that it was widely espoused by such 19th-century social theorists as Spencer (1892) and Pareto (1935) reinforces the notion that systems theory is obsolete, scientistic, or overly conservative (Collins, 1975).

INDICATORS FOR A SYSTEMS APPROACH

There are instances in sociological scholarship where a systems approach is indicated (or even mandated) and times when it appears less useful or is perhaps even contraindicated. Systems theory often is unnecessary when the goal is to correlate two or more variables for a single individual (for example, examining the correlation between education and income), which constitutes the bulk of current sociological research. Such studies using a random sample of individuals have little need for systems theory. This format roughly corresponds to Merton's (1949) "middle-range theory" in which the scholar formulates a theory that is sufficiently complex to yield explanatory power (but not so complex as to impede empirical investigation), and then formulates a research project to test this theory, usually with the individual as the unit of analysis.

Middle-range studies wed theory and data and they have the advantage of having a relatively high probability of successful completion. Such micro- and middle-range theories are necessary for sociological advancement but hardly sufficient. The studies are often rather

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specialized (even "piecemeal" from a systems perspective) and include a variety of familiar forms, such as case studies, various descriptive studies, ethnography, focus groups, surveys, experiments, and so forth. As important as these familiar modes of analysis are, they must be augmented with (but not supplanted by) modes of analysis that can be best described as global, integrative, large scale, comprehensive, complex, "grand theory," macro, and so forth.

The reason that the smaller studies are not sufficient as a mode of sociological analysis, even when aggregated, is because they can routinely exhibit a number of anomalies of various sorts (Kuhn, 1962). Writ large, we may define an anomaly as any unexpected or unsatisfactory result. This includes contradictory findings, inexplicable findings, unexpected findings, and disappointing findings, such as findings that fail to support hypotheses (for example, correlations that are not statistically significant). Such anomalous findings are not necessarily the result of flawed theory or flawed research design, but may occur with a valid theory and a well-designed research project if the scope of the project is simply too narrow and does not encompass the degree of complexity necessary to study such a complex phenomenon as society.

If anomalies or disappointing results of any sort are encountered during the course of the research, this may be an indication that the degree of complexity encompassed by the research design is simply insufficient. This may mean that the research design has to be expanded in as many as six or more ways, including increasing: (1) the number of individuals, (2) the number of variables, (3) the number of relationships among individuals (both linear and nonlinear), (4) the number of relationships among variables (both linear and nonlinear), (5) the number of macroconcepts, (such as societal integration, society–environment relationships, division of labor, and so forth), and (6) the number of instances when the focus of the study is the society *sui generis*.

Another point is that the dominant mode of contemporary sociological research, such as a small-scale survey or ethnographic study, is hardly the unique domain of sociologists. In fact, scholars from a variety of disciplines utilize this familiar research mode, including anthropology, social psychology, social welfare, geography, public health, political science, history, business, public policy, urban planning, market research, and other disciplines. While there is nothing wrong with sociologists working in this crowded arena, it does not justify their almost total exclusion of studies of a more complex nature as just described. In fact, a harsh critic might almost describe the paucity of studies of social complexity as sociological malfeasance, as sociologists are eschewing the area of research where they are seen to have the most expertise of any scholars (if not a unique mandate) and are engaging instead in the crowded arena of small- or midrange research, with the individual not only as the basic research unit but as the focus of ultimate interest.

Why is there such a reluctance on the part of sociologists to study the society *sui generis*, as advocated so long ago by Durkheim (1951)? Some of it is probably simple force of habit: doing that they have always done. Some of it is surely convenience and conformity. The "mainstream" study is safe, rewarding, and has a fairly high probability of completion. Some of it is undoubtedly the lack of a role model. How, indeed, does one study a whole society? How likely is it that such a study can be successfully completed? What tools are needed? What are the rewards for such research? Probably many contemporary sociologists are rather unsure about the answers to such questions.

Introductory sociology texts (see Gregory & Bidgood, 1939)) were much more comprehensive decades ago, when the society being studied was less complex. Newer introductory texts are considerably less complex, now that the society is more complex. What is the sense of

this? Until sociologists utilize complex modes of analysis to study complex societies, their work is open to criticism that it is superficial, tangential, piecemeal, and incomplete. Macrotheory offers the chief hope for the adequate study of complexity, and a macro social systems model is well-suited to the study of contemporary societal complexity.

My assessment of sociology is harsh. I do not believe that sociology can permanently defend a practice of limiting its work largely to the study of surveys done on a random sample of individuals. Nor do I believe that it is adequate to view society chiefly as a cultural phenomenon emanating from the interaction of individuals. I think that at some point it is inevitable that sociology must confront the need to allocate at least a portion of its resources to the analysis of the complex modern society *sui generis* (Durkheim, 1933, 1951), even if this task seems daunting, is prone to failure, and is devoid of an easy pathway to success.

This is not to say that all microsociologists must be transformed into macrosociologists, but only that in addition to its legions of hyperspecialists, sociology must count among its numbers some scholars who are willing and able to study holistically the complex modern society, all of its parts, all of its internal relations among its parts, and all of its external relations with other complex societies. Until this is done, sociology cannot claim to be the study of society, only the study of some parts of society.

Some might see this as a plea for theory rather than survey research, or for structure rather than agency. In reality, it is merely a suggestion that sociology, while continuing its current emphases on specialized studies, agency, culture, and other phenomena, also should reconsider the analysis of some long-neglected macrosociological topics such as complexity, societal differentiation, societal integration, the division of labor, technology, information processing, energy processing, and so forth.

In 1949, middle-range theory was perhaps an appropriate prescription for the ills of sociology. Many sociologists felt caught between the extremes of small-scale descriptive studies and grand theories. There was no good intermediate approach, and so middle-range theory was appropriate. It was the time for specialized studies. Now some 50 years later, specialized studies threaten to choke sociology with fragmentation. The challenge now is to study the complexity of modern society. I will first lay out the challenges that confront us and that specialized or middle-range theories are ill-suited for. These include the study of internal and external linkages, both vertical and horizontal, as well as the explication of boundary problems (including the insider–outsider dilemma), and an array of other epistemological issues. I will next review the extant sociological systems theories and will close with a recommendation for the future.

THE TASK AT HAND: THE CHALLENGE OF COMPLEXITY

The complex society is a multilevel system, with layers of both vertical and horizontal internal subsystems, and is subject to both vertical and horizontal internal differentiation and integration, all occurring within systems boundaries. In addition to nested vertical differentiation such as individuals, groups, and organizations, a society contains varied degrees of horizontal differentiation, with links among the various entities. For example, each group must relate horizontally to other groups, and individuals must relate horizontally to other individuals. In addition, entities at each level relate vertically to entities at other levels (e.g., individuals deal with groups, and groups with organizations). Thus, I am proposing that sociolo-

gists need to study the stuff of society—individuals, groups, organizations, and so forth—not separately, piecemeal, or even sequentially, nor in a specialized fashion, but rather in terms of all their possible interrelations (both vertical and horizontal, internal and external) with each other. Sociological systems theory has attempted to deal with these broad issues, but unfortunately past efforts made some mistakes that led to intense criticisms.

Past Mistakes

Sociological systems theory had its roots in 19th-century thermodynamics (Clausius, 1879) and was introduced into sociology by Spencer (1892), Pareto (1935), and others and subsequently was widely adopted by Parsons (1951) and others. Unfortunately, while systems theory was popular (at least in some circles) for almost 100 years, it endured a great deal of criticism in a number of areas.

Equilibrium. The notion that a social system was routinely in equilibrium unless disturbed by external forces and would return to equilibrium after a brief period was popularized by Pareto (1935). He said that societies that were the victims of external disturbances such as earthquakes or short wars in rich countries would return quickly to equilibrium (assuming that the forces that caused equilibrium in the first place remained intact). The concept of social equilibrium evinced strong criticism within sociology. Critics charged that equilibrium models favored the status quo, so that social change was seen basically as an aberration (Lockwood, 1956; Gouldner, 1970). Thus, critics charged that systems models were inadequate for the study of social change. Parsons (1961) and others reacted to their critics by attempting to defend and repair equilibrium models. Repairs were attempted by substituting some allied concept such as moving equilibrium, homeostasis, or steady state, but ultimately none of these mechanisms were able to satisfy critics (Bailey, 1990).

The reality was that as a physics concept, the concept of equilibrium was simply applied inappropriately in sociology. Thermodynamic equilibrium does not constitute a desirous state of social equilibrium at all, but rather is a state of maximum entropy (dissolution, or system death), as Spencer (Duncan, 1908) learned to his chagrin many years ago. Further, even if the equilibrium concept were appropriate, it was never adequately defined or operationalized in mathematical terms in sociology (Russett, 1966). In retrospect, from the standpoint of a pure systems perspective, the social equilibrium concept proved to be a giant red herring and an embarrassment. As applied in sociology, it was never appropriate, never successful, and in the end, never necessary. Modern systems theory does not rely on an equilibrium model.

Ideology. The emphasis on equilibrium favored the status quo. This, among other things, led to the criticism that not only is systems theory conservative by nature but that systems theorists themselves are politically conservative (Collins, 1975). Modern nonequilibrium systems theories do not have the same emphasis on integration that equilibrium theory had and are quite conducive to the study of social change (Rhee, 1982). Modern systems theorists span the range of political ideology, from liberal to conservative.

Abstraction. Social systems models, along with other "grand theory," have been criticized for being overly abstract or for neglecting the study of human activity, as evidenced by Homans' (1964) famous plea for "Bringing Men Back In." It seems that the pendulum has swung sufficiently to justify the reverse plea and issue a call to "bring society back in."

Difficulty in Testing. A fourth criticism is that systems theory often is insufficiently tested. Again, this is a more general critique that can often be applied to macrotheory as a whole and not just to systems theory. It is true that as one gets above the limits of "middle-range" theory that testability does become more difficult. The goal for macrosystems theorists is to design theory with testability in mind to generate testable hypotheses (Bailey, 1994; Miller, 1978) and to resist the temptation to draw a discrete demarcation line between "theory" "and research."

The Unit of Analysis. A legitimate debate arises over the proper unit or "component" for systems analysis. While many see the concrete human individual as the logical unit of systems analysis, others see the "act" or social role (Parsons, 1951) or the communication (Luhmann, 1986) as the proper unit. In reality, there is no one correct unit. It is possible to choose different units in different instances, as long as one realizes that these can define radically different systems. For example, Parsons (1979) recognized that the concrete individual is the "ultimate" systems unit but rejected the individual as the unit of the social system in favor of the role.

Other criticisms could probably be made, but these are some of the principal ones. In retrospect, it is clear that none of these are fatal flaws or even particularly damning for modern complex social systems theory. Some of these flaws are generic to "grand theory," and thus are applicable to most macrotheories. Clearly there are trade-offs with microtheory. Macrotheories (including systems theories) have flaws such as lack of manageability and lack of testability, are expensive and time consuming to conduct, and perhaps have uncertain probabilities of success. On the other hand, microtheories have their own flaws. They may be insufficiently complex, sometimes deal with simplistic issues, may be fraught with anomalies, or may simply leave critics with a general feeling of inadequacy. The obvious answer is to work with both micro- and macrotheories and to emphasize their integration (Alexander, Giesen, Munch, & Smelser, 1987).

THE COMPLEX SOCIETAL SYSTEM

The basic definition of a system is a (bounded) set of interrelated components, such that change in one component of the system initiates change in other components of the system. The exact nature of the subsequent changes is determined by the particular nature of the relationship, such as its strength of relationship, whether it is linear or nonlinear, and so forth. While the internal components of the system are highly interrelated, they are less related (or even uncorrelated) with the environment outside the systems boundaries.

The system may be a closed system that is entirely shut off to flows from the environment, or alternatively can be an open system that is open to flows of information and energy from the environment. In classic structural–functional systems theory, each internal component (subsystem) had a function that it performed to ensure the survival of the system (society) as a whole. If the subsystem failed to perform its function and if this function were not then subsequently picked up by another subsystem, the equilibrium and stability of the entire system, or perhaps even its very survival, would be at stake.

Systems exist at many levels, so the first task in social systems analysis is to decide what is the basic system that we wish to study. If one has a micro-orientation, the basic system of interest could be the individual, dyad, small group, and so forth. For our purposes, we consider it axiomatic that the basic system of interest for sociology is the holistic society *sui generis*,

generally operationalized as a politically bounded nation. The society is a fundamental unit. It has a certain degree of systemic autonomy, yet it has relations with other systems. In addition to this external focus, involving relations with other societies or even with smaller external units (such as corporations) or larger global units (such as the United Nations), there also is an internal focus of interest. This internal focus reveals a wealth of complexity in a large contemporary society such as the United States.

The internal complexity of a large society like the United States is so great that the systems model is the clear choice for analyzing it. Any narrower or more-specialized model quickly gives short shrift to the analysis of all salient internal societal features. Even with a far-reaching model such as the systems model, the researcher generally will be unable to simultaneously analyze all the salient internal features of the society, and thus will be forced to be selective and make some difficult choices as to how to frame these internal components. One alternative is to simply omit entire sections of the society from the analysis. We will reject this alternative as a distinctly "unsystemic" approach that would quickly lead us to the sort of narrow, piecemeal model that we are trying to avoid. If we seek comprehensiveness, we dare not leave portions of the society out of our analysis. The best alternative is to frame the whole of the internal society, but to delete some precision from the analysis (if we find that the fully comprehensive systems analysis is simple unmanageable).

Vertical Levels

For example, assume that we examine the vertical structure within a given society and identify (following Miller & Miller, 1992) the following levels: the societal level, the community level, the organizational level, the group level, and the individual level. The traditional (nonsystems) sociological approach is to study each level separately, in a piecemeal fashion. That is, one sociologist specializes in organizational analysis, while another studies small groups, and yet another conducts surveys on individuals. While we could give lip service to integrating these disparate studies at some point in time, the reality of this occurring successfully seems quite low.

The systems alternative to this problem is quite different. Rather than making the analysis manageable by limiting it to one narrow (but isolated) specialty, we prefer to frame the model so that it encompasses (and has the potential for recognizing) all these internal vertical levels, including even those that we might not yet be aware of. This is done by simply drawing wide boundaries for our model. Then, after all the levels are specified, the researcher can analyze them in the greatest degree of complexity that he or she can manage, given constraints of time, funding, and so on. For example, for our purposes here, we will focus on the internal vertical levels of the individual, group, and organization. The other levels remain in the model and we can return to them as needed.

Horizontal Links and Boundaries

In addition to the vertical levels, the complex society is replete with horizontally bounded entities within each level. The bounding for most of these entities is rather straightforward. For example, a business can be legally defined as an operating entity and also can have a spatial location that provides boundaries. Thus, "Roy's Bakery," with a total of seven employees, is a clearly delineated group comprising the seven persons who work daily in a set

physical location. Such entities can grow by division (starting another branch at a different location) or by aggregation (hiring another employee).

A more difficult group-bounding problem for systems theory (and really, for sociology as a whole) is the problem of deciding who the members of social groups or institutions are. The problem is basically a tautology: a group member is a person who is a member of the group. That is, groups would like to define themselves totally in terms of what they are, but this is basically tautologous (Luhmann, 1986). What is a scientist? That is a person who studies science. But what is science? That is what a scientist studies. So, groups must clarify their identity by defining themselves not only in terms of what they are but also in terms of what they are not (Luhmann, 1989). Thus, science is defined not only by what it is but also by what it is not. Members (scientists) are adamant about labeling aspiring members such as astrologers as nonscientists (and thus nonmembers).

Among the institutions that are very sensitive about protecting their boundaries are key institutions such as law, medicine, science, religion, education, and so forth. All these subsystems are vigilant in protecting their membership. Luhmann (1986) refers to such institutions as "differentiated function systems." This terminology indicates that the subsystem has matured to the degree that it exhibits functional autonomy, although operating with the context of the larger society.

In Luhmann's (1989) theory, binary coding plays a key role in boundary establishment and maintenance. Since the group cannot define itself in terms of itself, as this is tautologous, it must establish binary categories (a member and a nonmember). While pervasive in society, these dichotomies are themselves logically inadequate, as they result in a paradox. "A member is a person who is a member" is a tautology. But, "A member is not a nonmember" is a paradox, because a member cannot exist without a nonmember to define it and a nonmember cannot exist without a member to define it. The problems of tautology and paradox are illustrated by self-reference theory and are represented by the huge volume of binary coding in complex society.

Thus, the complex society is seen to be composed of many subsystems that can be identified both vertically and horizontally. The potential number of internal links is simply the number of links between all subsystems, both among and within levels, and is a very large (but finite number). In addition, all internal entities have potential links, both vertical and horizontal, with a large number of other external systems (societies) and with all of their internal components.

These links, whether vertical or horizontal, external or internal, are chiefly conduits of energy or information, or both. In previous centuries, the emphasis was on the challenge of successfully moving large energy sources, such as raw materials for industry. The successful movement of raw materials fostered the industrial revolution. In contemporary complex society, emphasis has shifted to the development of technology for information transmission and storage. Information links are increasing rapidly, not only in number, but also in speed of transmission. This revolution means that impacts, particularly global financial impacts, now can be almost instantaneous. Thus, if one country in a region suffers a financial calamity such as a currency devaluation, its neighbors best have their own financial houses in order, for the vast array of external and internal information links, both vertical and horizontal, means that the speed of the external impact on their own internal financial affairs leaves little time for extensive planning.

Societal Boundaries. Why are societies increasingly vulnerable to external impacts, such as financial crises? Is it because their boundaries are more easily penetrated by new

information-processing technology, or simply that their boundaries have always been vulnerable but the extreme speed of new technology exposes boundary weaknesses? Obviously, both are true to some extent. The analysis of societal boundaries incorporates much of the analysis of group boundaries just discussed but requires some additional discussion as well. A social system boundary is a demarcation that distinguishes the system from its environment. If a system were indistinguishable from its environment, then boundary placement would be purely arbitrary. Generally, however, a boundary represents a break (perhaps a sharp break) in entropy levels, with entropy being higher externally (outside the system, or in the environment) than it is in the system. This is an example and of course is not always the case, as this depends to a certain extent on the location of the observer.

Entropy is the degree of disorder in the system. Humans fix societal boundaries in a reflexive manner (Bailey, 1990, 1994). They post a boundary (sometimes for an important reason, but sometimes arbitrarily or out of convenience or necessity) and then reflexively react over time in a way that will lower the internal entropy within the system, as via the process of autopoiesis (Luhmann, 1986). The system defines the boundary and then the boundary subsequently defines the system. After a boundary is fixed and defended, the internal order is developed within the system through work, which consists of the expenditure of energy. This expenditure of energy must be increasingly guided by information in complex society, so that the outcome of the work is nonrandom (orderly). Random work conducted through ignorance (and without guidance by the most current information available) will not result in an optimal reduction of system entropy.

The best way to determine the existence of a system boundary is to compute entropy levels on both sides of the boundary. Since a boundary is by definition an entropy break, the entropy levels will be significantly different on different sides of the boundary. If entropy measurement cannot be done, then the easiest clue to the existence of a boundary is to look for breaks in energy and information flows, such as security measures. A similar clue is in coding, as in the 128-bit encryption used in computer security to protect financial information on the Internet. Any time a significant system boundary is crossed, it is necessary to recode a certain amount of information (e. g., money, language). Another clue to the existence of a boundary is the identity of persons on opposing sides of the boundary. If persons refer to themselves as insiders (us) and other persons as outsiders (them), then a boundary exists.

After determining the societal boundaries, the next step is to recognize the existence of a vast array of potential links (relationships), both within and between levels and internal and external. A given subsystem, be it an individual, group, corporation, or government entity, can have four basic kinds of links: internal–horizontal (e.g., a link between two corporations within the same society), internal–vertical (e.g., a link between a corporation and an individual within the same society), external–horizontal (e.g., a link between a corporation in one system [society] and another corporation in another system [another society], and external–vertical (e.g., a link between a corporation in one society and an individual in another society).

EPISTEMOLOGY

If one only considers the number of internal links (both vertical and horizontal) within a contemporary society, the degree of complexity is staggering, comprising perhaps billions of potential relationships. This challenging arena is the unique purview of sociology, as no other academic discipline has laid claim to it (although some other discipline may claim adverse

possession if sociology fails to act). Why have sociologists practically abandoned the study of societal complexity? There obviously are many reasons, some already discussed. One chief factor is that adoption of such a complex model represents a dramatic epistemological departure from the model of research extant in contemporary sociology.

The extant model, discussed previously, deals largely with a sample of individuals. Sociologists are accustomed to analyzing models to discover their underlying assumptions. Rarely do they examine carefully the consequences of a particular model. The current sociological model, with the individual as the chief unit of analysis, has one salient sequiter: it mandates the locus of power within the human individual rather than within some larger (macro) unit. For example, consider the typical sort of study, where a sociologist examines a random sample of individuals and finds a correlation between education and income. The locus of control is the individual. One conclusion is that if an individual wishes to increase his or her income, he or she will pursue additional education. The individual is assumed to have the power to alter his or her income (at least to some degree) in this situation.

A subtler exigency is that the extant sociological model demands not only individual power but also individual explanatory power. That is, a sociologist seeking an explanation of his or her findings can "fill in" an anomalous or incomplete explanation (e.g., can explain away a low correlation coefficient) by involving personal knowledge or experiences about individual-level affairs. Thus, one might find a sociologist studying "empty nesters" and "boomerang kids" (adult children who return to live with their parents) beginning with a sophisticated statistical analysis, but ending by repairing anomalies with homilies or by invoking his or her personal knowledge about "what teenagers are like," or "I know in my case, my son wanted to return home," and so on.

Epistemologically, the solution is much different for the mode of analysis in complex social systems theory. Here, the chief unit of analysis is the society *sui generis* (in all its holistic complexity). A chief sequiter from the model is that the individual does not have much control over the social complexity represented by billions of potential internal links that are processing energy and information. While some might find this model dehumanizing, I would say that it represents reality. It shows that individuals do exercise control, but only within the context posed by a high degree of societal complexity. Therborn (2000, p. 155) states the issue as a question. Is the world a system that directs the actors in it, or is it a stage upon which they act? I would of course answer that it is both, and Therborn (2000, p. 157) seems to reach basically the same conclusion.

A key component here is the role of the observer. The observer is an important element in reflexive sociology (Giddens, 1979, 1984; Luhmann, 1986, 1989; Bailey, 1997a). Systems theory has emphasized the role of the observer (Geyer & van der Zouwen, 1978; Marturana & Varela, 1980). Of particular importance is the second-order cybernetics focus on "observing the observer" (Luhmann, 1986). The role of the observer (including the researcher) is key to studying a system (or any social group). The observer not only has a role in the objectivity–subjectivity debate but also helps fix insider–outsider designations, fixes systems boundaries, and distinguishes the system from the nonsystem (environment), which often is a difficult thing for the system itself or its insider members to do.

We mentioned earlier the issues of tautology and paradox stemming from self-reference. Luhmann (1986) sees second-order cybernetics, as discussed below, as the greatest hope for resolving these issues in sociological systems theory. An internal observer that is observing or defining himself or herself (an insider) is in a very different position from an external observer who is observing the same system (an outsider), or is observing another observer in the process

of observing his or her own system, and so on. Of course, second-order observation is only one link in an infinite chain, and *n*-order observation just as easily can be envisioned (Bailey, 1997a, 1998).

Insider–Outsider

While some scholars might view the insider–outsider issue as merely a facet of the group membership issue discussed previously, I see it as a deeper epistemological issue and so I decided to explore it here. It is not simply a boundary issue or a membership–nonmembership issue but involves vertical power relations and dominance issues as well. The insider–outsider issue is epistemologically difficult for sociology, partially because the extant middle-range formulations are ill-suited for dealing with the origins of the insider–outsider dilemma. Small-scale studies in homogeneous societies can largely skirt this issue, as can holistic or global studies. It is primarily middle-range studies that leave themselves most open to the vagaries of insider–outsider claims.

The insider–outsider dilemma stems from the ubiquitous practice of closed binary coding in the complex society, as discussed previously. I think that the only solution is to formulate multichotomies (within the context of the complex system), rather than relying on perpetually inadequate dichotomies. The dyadic member–nonmember distinction is internally closed, as will be discussed later. Dichotomous boundary formulation (member–nonmember) is deceptive, as it is so familiar that it can appear to be "natural" when it is really being imposed (perhaps arbitrarily) by a dominant insider.

For example, many Americans would probably accept the familiar "heterosexual–homosexual" distinction as a "natural" dichotomy of sexual preference. Unfortunately, this distinction is quickly seen to be anomalous, as it does not provide a category for the increasingly visible designation of "bisexual." Adherents of the heterosexual–homosexual dichotomy face a crisis in the form of a bisexual liberation movement, as they fear that their dichotomy will be deposed by the equally "natural" (but not so familiar) unisexual–bisexual dichotomy. In this new dichotomy, the distinction between heterosexuality and homosexuality has disappeared (as indeed these concepts have disappeared) as both are merged into "unisexual." This effectively usurps power from the previously dominant heterosexual group. Thus, some people (both heterosexual and homosexual) may take defensive measures, such as claiming that bisexuality does not really exist.

The only way that the anomalies of tautology (posed by unichotomous group membership definition) or paradox (posed by dichotomous group membership definition, and now standard) can be removed is by shifting the scope of the research to the society as the basic unit of analysis. Then, by analyzing the group as a subsystem within the larger context of the complex society, we allow for the analysis of multichotomous categories. Now, the locus of analysis rests not on the insider individual but on the society, so that the plurality of all social groups can be analyzed without contradiction and without the need to deny the existence of one or more groups (such as bisexuals or multiracial persons).

The insider–outsider dilemma is a classic example of an anomaly that is ill-treated with a middle-range formulation. Other examples of common anomalies in overly narrow sociological models often can be found by searching for unresolved debates or controversial issues. These often can be identified by looking for dichotomies with connecting terms such as "versus" or "or." Some common examples include the debates over free will versus determinism, structure or process, synchronic versus diachronic, agency or structure, abstract

versus concrete, and so forth. The central problem with all these is that they are formulated as dichotomies. For example, the insider–outsider distinction is hardly a dichotomy in a pluralistic society. There may be one insider (you) but hundreds of outsiders representing the plurality of groups within the larger society. In reality, complex societies have many insiders as well as many outsiders. Middle-range studies have difficulty representing them all, but complex systems theory comes much closer to providing a realistic rubric for their analysis.

Indeed, with a mere shift of scope from the individual or the middle-range study to the complex model, the entire insider–outsider anomaly largely (but not entirely) disappears. If the entire complex society (rather than the individual) is taken as the basic unit of analysis, then individual researchers (as well as individual research subjects) are all insiders as well as outsiders. That is, at the system level, all individuals are insiders, as they all reside within the system. At the subsystem level, as observed from the larger perspective of the society, all individuals are dual insiders and outsiders, as they reside within one subsystem and outside of another subsystem.

In our complex model the research focus is not on individuals and their study by either outsiders or insiders, but rather on the society as a whole as a research arena. That is, the focus is on the analysis of a huge amount of data conducted by countless researchers and stored in a computer in a fashion to be subsequently aggregated so as to effect macrological conclusions concerning the holistic complex society. Not only is complex systems theory sociology's best hope for avoiding self-destructive solipsism, it also is the best hope for avoiding not only legions of anomalies (such as those mentioned above), but also for avoiding the kind of unwitting change of scope (or Durkheimian fallacy, or ecological fallacy, see Bailey, 1990, 1994) that long has plagued sociology.

CONTEMPORARY SYSTEMS APPROACHES

Now that I have sketched some of the criticisms of past systems theorists and have examined in some detail the high degree of complexity that any systems model of the complex society must deal with, it is time to briefly review some of the extant systems approaches. Readers who have not kept abreast of the field may be surprised by the depth and breadth of contemporary approaches, such as soft systems theory, critical systems theory, world systems theory, functionalism, neofunctionalism, autopoietic theory, sociocybernetics, complexity and chaos theory, living systems theory, social entropy theory, and others. This list is not complete and obviously a full review is impossible here. We must be content with a brief sketch of the major features of some of the major approaches. The most visible approach has been functionalism. It is important for students of sociological systems theory to be familiar with structural–functionalism, but also to recognize that most of the contemporary approaches are not functionalist approaches. Since we already have discussed briefly functionalism in our review of the critiques of earlier systems models, we shall consider it again only very briefly in our discussion of contemporary approaches.

Functionalism

The most visible social systems theory has been the approach known broadly as structural–functionalism. This approach and its variants have been presented by a large number of scholars, most notably Parsons (1951, 1961), Merton (1949), and others (see Buckley,

1967, 1968, 1998). This approach continues to be visible in sociology in the form of neofunctionalism (Alexander & Colomy, 1990). Since neofunctionalism is represented in this volume and functional systems theory has been discussed and analyzed at great length (see Turner & Maryanski, 1979; Bailey, 1982, 1984, 1990, 1994), it is unnecessary to discuss it here in much detail.

Since there are many variants and applications of functionalism, it is difficult to summarize them all. However, from the standpoint of systems theory, the main points are clear. Functionalism emphasizes part–whole relationships. The social system is seen as a whole that incorporates a set of interrelated subsystems, such as institutions (education, religion, science, law, etc.). A central notion (as discussed earlier) is that the interrelated internal parts interact over time (function) in a manner that ensures the survival of the system. Systems can be classified as either open (allowing exchanges with the environment) or closed (not allowing such changes). Social systems are said to be open systems.

While functionalists in reaction to their critics stressed that the social system is adaptable and amenable to change, nevertheless the bias toward integration and stability was clear. The function of each subsystem separately (and in concert) was to ensure the survival of the society. If one subsystem was impaired, since all were interrelated the others would react to compensate for the loss of function in the ailing subsystem. Thus, the internal cohesion of the system was maintained over time. This coherence was variously represented by equilibrium, homeostasis, or a steady state (Bailey, 1990, 1994). If equilibrium were disturbed (usually by external forces), it would be restored through the internal changes of the interrelated subsystems, usually within a short period of time. That is, as long as the original forces that achieved equilibrium remained, external disturbances would soon be rectified (Pareto, 1935).

As discussed previously, writers soon decried the inability of the system to respond to change, since equilibrium presumed a return to the status quo. There were charges of conservatism and a bias toward integration, with deemphasis on societies that were undergoing a revolution or societies that had disappeared altogether. Further, critics said that equilibrium was a physics concept that was inappropriately applied to sociology and that equilibrium was vague, not properly operationalized, and not subject to empirical test (see Russett, 1966).

While the bulk of the criticism of functionalism came from critics who were not systems theorists, some systems theorists also were unhappy with some of the tenets of functionalism. In particular, Luhmann (1986) was critical of the part-whole emphasis and with the overly simplistic closed–open systems model. While his own subsequent systems approach (Luhmann, 1995) dealt with both parts and wholes, it dealt with them in a much different way. Luhmann (1986) did acknowledge of course the relation between parts (differentiated function subsystems) and the whole society, but he focused primarily on the boundary and relations with its environment. This approach was rather unique in systems theory in terms of the amount of emphasis he placed not only on system–environment relations, but also on subsystem–environment relations. This protects the autonomy of the subsystems and emphasizes their role in dealing with the environment in a manner that is not only distinct from but different from system–environment relations.

Functionalism did systems theory (and sociology) a great service by emphasizing the holistic analysis of the social system. As the dominant theoretical paradigm of the 1950s and 1960s, functionalism was invaluable in keeping sociology focused on macrotheory. Its limitations were that it depended too heavily on the 19th-century equilibrium model of Pareto (1935), which was based largely on the study of isolated (closed) systems in thermodynamics. If systems theory is to be successful, it cannot continue to look inward to such an extent that internal relations are emphasized at the expense of internal-external relations. In order to get

from the model of equilibrium-based classical functionalism to the externally-directed model of social complexity, sociological systems theory must make three main shifts away from classic functionalism:

1. Nonequilibrium. Analysis of social system internals must shift from an equilibrium model to a nonequilibrium model.
2. Control. There must be a shift toward explication of decision making and control, as in Miller's (1978) emphasis on the decider as the most important subsystem. Classic functionalism relied so heavily on equilibrium that return to the status quo was considered almost automatic, and this precluded the necessity to explicate how and where decisions regarding system control are made. It is very important to acknowledge and analyze the exercise of power (at all levels, individual, corporate, governmental, etc.) within the complex social system.
3. Internal–external relations. There must be a shift away from the overly simplistic open–closed dichotomy and toward a more sophisticated model detailing the complex interplay between internal systems components (at all levels) and the external environment.

Fortunately, recent trends in sociological systems theory have approximated these needed shifts. This is fortuitous, as these shifts have occurred without the guidance of an overarching paradigm to replace functionalism and in the context of waning interest in sociological systems theory. With so few sociologists currently identifying themselves as systems theorists (particularly in North America), it is amazing that the field continues to advance as it does. However, progress has proceeded apace in a number of areas. Although space precludes extended analysis, we can briefly discuss some of the chief areas of contemporary systems emphasis relevant to sociology.

General Systems Theory

The general systems theory (GST) movement (von Bertalanffy, 1956) has itself waned since its apex in the 1950s and 1960s (roughly corresponding with the height of systems popularity in sociology) and ironically also has faced fragmentation in the form of a number of competing associations and internal specialization within associations. Nevertheless, there are still a number of associations like the International Society for Systems Science (ISSS) that do continue to foster the aims of integrative scholarship. GST seeks to identify commonalities across disciplines, so that generic systems principles can be identified, redundant or contradictory efforts can be minimized, and integrative systems research can follow. GST has been perhaps the most visible force for countering the increasing fragmentation and hyperspecialization that if carried to an extreme could trivialize research in many disciplines (not just sociology). In addition to carrying the symbolic banner of academic integration, GST has been notable for a number of other achievements. Space precludes extended discussion of all of these, so I will focus on the first recent trend noted above: the shift from equilibrium to nonequilibrium models.

While sociology clung strongly to its emphasis on equilibrium (Parsons, 1951) in spite of mounting criticisms and evidence that the application in sociology was inconsistent with the concept of equilibrium in thermodynamics, GST was instrumental in adopting entropy rather than equilibrium as the basis for a systems model applicable to social science and biology. GST faced a dilemma in attempting to integrate social science and thermodynamics, as the second law of thermodynamics dictates that in an isolated system, entropy will increase over

time until it reaches a maximum (equilibrium). But equilibrium is essentially a state of dissolution rather than its opposite—a state of maximum cohesion or integration—as envisioned by equilibrium theorists in sociology. It was clear that social systems such as bureaucracies did not fit the second law, as they tended to grow increasingly complex (orderly) over time rather than more disorderly. Was it possible that the second law was incorrect? This loomed as a major anomaly until Prigogine (Prigogine, 1955; Prigogine & Stengers, 1984; see also von Bertalanffy, 1956) demonstrated that while entropy increases inexorably in a closed system (such as the isolated heat bath studied in thermodynamics), in an open system the exchanges with the environment can result in decreasing entropy that is sufficient to compensate for the internal increase of entropy. This explains how vast bureaucracies can arise in apparent contradiction of the second law.

Another development that has contributed to our first trend (the shift from equilibrium to nonequilibrium models) is synergetics (Haken, 1983; Weidlich & Haag, 1983). Although Haken does not seem to identify himself too closely with GST, synergetics does contribute to the trend of emphasizing entropy rather than equilibrium. Haken moves from entropy analysis in isolated thermodynamic systems to entropy analysis in self-organizing systems that may be far from equilibrium, such as biological or social systems.

While synergetics is quite quantitative, another development within the grand rubric of GST is so-called "soft systems theory." This is an approach to organizational analysis that is decidedly less quantitative than many systems approaches. It was developed in England by Checkland (1994). The existence of soft systems theory, as well as critical systems theory (Flood & Jackson, 1991), is probably a surprise to many sociologists who stereotype the systems approach as being positivistic, conservative, or even "scientistic."

Still another notable development within GST is living systems theory (LST), as developed over a number of years by an interdisciplinary group led by Miller (1978; Miller & Miller, 1992). Miller provided much of the detailed concrete analysis of systems internals that can aid in the analysis of the processes of control and decision making. Miller (1978; Miller & Miller, 1992) specified eight levels of living systems analysis (cell, organ, organism, group, organization, community, society, and supranational). He also specified 20 subsystems that process either matter–energy or information, or both. The reproducer and the boundary are dual subsystems that process both matter–energy and information. The eight matter–energy-processing subsystems are the ingestor, distributor, converter, producer, matter–energy storage, extruder, motor, and supporter. The ten information-processing subsystems are the input transducer, internal transducer, channel and net, timer, decoder, associator, memory, decider, encoder, and output transducer.

Miller's schema provides for the comprehensive analysis of all 20 subsystems at all eight levels. In particular, it provides for the detailed analysis of information processing. By presenting a framework for analyzing the complex network of energy and information flows, LST sets the stage for developing a modern theory of systems complexity. LST is notable for choosing the concrete individual as the basic system unit (a concrete systems in Miller's terminology) rather than the social role (an abstracted system in Miller's terminology) as did Parsons. Parsons continues to oppose Miller on this even in one of his last publications before his death (Parsons, 1979), contending that concrete systems analysis was insufficient for the study of the social system.

Among the latest developments of a general systems nature are chaos theory and complexity theory (although some of their proponents may strongly resist any association with the old GST model). Complexity theory shares some of the same goals as earlier systems movements, except that it is more quantitative and seems somewhat less general. Its activities are centered largely (but not exclusively) around the Santa Fe Institute and many of its

adherents are from scientific fields such as physics, biology, or mathematics (but with some interest from sociologists and others; see Eve, Horsfall, & Lee, 1997). A chief concept in complexity theory is the notion of the complex adaptive system (CAS). Somewhat ironically, one of the earlier publications on this topic was by a sociologist (Buckley, 1968, 1998).

Gell-Mann (1994a) defines a complex adaptive system, such as a society, as a system that acquires information about the environment and its own interaction with it. It further identifies regularities in this information, condenses these regularities into a "schema" or guide model, and uses this information to guide its activities in the real world. Complexity theory contributes to the first shift (from equilibrium to nonequilibrium models) by emphasizing entropy. It also contributes toward the third shift (toward the analysis of system–environment relations) by focusing on the manner in which the system adapts to its environment through information processing. For further discussion, see Bailey (1997b), Gell-Mann (1994a,b), Casti (1994), Holland (1995), Gleick (1987), and Goerner (1994).

The second necessary shift in sociological systems theory is toward increased specification of internal decision making, power, and control processes. We saw that LST (Miller, 1978) contributed significantly toward this trend through its careful analysis of information processing and its emphasis on the decider as the most important systems component. A second contribution has come from sociocybernetics, or the "new cybernetics" (Geyer & van der Zouwen, 1978, 1986). Growth in this area is significant, as evidenced by the fact that in 1998 the International Sociological Association (ISA) recognized "sociocybernetics" as research group 51.

As originally developed by Wiener (1948) and others, cybernetics was seen by many sociologists largely as a mechanical or "engineering" analysis of control systems such as thermostats, with limited applicability to sociology. Classic thermodynamics was responsible for disseminating a number of terms that are now commonly used not only in sociology, but in the larger lay language. These include "feedback loop" and "steady state." Unfortunately, these terms have been widely misapplied. The term "negative feedback" is certainly familiar to every American, but unfortunately is consistently misused. In cybernetics, a negative feedback (signified by a minus sign) in a loop serves to rectify a positive feedback (signified by a plus sign), leading to an overall steady state (equilibrium analogue) in the system. In common parlance it is used to indicate disagreement with a speaker's previous comment.

Recent developments are more fortuitous for sociological systems theory. Sociological systems theorists such as Geyer and van der Zouwen (1978, 1986), and Aulin (1986) have developed cogent sociological analyses based on cybernetics. This new sociocybernetics moves beyond the machine imagery of early cybernetics to an actor-oriented approach somewhat reminiscent of the earlier work of Buckley (1967, 1968) and Parsons (1951). The new cybernetics emphasizes control, often denoted by the term "steering." One characteristic of the new sociocybernetics is that it views information as constructed and reconstructed by an individual interacting with the environment (the parallels with complex adaptive systems within complexity theory are striking). This provides an epistemological foundation for systems theory by viewing it as observer dependent. An important concept is second-order cybernetics, which essentially deals with "observing the observer" and has parallels with sociological work of a recursive or reflexive nature by Giddens (1979, 1984), Luhmann (1986, 1995), and others (see Bailey, 1997a, 1998). The work of Aulin (1986) also is important for an understanding of control issues within the social system. He makes the distinction between partial steering of the system from the external environment (power) and human self-steering action, which emanates internally.

The third major shift mentioned above deals with boundary relations. In particular, the shift must be from the simple open–closed dichotomy to a more sophisticated analysis of the relationship between internal system components and the external environment. A major

recent development in systems theory that has contributed to boundary analysis is autopoiesis (Maturana & Varela, 1980; Luhmann, 1986, 1989, 1995). Autopoietic systems are self-reproducing and self-organizing. Self-reproduction means that they possess internally the means for their own reproduction, or that the system produces the processes that produce the system. This theory was developed chiefly by Maturana and Varela (1980) for cellular self-reproduction, and there is widespread consensus that the theory holds at the level of the cell.

However, there is a continuing debate over whether social systems are autopoietic. Maturana and Varela themselves leave the situation unresolved, saying that humans are autopoietic and so human society forms the context for autopoiesis (and has autopoietic components), but they stop short of saying that the social system itself is autopoietic. Some scholars such as Mingers (1995) are rather adamant in stating that social systems are not autopoietic, while others such as Robb (1989) say that they are. For further discussion, see Bailey (1994, 1998). This debate centers largely around a prior debate over the proper unit of systems analysis. Mingers (1995) argues that the unit of the social system is the human individual and that humans reproduce themselves, not social systems. In contrast, Luhmann (1986) rejects the individual, the act, and the role and designates the communication as the basic system unit. He says that societies are definitely autopoietic, as communication does self-reproduce continuously. An utterance immediately disappears as soon as it is uttered and must be continually self-reproduced by the society.

A key feature of autopoietic theory is that the system is simultaneously both closed and open. That is, it is organizationally closed, in the sense that the internal self-reproductive loop is autonomous, but it is open to exchanges with the environment and with other systems. An important concept here is structural coupling, which refers to the relations between the autopoietic system and its medium (environment), which allows the system to maintain its autopoiesis. That is, through structural coupling the system selects those exchanges that foster internal reproduction and rejects those that would lead to internal disintegration (Maturana, 1978; Maturana & Varela, 1980). The role of the observer also is very important in autopoietic theory, with the observer able to operate as if he or she were external to the circumstances in which he or she finds himself or herself (Marturana, 1978, p. 31).

Luhmann (1986, 1989, 1995) has applied autopoiesis to sociology. He studied briefly with Parsons, and his theory still shows the functional influence, as in his discussion of the theory of functional–system differentiation (Luhmann, 1989, pp. 34–35). Luhmann's systems theory is extremely well-developed and extremely valuable. It clearly shows the value of mature systems theory for sociology and goes far beyond Parsonian functionalism. Unfortunately, it is not very accessible, particularly for scholars who do not read German. However, quite apart from the language, the theory is very dense and abstract and requires substantial effort on the part of the reader. Those willing to invest the considerable amount of time required to understand Luhmann's theory will find it very rewarding and to be time well spent.

Luhmann's systems theory is too massive, comprehensive, and cogent to present here without doing it a major injustice. For more discussion, see Bailey (1994, 1997a, 1998). I consider Luhmann's systems theory to be a masterful contribution, but it does have critics (see Mingers, 1995), particularly with regard to the choice of communication as the unit of analysis of the social system and the contention that social systems are autopoietic. The contributions are many but are not all well understood. This is probably due partially to the relative unpopularity of systems theory at the moment (particularly in North America) and the difficulty that readers have in mastering Luhmann's theory. Rather than attempt to discuss all these contributions in the short space available, I will focus on the contributions to the third theoretical shift discussed above: boundary relations (although it is clear that Luhmann contributed to the literature on all three theoretical shifts).

Luhmann is best known for his work on social autopoiesis, with the communication as the

unit of analysis. But even this internal analysis is set in the context of his abiding interest in system–environment relations. He says that society is environmentally open but operatively closed, with communication being its sole mode of observation. The environment cannot communicate with the society, as communication is an exclusively social operation. The environment can only make itself noticed through communicative disturbances (Luhmann, 1989, p. 79). Luhmann (1989, p. 12) poses the question, "How can a restrictedly complex society exist in a much more complex environment and reproduce itself?" The answer is greater system complexity. Greater system complexity is seen in the internal development of differentiated function systems. These differentiated function systems within the society (law, science, medicine, etc.) are reciprocally dependent: "Functional differentiation generates interdependence and an integration of the entire system because every function system must assume that other functions have to be fulfilled elsewhere. This is the precise purpose of the binary code" (Luhmann, 1989, p. 42).

Binary coding is critical in Luhmann's theory. Indeed, the code and the program for the code make possible the combination of closure and openness in the same system (Luhmann, 1989, p. 40). The internal code is always closed. That is, in binary coding, with two codes *X* and *Y*, *X* only refers to *Y*, and *Y* only to *X*, and no other values exist in the closed system. But the programming of the system brings in external data (Luhmann, 1989, p. 40).

A contemporary example of this is the recent development of public key infrastructure (PKI) technology for Internet security. This is a coding system (for example, with 128-bit encryption) that uses both a private key and a public key. The private key is in the individual computer user's system, which remains internally closed even during interaction with external parties. However, through interaction between the internal system and the external environment, through coding and recoding (encryption), and through dual use of the private and public keys, secure communication takes place, thus protecting information such as credit card numbers. An external party can communicate with you only by accessing the public key.

This example not only illustrates Luhmann's assertion that systems can be simultaneously closed and open but also illustrates a key to the continued development of the Internet. Unless individuals can be convinced that their internal closed communications regarding private data such as credit card numbers can remain secure, they will be unwilling to purchase over the Internet, thus stifling its further development. This is a classic example of the role of structural coupling in the maintenance of internal autopoiesis. The autopoietic system will allow those external interactions (such as encrypted interactions), which preserve its internal autopoiesis, but will reject those external interactions (such as interactions lacking PKI), which may threaten internal autopiesis by revealing internal financial information to non-authorized users.

As noted, much more attention has been paid to Luhmann's discussion of autopoiesis than to his discussion of coding. But coding is really the key to it all—communication, autopoiesis, boundary determination, and openness–closure—so students of Luhmann should pay particular attention to coding.

Social Entropy Theory

Functionalism performed a great service for sociology and for systems theory. It counteracted (temporarily) hyperspecialization, it emphasized macrotheory, and it delimited important part–whole relationships. But its weaknesses were evident, and eventually led to its demise. However, it is important that in critiquing functionalism we do not throw out the systems baby with the functionalist bath water. It was not systems theory (which in its skeletal form is quite general) that was flawed, but only specific features of functionalism (such as

equilibrium). The idea is not to abandon systems theory but simply to construct a systems theory without the flaws of functionalism (which can be done). The critical decision has to be whether functionalism can be merely repaired, or whether we should abandon it for a new model. In developing social entropy theory (SET), I made the decision to construct a new model (Bailey, 1990, 1994). I felt that the negative legacy of functionalism was so entrenched in sociology that any revision of it probably would be viewed with a persisting bias. It seems difficult to get some sociologists even today to realize that not all sociological systems theory is functionalism.

SET roughly uses the model of the complex society sketched above. I started with a search for the bare essentials of the social system (society). I began with the population (P) and the spatial (S) environment that the population occupies. Within this space, the society must use energy (as derived both from its internal resource base and from external exchanges) to do work, so as to maintain or improve its level of living (L). The society accomplishes useful work by organizing (O) itself in a manner that is efficacious for using the technology (T) and information (I) available to it.

These are the six key macrosocietal variables (PILOTS or PISTOL). They are all reciprocally interrelated, so that at a given time any one can be seen alternatively as a dependent variable (with the other five as independent variables), or as one of the five independent variables (see Bailey, 1990, 1994). If the social system can effectively organize within its boundaries to efficiently use its technology and information, then it can raise or maintain its level of living and can offset the inexorable increase of internal entropy. If the society does not do this, then entropy will increase.

GLOBALS, MUTABLES, AND IMMUTABLES. The PILOTS variables are considered to be global variables in SET, or purely macrosocietal variables, meaning that (with the exception of P) they can be measured with little or no information about characteristics of individuals. Thus, they are characteristics of the society *sui generis*, as distinct from societal characteristics that can only be computed by aggregating information about individuals. In contrast to the globals, we also can delimit some uniquely microproperties of individuals, such as race, sex, and age (birthdate). These are termed "immutable variables," as they generally (with a few exceptions) cannot be changed during the individual's lifetime.

In between the purely macrovariables (globals) and the purely microvariables (immutables) are the mesovariables (mutables). The mutables are a micro–macro link having essentially a dual micro–macro character. They can be measured at the microlevel as mutable properties of individuals that are amenable to change in value over the course of the individual's lifetime. Mutable variables are roughly equivalent to achieved variables, while immutables are roughly equivalent to ascribed variables. Common examples of mutable microcharacteristics of individuals (and their corresponding PILOT representations) are occupation (O), education (I), income (L), residence (S), and technological (T) proficiency licenses, such as a pilot's license.

In addition to the micromutable level, we can discover a macromutable level. The macrovariables are derived by distributing the population (P) across the other five global variables (ILOTS) to form five mutable distributions. These five mutable distributions are macroproperties, but they are analytically distinct from the macroglobal properties, as the mutables are aggregated from individual data, while the globals are not. Some examples of macromutable distribution measures would be measures of the occupational division of labor in a society (O), measures of the percentage of households with computers (T), measures of the mean income (L), and measures of the mean educational level (I).

Each individual is born with a particular set of immutable characteristics (sex, race, birthdate) and a particular position in the five-dimensional mutable space [family residence (S), family occupation (O), family income (L), family education (I), and family technological skills (T)]. Social mobility is achieved by changing one's position in one or more of these five mutable dimensions.

Consider a person wishing to change his or her position in the occupational mutable structure (O) by applying for a new job. This involves initiating a relationship between the prospective employer and the prospective employee. Each of these individuals has an initial perception of the other person. The relationship could be initiated through a personal visit (interview), and in this case the first impression would be achieved through direct observation of each other, and precedence would likely be given to important easily observed immutable characteristics such as age, sex, and race. Alternatively, the job search could be initiated, for example, over the Internet. The applicant could send his or her resume electronically. Here, the initial emphasis would likely be on the mutable characteristics emphasized in the resume, such as education (I), residence (S), prior organizational affiliations (O), and licenses (T).

The individual's locus of control can vary widely in complex society. A 19th-century farmer in the midwestern United States perhaps was substantially a subsistence farmer, having only minimal contact with other individuals. He or she was most interested in energy flows (as if a stream bringing water into his or her property was diverted by neighbors) and had few if any external links with entities outside the United States and relatively few internal vertical links. In contrast, the President of the United States now has a locus of control that involves directly (or indirectly through delegation of authority) millions of internal and external links, both vertical (mostly vertical within the United States) and horizontal (links with other countries).

Each individual acts within the social context provided internally within the society by the six global variables [the country's population size (P), wealth (L), educational level (I), etc.], the five-dimensional mutable distributions, and his or her salient immutable characteristics. Thus, while the six globals may be constant at a given moment for all residents of the United States, the various individuals living within the context provided by these six globals still have different social contexts and different mobility chances, due to their different positions in the five mutable distributions and their particular configuration of immutables.

For example, consider two persons at the same position in the five-dimensional structure (same residential neighborhood, same income, same occupation, etc.) but with different immutable configurations. Imagine that one is a young black female and one is an elderly white male. These two persons would have different social contexts, as would two persons with the same immutable configurations, but with radically different positions in the five-dimensional mutable structure. While different individual actors within the complex society have different specific configurations of immutables and mutables, all work (by processing energy and information) to accomplish their goals within a certain global structure (population size, etc.). The aggregate effects of all of these situated individual efforts, of all persons in the population, must be sufficiently orderly (as guided by the globals, mutables, and immutables) to ensure that internal entropy does not rise to unacceptable levels.

CONCLUDING REMARKS

Our discussion to this point has established a number of important facts. It has become abundantly clear that while the development of specialized approaches via middle-range

theory was desirous in 1949, by the same token, in 2000 we clearly again need an alternative to this extant model. We cannot stay stuck in the middle range while global complexity is exploding all around us. It is increasingly clear that the approaches of mid-20th-century sociology (including not only middle-range theory, but also equilibrium-based systems approaches) will no longer suffice. The goal is not to eliminate or even supplant existing approaches such as middle-range theories or even equilibrium models. Indeed, SET does not preclude the analysis of equilibrium when this is warranted, but does not rely on it (Bailey, 1990, 1994).

It is clear that narrow specialties have not adequately dealt with important issues such as boundary problems, the insider–outsider anomaly, information-processing across group boundaries, and so forth. Our brief review of contemporary systems approaches shows that they certainly have not solved all the problems of analyzing complex society. In fairness, they have barely begun the task. But to their credit they have at least been dealing with the issue of complexity, something that middle-range theories have largely failed to do and indeed are ill-equipped to do.

Ironically, while some sociologists might see a resurgence in sociological systems theory as a return to the past, a strong case can be made that to the contrary it is really a major step toward the future. Our example of the job search within the global, mutable, and immutable context shows that the complex systems model is a boon and not a bane for individual-level analysis. The complex systems model also will prove to be a viable framework for the synthesis of a number of important but isolated topics within sociology, such as the insider–outsider distinction and globalization. Globalization is an important (but undeveloped) concept that can benefit from the grounding provided by the complex systems model of society, as adequate grounding of this concept requires careful analysis of vertical and horizontal links, internal as well as external.

The world systems literature on globalization (Wallerstein, 2000) refutes the notion that systems theory is inherently conservative, as the world systems approach hardly has the reputation of being conservative. Further, as the article by Mato (2000) illustrates, indigenous people are currently recoding their external communications to include global terms such as biosphere, biodiversity, ecology, and so forth, so that they may foster viable external–vertical links of the type discussed above. The reason that an indigenous representative uses recoded neutral global jargon in external links is not through a wish to have his or her indigenous culture merged into a global "melting pot" culture, but the opposite—to save his or her indigenous lifestyle from the external invaders.

Mato (2000) noted that an indigenous leader of the Embera people of Panama had incorporated these expressions into his vocabulary through exchanges with representatives of nongovernmental organizations (NGOs) from both Panama (internal–vertical links in my terminology) and abroad (external–vertical links in my terminology). By adopting this external global "eco-jargon," the indigenous representative can use such language in the public sphere (the equivalent of the public key in PKI), while safeguarding the internal security and autopoesis (insider status) of all internal tribal communications. Tribal communications remain in the tribal (Embera) language (the equivalent of the private key in PKI), and thus are permanently closed to outsiders.

In addition to safeguarding the internal autopoiesis of Embera society, the act of recoding into the public eco-jargon provides acceptable meaning of Embera activities to Panamanian and foreign governmental and nongovernmental entities (internal– and external–vertical links). As this illustration shows, the complex social systems model is not inherently conservative or a hindrance to the understanding of such topics as insider–outsider relations and the inclusion of indigenous peoples, but can in fact be a valuable tool in the analysis of such phenomena.

This sort of coding and recoding occurs billions of times a day in the complex society and can be observed at virtually every group boundary within the complex society. The understanding of this coding phenomenon, as well as of other boundary phenomenon, is crucial to the analysis of the complex society. In fact, I would go so far as to say that until we understand how private (insider) keys and public (outsider) keys are linked through recoding or through various forms of symbolic encryption, we will not fully comprehend how groups can retain their identity within the complex society, or how the complex society itself operates. However, this boundary recoding is widely neglected in sociology, despite its obvious importance. This is simply because most specialized studies do not cross boundaries and so tend to miss the crucial coding and recoding phenomenon that occurs at the boundary.

Not every sociologist should be a systems theorist, but not all should neglect systems theory either. The complex society is too important, too intellectually inviting, and too encompassing for sociology to neglect. Although specialized studies of a small portion of the whole society are familiar and perhaps have a higher probability of success, we neglect study of the complex society *sui generis* (and its relations with other societies) at our peril. If we can find a way to aggregate piecemeal specialized studies of the type that are common in sociology today into a unified portrayal of the social whole, then this approach should be pursued.

I for one am skeptical of the success of this endeavor for a variety of reasons. The most obvious reason that the aggregation of specialized sociological approaches cannot succeed is because, as we have just discussed, each specialty is coded into its own unique jargon for consumption by its insiders. Aggregation would require the adoption of a public key in the form of an external jargon accessible to all specialized approaches. Such an external jargon does not exist. Its creation would require either the adoption of the jargon of one specialty by all specialties (probably an impossibility) or the invention of a new neutral language that all specialties would be willing to adopt (probably also an impossibility).

Similarly, if one could find an alternative to the systems framework that is adequate for the holistic study of the complex society *sui generis*, then this approach also should be pursued. However, a realistic view is that at the present time, viable forms of both alternatives are lacking. Thus, I invite you to join me in the systems analysis of complex society, not by default and not as an alternative to microsociology, but as a viable complement to the other extant variations of contemporary sociological theorizing.

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