Emergence in Sociology: Contemporary Philosophy of Mind and Some Implications for Sociological Theory[1]

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Many accounts of the micro-macro link use the philosophical notion of *emergence* to argue that collective phenomena are collaboratively created by individuals yet are not reducible to explanation in terms of individuals. However, emergence has also been invoked by methodological individualists; they accept the existence of emergent social properties yet claim that such properties can be reduced to explanations in terms of individuals and their relationships. Thus, contemporary sociological uses of emergence are contradictory and unstable. This article clarifies this situation by developing an account of emergence based in contemporary philosophy of mind. The philosophical account is used to evaluate contradictory sociological theories. Several unresolved issues facing theories of emergence in sociology are identified.

THE SLIPPERY CONCEPT OF EMERGENCE

The relationship between the individual and the collective is one of the most fundamental issues in sociological theory. This relationship was a central element in the theorizing of the 19th-century founders of sociology, including Weber, Durkheim, Simmel, and Marx, and was essential, if implicit, in many 20th-century sociological paradigms, including structural functionalism (Parsons [1937] 1949, 1951), exchange theory (Blau 1964; Homans 1958; Homans 1961), and rational choice theory (Coleman 1990). In recent years, this relationship has become known as the *micro-macro link* (Alexander et al. 1987; Huber 1991; Knorr-Cetina and Cicourel 1981; Ritzer 2000).

Many accounts of the micro-macro link use the philosophical notion of *emergence* to argue that collective phenomena are collaboratively created by individuals yet are not reducible to individual action (Archer 1995; Bhaskar [1979] 1998, 1982; Blau 1981; Edel 1959; Kontopoulos 1993; Mihata 1997; Parsons 1937; Porpora 1993; Smith 1997; Sztompka 1991; Whitmeyer 1994; Wisdom 1970). Most of these accounts argue that although only individuals exist, collectives possess emergent properties that cannot be reduced to individual properties (cf. Brodbeck [1958] 1968). Thus, these accounts reject sociological realism and are methodologically collectivist. Other theorists make the stronger argument that emergence can be used to ground sociological realism (Archer 1995; Bhaskar 1998).

However, emergence has also been invoked by methodological individualists in sociology and economics. Methodological individualists accept the existence of emergent social properties, yet they claim that such properties can be reduced to explanations in terms of individuals and their relationships. Methodological individualism's focus on micro-to-macro processes is explicitly considered to be a study of how social properties emerge from individual action (Axelrod 1997, e.g., p. 4; Coleman 1987, p. 171; 1990; Epstein and Axtell 1996, e.g., pp. 6–20; Homans 1964*a*). For example, Homans argued that "emergence, and the nature of the properties that emerge, are to be explained by psychological propositions," and he claimed that he had demonstrated this reducibility in his 1961 book *Social Behavior* (1964*a*, p. 229). These sociologists draw inspiration from economics, where emergence is conceived of as the process whereby unintended macrosocial phenomena arise from the actions of many participating individuals (Hayek 1942, 1943, 1944; Menger [1883] 1963). In contrast to sociologists who believe that emergence is incompatible with reductionist individualism—I will call them *collectivist emergentists* —individualist emergentists believe that macrosocial properties and laws can be explained in terms of properties and laws about individuals and their relations.[2]

Thus, contemporary sociological uses of emergence are contradictory and unstable; two opposed sociological paradigms both invoke the concept of emergence and draw opposed conclusions. The problem arises in part

[2] Some sociologists define the micro- and macrolevels in terms of the size of social units (e.g., Münch and Smelser 1987, pp. 356–57; Ritzer 2000, pp. 499–505). However, both individualist and collectivist emergentists agree that the micro-macro debate must be couched in terms of relations between properties at multiple levels of analysis, not in terms of group size, and this is consistent with the philosophical account I give in the second part of this five-part article. Because systems may have some properties that are merely aggregative and others that are emergent, it does not make sense to speak of systems or structures as emergent, but only of properties of those systems (Archer 1995, pp. 8–9; Wimsatt 1986, p. 260).

because sociologists have not developed an adequate account of emergence. In this article, I make an initial attempt to develop such a foundational account, with the goal of clarifying these different concepts of sociological emergence. To do so, I will draw heavily on a long tradition of emergentism in the philosophy of science. Philosophical interest in emergence has gone in several cycles since the term was first coined in 1875 by the philosopher G. H. Lewes; I focus on emergentist theories from the 1970s through the 1990s that have been inspired by developments in cognitive science. Although philosophical arguments about emergence and reducibility have focused on the mind-brain relation, they can be generalized to apply to any hierarchically ordered sets of properties, as noted by many philosophers (Fodor 1989; Humphreys 1997, p. 3; Jackson and Pettit 1992, p. 107; Kincaid 1997, p. 76; Yablo 1992, p. 247n5).

Contemporary sociologists are not the first to be confused about emergentism. Throughout the long history of the usage of the term (see Sawyer, in press a), one finds comments on the confusion surrounding it (Broad 1925, p. 59; Edel 1959, p. 192; Kim 1992, p. 122). In the face of almost a century of confusion, it would be overly ambitious to resolve these issues for sociologists in a single article; this article should be viewed as an initial attempt to demonstrate the relevance of these philosophical debates to sociological theory, rather than as a conclusive solution. The article format allows only the briefest of summary treatments of complex debates in the philosophy of mind, and I necessarily brush over many subtle differences in presenting what most philosophers of mind agree is the current consensus.

I begin this article by summarizing this consensus. I then summarize the two competing uses of emergence in sociology, beginning with individualist emergentism and then turning to collectivist emergentism. In both cases, I use arguments from the philosophy of mind to evaluate these competing theories of emergence, and I conclude that none of these theories has adequately addressed all of the implications of the philosophical account. I conclude the article by identifying several unresolved issues facing sociological theories of emergence.

EMERGENCE IN PHILOSOPHY

The concept of emergence has a long history predating the 19th century (see Wheeler 1928), but the term was first used in 1875 by the philosopher George Henry Lewes. In a critique of Hume's theory of causation, Lewes (1875) found it necessary to distinguish between two types of effects: *resultants* and *emergents* (e.g., 1875, p. 412). An emergent effect is not additive, not predictable from knowledge of its components, and not de-

composable into those components. Lewes's classic example was of the formation of molecules from their component atoms; hydrogen and oxygen are the cause, and water is the effect—the properties of water are emergent from the combination of hydrogen and oxygen.

These ideas were picked up by several British philosophers after World War I—most notably by Morgan (1923) and Whitehead (1926). Emergentism in the 1920s rejected vitalism and dualism, accepting the materialist ontology that only physical matter existed. Higher-level entities and properties were grounded in and determined by the more basic properties of physical matter; this was referred to as *supervenience*. However, the 1920s emergentists argued that when basic physical processes achieve a certain level of complexity of an appropriate kind, genuinely novel characteristics emerge; these emergent higher-level properties could not, even in theory, be predicted from a full and complete knowledge of the lower-level parts and their relations. Further, they could not be reduced to properties of the parts and their relations, even though those properties are supervenient on and thus determined by the system of parts (Kim 1993b, p. 134; Teller 1992, pp. 140–42).

Philosophers of mind turned to emergence beginning in the 1960s, following the cognitivist rejection of behaviorism. The cognitive revolution reactivated a 19th-century debate between identity theorists and dualists. Identity theorists hold to the reductionist and eliminativist position that the mind is nothing more than the biological brain, and dualists hold that the mind and the brain are distinct. Emergence has been perceived as a third path between dualism and identity theory (Beckermann, Flohr, and Kim 1992; Horgan 1993; Humphreys et al. 1997; Kim 1993a), and this third path is generally known as *nonreductive materialism* (Kim 1992).[3] Nonreductive materialism holds that mental properties are not reducible to physical ones (Davidson 1970; Fodor 1974) and may indeed have causal power over the physical brain (Andersen et al. 2000; Heil and Mele 1993). Although nonreductive materialism is widely accepted, its acceptance is not universal, and emergence continues to be debated in the philosophy of science, as indicated by several recent journal special issues (*Intellectica* 1997, no. 25; *Philosophical Studies*, August 1999; *Philosophy of Science* suppl., 1996). In fact, just as methodological individualists claim that emergentism is compatible with their stance, some philosophers of science likewise argue that emergentism is compatible with reductionism (e.g., Kim 1993a; Wimsatt 1997).

In the 1990s, emergence became one of the core concepts in compu-

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[3] In philosophy of biology as well, the dominant view is *emergent mechanism* (Bechtel and Richardson 1993) or *physicalist antireductionism* (Rosenberg 1997). Here I restrict my arguments to the philosophy of mind, but the issues are quite similar in both cases.

tational modeling of complex systems, including connectionism (Clark 1997), artificial life (Brooks and Maes 1994; Langton 1994), and multiagent models of social systems (Gilbert and Conte 1995; Sawyer 2001a). In this recent formulation, *emergent systems* are complex dynamical systems that display behavior that cannot be predicted from a full and complete description of the component units of the system. Canonical examples of emergence include traffic jams, the colonies of social insects, and bird flocks. For example, the V shape of the bird flock does not result from one bird being selected as the leader, and the other birds lining up behind the leader. Instead, each bird's behavior is based on its position relative to nearby birds. The V shape is not planned or centrally determined; it emerges out of simple pair-interaction rules. The bird flock demonstrates one of the most striking features of emergent phenomena: higher-level regularities are often the result of quite simple rules and local interactions at the lower level.

To elaborate these various theories of emergence, in the following I briefly summarize the current emergentist consensus position in the philosophy of mind. This nonreductive materialist argument is grounded in the philosophy of science tradition and focuses on the terms, concepts, laws, and theories associated with a scientific discipline. In this tradition, the question of reductionism is not only an ontological question about the putative existence of higher levels of analysis, but it is often formulated as a question about scientific laws, concepts, and terms: Can a law or concept from psychology be reduced to a neurobiological law or concept? The nonreductive materialist argues that there are strong grounds for believing that this reduction is not possible, even though there is nothing in the universe other than physical matter. The argument is based on supervenience, multiple realizability, and wild disjunction.

Supervenience

Most sociologists, both individualists and collectivists, try to avoid hypostatizing or reifying social groups; they accept that the only real entities are individuals. This position is known as *ontological individualism*: the ontological position that only individuals exist. The emergentist argument of nonreductive materialism starts with a parallel ontological assumption: all that exists is physical matter. Because there is only physical matter, there are only physical events; thus, psychological events are the same events as neurophysiological events. This is known as the *token identity thesis*: any token psychological event is identical to a physical event. Token event identity entails that emergent higher-level properties *supervene* on the system of lower-level components (Davidson 1970; Fodor 1974; Kim 1993b). Supervenience refers to a relation between two levels of analysis

and states that if two events are identical with respect to their descriptions at the lower level, then they cannot differ at the higher level. If a collection of lower-level components with a given set of relations causes higher-level property E to emerge at time t, then on every other occasion when that same collection of components in that same set of relations occurs, E will again emerge. Note that this implies that an entity cannot change at a higher level without also changing at the lower levels.

Several philosophers of social science have suggested that the individual-collective relation is one of supervenience (Bhargava 1992, pp. 62–68; Currie 1984, p. 357; Kincaid 1997; MacDonald and Pettit 1981, pp. 119–20, 144–45; Mellor 1982, p. 16; Pettit 1993, pp. 148–54). However, most of these philosophers have argued that supervenience is compatible with methodological individualism and that it does not entail the irreducibility of the social. In fact, philosophers of mind generally agree that supervenience alone is not an argument for irreducibility of the mental (Bunge 1977; Heil 1998; Heil 1999; Humphreys 1997; Margolis 1986; Wimsatt 1997, p. 373). Supervenience is compatible with the *type identity thesis*; that is, the claim that all higher-level types or properties are identical to some type or property in the physical language. To develop an argument for irreducibility consistent with supervenience, philosophers of mind have elaborated the notions of multiple realizability and wild disjunction.

Multiple Realizability and Wild Disjunction

Fodor's (1974) influential argument against reductionist physicalism is based on the concept of types as *natural kind terms* and on a certain notion of what counts as a scientific law. A law is a statement within which the basic terms are natural kind terms of that science. To reduce a law to the science of the lower level, a *bridge law* must be identified that translates that law. To accomplish this, each of the natural kind terms of the higher-level science must be translatable into natural kind terms of the lower-level science.

The crux of Fodor's argument is that there is no a priori reason to believe that this translation will be possible for any given pair of scientific disciplines; whether or not such a reduction is possible must be determined empirically. His argument is that a simple translation—in his case, from a psychological term to some combination of neurobiological terms—may not be possible. The argument is based on the notion of *multiple realizability*: the observation that although each mental state must be supervenient on some physical state, each token instance of that mental state might be implemented, grounded, or realized by a different physical state. For example, the psychological term "pain" could be realized by a wide

range of different neurobiological terms and concepts, and each token instance of "pain" might be realized by a different supervenience base. Multiple realizability is thus an account of how one could accept token identity and yet reject type identity.

Multiple realizability alone does not necessarily imply irreducibility; if there are only a few realizing states, or if those states display some common features, the reduction may not be problematic. However, reduction would be difficult if the neurobiological equivalent of a psychological term were an otherwise unrelated combination of many neurobiological concepts and terms (see fig. 1). Fodor termed such a realization *wildly disjunctive*. If a higher-level property is realized by a wildly disjunctive set of lower-level properties, then the physical equivalent of a psychological law must contain wildly disjunctive terms. Fodor argued that a true scientific law cannot have wildly disjunctive components and that wild disjunction thus implied that there could be lawful relations among events, described in psychological language, that would not be lawful relations in the language of physics. Whether or not one holds to this definition of a law, it is clearly of limited scientific usefulness to have laws with wildly disjunctive terms, because they provide only limited understanding of the phenomena; they are of limited predictive usefulness, because they apply only to a specific token instance, whereas the higher-level law is likely to be more generally applicable. Such reductions can nonetheless be useful to explain exceptions to the higher-level laws; Fodor's argument explains why laws in sciences other than physics always have exceptions.

When supervenience is supplemented with the argument for wild disjunction—the observation that a single higher-level property might be realized by many different lower-level supervenience bases and that these different supervenience bases may have no lawful relations with one another—we have an account of emergence that shows why certain social properties and social laws may be irreducible. There may be a social property that in each token instance is supervenient on a combination of individual properties, but each token instance of that property may be realized by a different combination of individual properties. Many social properties seem to work this way. The collective entity that has the social property "being a church" also has a collection of individual properties associated with each of its component members. For example, each individual I_n may hold properties "believing in X_n" or "intending Y_n," where the sum total of such beliefs and intentions are (in some sense) constitutive of the social property "being a church." Yet the property of "being a church" can be realized by a wide range of individual beliefs and dispositions. The same is true of properties such as "being a family" and "being a collective movement." Microsocial properties are no less multiply realizable: examples include "being an argument," "being a conversation,"

Higher-level law $S_1x \longrightarrow S_2x$

Disjunctive properties of P_1x *or* P_2x *or* P_3x ... P_nx → $P_1{}^*x$ *or* $P_2{}^*x$ *or* $P_3{}^*x$ $P_n{}^*x$
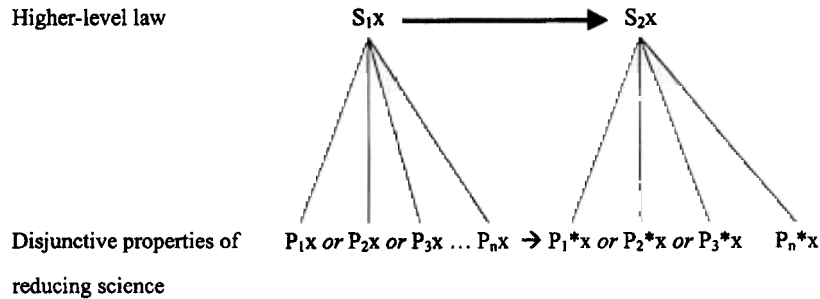
reducing science

FIG. 1.—Wild disjunction and the reduction of higher-level laws

and "being an act of discrimination." In fact, most social properties of interest to sociologists seem to have wildly disjunctive individual-level descriptions.

Emergentism does not claim that all higher-level properties are irreducible; some of them are predictable and derivable from the system of lower-level components. Only in cases where the relation between higher- and lower-level properties is wildly disjunctive beyond some threshold of complexity will the higher-level property not be lawfully reducible. Whether or not this is indeed the relation between any given set of higher- and lower-level properties is an empirical question to be determined by empirical study.

Downward Causation

Irreducible emergence and social causation have always been linked in sociology. Durkheim's ([1895] 1964) emergentist account of the autonomy of sociology was foundationally based on emergent (or "sui generis") social properties having causal force on the individual. His defining criteria of the social fact was its *external constraint* on individuals. This is a methodological claim, not necessarily an ontological one: if we can identify that a phenomenon has causal power, then we must treat it as real.

Durkheim's theory of social causation was famously criticized for seeming to hypostatize the social. Likewise, higher-level causation is problematic in the philosophical account of emergence. Several philosophers have argued that this account does not provide for the appearance of mental causation, claiming that in nonreductive materialism, the mental is epiphenomenal (e.g., Kim 1992, 1993a; Lowe 1993). Consequently, many philosophers of mind have attempted to extend nonreductive materialism to allow the mental to be more than epiphenomenal. Although nonreductive materialists accept supervenience, many of them also hold that

higher-level properties can have causal powers over lower-level properties (Davidson 1993; Fodor 1989; Horgan 1989). For example, several philosophers have argued that some complex systems exhibit *downward causation*, in which an emergent higher-level property or pattern begins to cause effects in the lower level, either in the component entities or in their patterns of interaction (Andersen et al. 2000). Others reject this "downward causal" claim (see esp. Kim 1993*a*). For example, they claim there is no downward causation in a bird flock; the V shape has no effect on the birds, and none of the birds is aware that such a shape exists (Darley 1994). Likewise, there is no downward causation in multiagent social simulations; because only agents and their local interactions are modeled, higher-level patterns must be epiphenomenal.

Kim noted that emergentism and nonreductive materialism entail a commitment to downward causation and argued that the attempt to account for downward causation was the primary motivation for emergentist accounts (1993*a*, p. 121). Kim's critique was that such emergent causation can only derive from the causal powers of the supervenience base and that a higher-level property can only cause another higher-level property by causing its supervenience base (Kim 1992, p. 136; Sawyer, in press *c*) Thus, Kim referred to such causation as either "epiphenomenal causation" or "supervenient causation" (1984).

In response, arguments for mental causation have taken a specific philosophical form: there can be a lawful, causal relation between a mental property and a physical property, even though there is no lawful, causal relation between the realizing physical properties of that mental property and the caused physical property (Sawyer, in press *c*). This follows from Fodor's wild disjunction argument; in figure 1, the higher-level relation may be a causal law, even though the lower-level relation is not lawful because it is a relation among wildly disjunctive terms.

In sum, philosophers of mind have staked out a nonreductionist position that is not found in contemporary sociology. Sociological theorists who invoke emergence have not drawn analogies between these emergentist arguments in the philosophy of mind and emergentist arguments for the independence of a sociological level of analysis. The analogous position in sociological theory would be to hold that only individuals exist and that social entities do not have a distinct existence, yet there may be irreducible social properties and social laws.

In the following two sections, I first discuss sociological theories of emergence that are reductive and methodologically individualist, and then those that are nonreductive, collectivist, or realist. Throughout these discussions, I evaluate these arguments by reference to the philosophical account presented above. Following my discussion of these two views of emergence, I identify a set of unresolved issues, and I provide a list of

empirical features of social systems that are likely to manifest irreducible emergent properties, drawing on complex systems theorists.

INDIVIDUALIST THEORIES OF EMERGENCE

Individualist emergentists claim that the existence of emergent system properties that are not possessed by the parts does not entail irreducibility of those properties. Most scientists call a system property *emergent* relative to properties of the system's parts if it depends upon the mode of organization of those parts; this conception of emergence is generally considered to be consistent with reduction (Cottrell 1978, p. 130; Phillips 1976, p. 13; Wimsatt 1997, p. S372). The physical sciences can provide many examples of successful explanation of higher-level emergent properties from the lower-level components' properties and their relations. The classic example that the 1920s British emergentists borrowed from Mill and Lewes, chemical combination, demonstrates this point. Lewes (1875), in coining the term "emergent," observed that water has properties that are not held by hydrogen nor oxygen: it is transparent, it is a liquid, it is colorless, it observes certain pressure and fluid laws. However, in the 20th century, quantum mechanics provided the reduction. The properties of water can now be explained in terms of—reduced to—the properties of hydrogen and oxygen and their relation of combination, even though neither hydrogen nor oxygen have thosee properties. A second example is the reduction of the laws of thermodynamics to statistical mechanics. Although the pressure of a volume of a gas is a property of that whole, and none of the component molecules can be said to possess the property of "pressure," the laws of statistical mechanics allow the reduction of the pressure of the whole to the aggregated individual motions of the component particles. Such developments in the physical sciences contributed to the rejection of emergentism that accompanied logical positivism and the unity of science movement (McLaughlin 1992); Hempel (1965, pp. 258–64) and others argued that emergence is not a property of reality; it is, rather, a statement about our incomplete knowledge of the world.

In sociology, the observation that social groups have properties that cannot in principle be held by any single individual is likewise compatible with *methodological individualism*, the stance that sociological explanation should always be in terms of processes of individual-to-social emergence. Methodological individualists argue that the task of sociology is to explain social properties by reduction to properties of individuals and their interactions; this perspective is foundational in economics and in several influential sociological theories including behavioral sociology (Homans 1958, 1961), exchange theory (Emerson 1972), and rational

choice theory (Coleman 1990). Methodological individualists draw on concepts of emergence to account for the micro-to-macro link, yet they are reductionist nonetheless: they hold that social properties can be fully explained in terms of properties of individuals and their interactions.

Since the origin of sociology in the 19th century, the field has included reductionist individualists. Mill claimed that sociological phenomena could be understood by analysis of the component individuals and their interactions (e.g., Mill 1843, 2:469), and many early sociologists emphasized the study of individuals and interaction, including Simmel, Tarde, and Weber. In part influenced by Mill's writings, Carl Menger, founder of the Austrian school of economics, insisted—in opposition to German social organicism and other forms of sociological holism—that even unintended, organic social forms, including law, language, money, and markets, could be analyzed by reducing them to the analysis of individuals pursuing individual interests, using a reductionist atomist method that he called the *exact orientation* (Menger 1963, pp. 151–59). F. A. von Hayek, in his influential three-part essay *Scientism and the Study of Society* (1942, 1943, 1944), elaborated Menger's theories to develop a canonical statement of what Popper called "methodological individualism." In this essay, Hayek argued that emergent social phenomena must be explained in terms of individuals. Like Menger, Hayek rejected sociological holism and described higher-level social phenomena as emergent from individual action (1942, p. 288). His examples included the forest trails that form gradually as hundreds of people each seek the best path; the task of social science is to discover how the independent actions of many people can produce emergent social structures that are not intentionally designed (1944, p. 27).

In the 1950s, there was a wide-ranging debate among philosophers about the merits of taking Hayek's methodologically individualist stance (O'Neill 1973). J. W. N. Watkins (1955, 1957) formulated an even stronger version of methodological individualism. Whereas Hayek held that an understanding of social phenomena using the compositive method could never be complete due to the extreme complexity of the task and the limitations of the human mind (1944, pp. 30–31), Watkins was more optimistic: "We shall not have arrived at rock-bottom explanations of such large-scale [social] phenomena until we have deduced an account of them from statements about the dispositions, beliefs, resources and interrelations of individuals" (Watkins 1957, p. 106).

During this same period, Homans shifted from an earlier holism to methodological individualism. In his first books, Homans held to a nonreductionist emergentist view (1941, 1950; see Blain 1971, p. 5; Buckley 1967, pp. 35, 140; Wallace 1969, p. 52). For example, Homans referred to groups as "complex organic wholes" (1950, p. 91), acknowledged that

groups experience "emergent evolution" (p. 94), and wrote that the sociologist studies "the very act of emergence" (p. 272). Yet by 1958 Homans had discarded all talk of complex wholes and had become an "ultimate psychological reductionist" (1958, p. 597). This approach led to the foundational emphasis of exchange theory, which is to derive all of the laws of sociology from "elementary" social behavior, the behavior of individuals in interaction. For example, a group's equilibrium must be explained by appeal to the behaviors of each individual in exchange with other members of the group, rather than explaining equilibrium as a functionally necessary feature of groups (Homans 1958, p. 601).

Consistent with Watkins's methodological individualism, Homans argued that propositions about groups or societies should be explained by reduction to propositions about the behavior of men (1964a, p. 227) and that "new properties are always emerging. . . . The question is how the emergence is to be explained. I say that the emergence, and the nature of the properties that emerge, are to be explained by psychological propositions" (1964a, p. 229). In his 1961 book *Social Behavior*, Homans's goal was to show how emergent properties could be explained using psychological propositions (see 1964a, p. 229).

Homans believed that emergent properties were the same as the "composition effects" noted in the physical sciences, and were not qualitatively different from aggregate or additive properties (1964b, p. 970.) Yet, on several occasions he admitted that with very complex composition effects we may never have a complete reductionist explanation; many large groups cannot be explained in this way, and some institutions, like money and markets, cannot be explained because we do not have sufficient historical data (1964a, p. 227). Homans suggested that later developments in computers might help in this task, a prescient statement considering the recent growth of multiagent system models (1964a, pp. 225–26; see Sawyer 2001a). Homans's claim that a social causal law is not an explanation is questionable; under such a conception, psychological laws are not explanations either, because their true explanation can only be found in terms of neurobiology (as Blau argued [1970, pp. 337–38]). Homans claimed that a social explanation must always be expressed in terms of its implementing mechanism at the individual supervenience base. Yet as Fodor noted in connection with his wild disjunction argument, the claim that there are higher-level types that are irreducible to the lower-level does not entail that there are no implementing mechanisms. In fact, token identity and supervenience require there to always be such an implementing mechanism. However, if wild disjunction holds, then the existence of an implementing mechanism does not mean that there will be a lawful reduction, nor does it mean that higher-level causal laws can be translated into lawful lower-level causal laws. A description of the im-

plementing mechanism of a given token instance may be of some limited interest, but it will not constitute an explanation of the higher-level type or law.

Rational choice theory is also individualist emergentist; it holds that social institutions and social change must be explained in terms of their emergence from the action and interaction of individuals (Coleman 1990; Elster 1989). Like most individualist emergentists, Elster viewed social terms and laws as "shorthand" for what ultimately must be explained in terms of individuals (1989, p. 158). Elster famously read Marx as a methodological individualist, citing Marx's focus on the unintended consequences of human action (Elster 1985, p. 1) and his attempt to provide "causal explanation of aggregate phenomena in terms of the individual actions that go into them" (1985, p. 2). Coleman's influential focus on "the internal analysis of system behavior" (1990, p. 2) is methodologically individualist because it examines component parts of the system, explains the behavior of the system in terms of the behavior of its parts, and shows how one can compose and synthesize the systemic behavior from the actions of the parts. Coleman explicitly accepted emergence: "Interaction among individuals is seen to result in emergent phenomena at the system level, that is, phenomena that were neither intended nor predicted by the individuals" (p. 5). System behavior is "an emergent consequence of the interdependent actions of the actors who make up the system" (Coleman 1986, p. 1312); it is emergent because it results from social organization, not "merely aggregated individual behavior" (Coleman 1987, p. 157; also 1990, p. 22). Coleman's theory is devoted to working out the processes of this emergence, which he called the "micro-to-macro transition." Coleman accepted that there may be emergent social properties and that lawlike generalizations between them could be identified (1990, p. 28). But like all methodological individualists, Coleman maintained that these propositions are temporary shorthand for, and are less general than, the individual-level explanation (1990, p. 20).

Originating outside sociology, in mathematics and economics, emergence has been an important concept in complex adaptive systems theory, which studies "the emergence of complex large-scale behaviors from the aggregate interactions of less complex agents" (Holland 1995, p. 11). In this conception, emergence is a strictly reductionist notion: "The laws at the higher-level derive from the laws of the lower-level building blocks" (p. 36), although nonlinear interactions can make this derivation difficult to discover (p. 15). Complex social systems have been modeled with multi-agent system technologies (Sawyer 2001a), and these "artificial society" models are grounded in individualist concepts of emergence (Conte et al. 2001). In an artificial society, macrostructural phenomena emerge, attain equilibrium, and remain stable over time. Several artificial societies have

been created that begin with no social structure and in which differentiated and hierarchically structured groups emerge during the simulation. An early example of such a simulation is Schelling's (1971) checkerboard simulation of residential segregation, which showed that almost total segregation can result from even rather small tendencies toward like neighbors.

Axelrod defined emergence in artificial society simulations in reductionist terms: "The large-scale effects of locally interacting agents are called 'emergent properties' of the system" (1997, p. 4). Axelrod (1995) used an artificial society to explore the emergence of new political actors: supranational entities that can regulate resource use at the global level. In his model, each agent represents a national state, and in repeat runs of the model, clusters of commitment emerge surrounding strong states. Thus, higher-level actors emerge from the interactions among lower-level actors. This is a simpler version of Coleman's theory of how corporate actors emerge from the rational action of component members (Coleman 1990). Yet despite its simplicity, the simulation allowed an examination of the unexpected effects of microtheoretical assumptions. For example, Axelrod's simulation reproduced historically observed patterns, such as *imperial overstretch*, which occurs when powerful empires are weakened by being dragged into fights involving weaker actors to whom they have developed commitments.

Artificial society techniques have been extended even to the emergence of symbolic structures such as communicative norms. For example, Steels (1997) developed a multiagent simulation in which a set of language conventions emerged. In such social simulations, once the conventions have emerged, the system typically reaches a steady state such that the emergent conventions are maintained over time through the same self-organizing emergence processes.

How do these variations of individualist emergentism compare with the philosophical account of emergence presented above? Individualist emergentists claim that the existence of emergent system properties that are not possessed by the parts does not entail irreducibility of those properties. This is consistent with the philosophical account of token identity and supervenience; those accounts show that emergence, conceived of as supervenience alone, is compatible with reductionism. However, the philosophical account leads to potential irreducibility for those emergent properties that are multiply realizable and wildly disjunctive; this possibility poses several problems for individualist emergentists.

First, individualist emergentists fail to address the implications of multiple realizability; there are two serious implications. First, a plausible account of an instance of the micro-to-macro emergence of a social property may be provided, but that account might not be the one that actually

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led to the emergence of that property in that token instance; due to multiple realizability, the instance of the social property being modeled might have emerged from a different supervenience base. But suppose that all agree that the micro-to-macro emergence of a social property has been successfully modeled for one token instance of that social property. This still leaves us with the second, more foundational problem: that account may not be applicable for any other token instances of the same social property, due to multiple realizability, and it may not provide any explanatory power beyond that token instance, due to wild disjunction. The philosophical account shows that individualist emergentism can only work if a form of type identity between social and individual properties holds, and empirical evidence suggests that type identity does not hold.

A second failing is that individual emergentists do not address the causal implications of wild disjunction. If social properties are implemented in wildly disjunctive sets of individual properties, then social terms and laws may not be lawfully reducible to individual terms and laws. If a social property has a wildly disjunctive individual base, then the social property can participate in causal laws even though there is no equivalent lawful description in the language used to describe individuals.

These two failings result in part from a common error among methodological individualists: making the assumption that ontological individualism entails methodological individualism. The logical error of making ontological arguments in support of methodological claims is quite common in the philosophy of social science and is found in Popper's confusion of materialist metaphysics with epistemology (Popper 1962, e.g., p. 341), in Elster's methodologically individualist reading of Marx (Elster 1985), and in Giddens's attacks on structural sociology (Giddens 1984, e.g., chap. 4). The fact that social properties are nothing more than their individual supervenience bases does not entail that an explanation can necessarily be provided in the language used to describe individuals.

COLLECTIVIST THEORIES OF EMERGENCE

Above, I showed that methodological individualists conceive of their approach as a way of explaining the micro-to-macro emergence of social phenomena from individual action. These accounts hold that emergence is not necessarily incompatible with reduction to individual-level explanation of social phenomena. In this, they are in agreement with the philosophical account. How can one reconcile these claims with those of contemporary sociological theorists who have explicitly drawn on emergence to ground nonreductionist, nonindividualist sociological theories? In this section, I review these collectivist versions of emergence, and I

evaluate them against the philosophical account. With regard to the complex social phenomena under study, this form of emergentism accepts that nothing exists except the component individuals and their interactions, but nonetheless maintains that some complex social phenomena cannot be studied with reductionist methods. I discuss the theories of three influential theorists: Peter Blau, Roy Bhaskar, and Margaret Archer.

Peter Blau

Blau's concept of emergence has evolved over his career, but both his earlier more reductionist writings and his later structuralist work represent variants of emergentism. His 1955 account of status exchange was reductionist because it showed how a stable and differentiated social structure emerges from a process of exchange between members (Homans 1958, p. 604). In his 1964 book, Blau elaborated this exchange-theoretic concept of emergence, emphasizing the need to "derive the social processes that govern the complex structures of communities and societies from the simpler processes that pervade the daily intercourse among individuals and their interpersonal relations" (1964, p. 2). At the same time, Blau cautioned against Homans's psychological reductionism, claiming that it "tends to ignore these emergent characteristics of social life" (p. 3).

Such passages led some scholars (e.g., Archer 1979, pp. 5–42; Buckley 1967, p. 143) to emphasize Blau's methodological differences with Homans in his 1964 work. Yet Blau's 1964 concept of emergence was different from the structuralist nonreductionism that he was to advocate later (1977, 1981), because it focused on social exchange between two individuals and argued that "more complex social processes evolve out of simpler ones and have their ultimate source in psychological dispositions" (1964, p. 7). Blau himself later noted that in his 1964 book he thought that "macrosociological theory should be built on the basis of microsociological theory" (1987, p. 99), and he gradually shifted from this more reductionist view of emergence to a more structuralist and sociologically realist view. By 1970, Blau had begun to reject his earlier attempts to ground macrotheory in microsociology (Blau 1970, p. 338; also see 1977, 1987), and he concluded that there could be no such foundation because "the major terms of macrosociological theories refer to emergent properties of population structures that have no equivalent in microsociological analysis" (1987, p. 87). The reason why this is so is the large size and complexity of societies: "It is impossible to trace and dissect the interpersonal relations of many thousands or millions of people, and neither would it be meaningful if all were described" (1987, p. 97).

The philosophical account shows that Blau's invocation of emergence is incomplete. In 1981, Blau argued that emergent properties were irre-

ducible by using Lewes's and Durkheim's 19th-century analogy: the properties of water emerge from those of hydrogen and oxygen. Yet note that the emergent properties of water have in fact been reductively explained by quantum mechanics. The philosophical account shows that a focus on emergent properties is not "inherently anti-reductionist" as Blau claimed (1981, p. 10).

These inadequacies lead to another significant weakness of Blau's account: he did not provide an account of how emergent social properties could have causal power. For Blau, social structure is not simply an abstract conceptual representation of the sociologist, but possesses causal powers over actors (1981, pp. 15–16; see also 1977, pp. 2, 244). Several theorists have criticized Blau and other structuralists for proposing causal accounts that reify social structure, such that society becomes ontologically autonomous from individuals (Cohen 1989; King 1999, pp. 270–71; Varela and Harré 1996, pp. 316–19). If structure supervenes on individuals, then a theory that attributes to it a causal force over those individuals must be careful to clarify the theory's ontological and epistemological commitments.

The weaknesses in Blau's account can be addressed by the philosophical account. Although emergence is not "inherently antireductionist," emergence conceived of in terms of multiple realizability and wild disjunction can ground nonreductionist claims. The philosophical account provides a justification for Blau's claims that social properties can participate in causal laws, although the existence of such laws does not necessarily imply the ontological autonomy of social properties, because the causal power of such social properties inheres in their individual supervenience base (cf. Cohen's critique [1989, p. 71]). However, with each social property, whether or not it is realized with a wildly disjunctive supervenience base is an empirical question that can only be resolved through sociological study. Blau generally implies that such an empirical demonstration is unnecessary, and that all emergent social properties are irreducible.

Roy Bhaskar's Transcendental Realism

In developing his argument for *transcendental realism*, Bhaskar appealed to emergence in arguing that social reality is ontologically stratified. Bhaskar referred to his thesis as *synchronic emergent powers materialism* and argued that although social structure is dependent upon individuals' actions it is irreducible to them and ontologically autonomous from them (1998, pp. 37–44, 97–107). In sharp contrast with individualist emergentism, Bhaskar held that emergentism is identical with realism: "It is only if social phenomena are genuinely emergent that realist explanations in

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the human sciences are justified . . . conversely, emergent phenomena require realist explanations" (1982, p. 276).[4]

Bhaskar implicitly accepted supervenience as an account of the relation between higher- and lower-level properties. He held that there is only one substance in the universe; synchronic emergent powers materialism "does not require the postulation of any substance other than matter as the bearer of the emergent powers" (1982, p. 282). He accepted the supervenience claim that societies "are unilaterally, existentially dependent on" the material world, such that "any social change entails a natural change" (1982, p. 281)—one of the implications of supervenience.

The philosophical account of emergence is incompatible with several elements of Bhaskar's account. For example, Bhaskar claimed that emergence is not an argument about properties of events, but is an argument about entities (1982, p. 277), and on other occasions he referred to these entities as "mechanisms" ([1975] 1997, p. 47) or "things" (p. 51).[5] This seems to entail a rejection of token event identity and the property focus of the philosophical account; yet this would also entail a rejection of supervenience. This would be hard to reconcile with Bhaskar's many claims that suggest that society is supervenient on individuals.

Like Blau, Bhaskar connected emergence with social causation (1979, p. 39). But how can social entities have causal autonomy from individuals, when they are supervenient on these individuals? Several critics have noted that Bhaskar did not present an account of causality that is grounded in his conceptions of generative mechanisms (Keat and Urry [1975] 1982, p. 243; Suchting 1992, p. 25; Varela and Harré 1996, p. 316), and that his concepts of structure, causal power, and generative mechanism remain unclear. In part because Bhaskar never articulated in detail the nature of the supervenience relation between lower- and higher-level properties, his argument does not successfully accomplish its realist goal. Bhaskar's account of higher-level autonomous causation is incompatible with society-person supervenience, as shown by arguments in the philosophy of mind. Even if emergent properties are not ontologically autonomous, the philosophical account explains how they can participate in causal laws.

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[4] Other transcendental realist variants of emergentism include Collier (1989, pp. 183–85) and Lawson (1997, p. 63). Occasional rhetorical similarities with structuration theory are misleading: Giddens has explicitly rejected emergentism and social realism (Archer 1995, p. 96; Varela and Harré 1996, pp. 319–21). As Cohen wrote in his overview of structuration theory, a practice orientation "entails dispensing with all arguments for the emergence of social patterns" (1989, pp. 76–77).

[5] Collier's reading of critical realism also speaks of the emergence of entities rather than properties as in the philosophical account (1989, p. 183).

Margaret Archer's Morphogenetic Dualism

Margaret Archer's account of emergence has shifted over her career from methodological collectivism to sociological realism. Before 1995, Archer held to a nonrealist form of emergentism, accepting the supervenience assumption "that groups are made up of nothing more than individuals and the relations between them" (1979, p. 6). Although accepting ontological individualism and rejecting sociological realism, Archer used emergence arguments to reject methodological individualism in favor of "explanatory emergence" (1979, p. 6, following Brodbeck 1968, pp. 301–3). Archer claimed that social science had demonstrated the intractable complexity of the composition laws that might allow us to explain collective phenomena in terms of individuals; therefore, explanatory emergence is the only methodological option currently available to sociologists (1979, p. 9). She also agreed with the philosophical account in claiming that resolution of the emergence question requires empirical research, and granting to individualists that "such emergent organizational properties may ultimately prove susceptible of reduction" (p. 31).

Archer (1982, 1988) further elaborated her theory of emergence in her account of *analytic dualism*, an alternative to Giddens's inseparability of structure and action. Archer appealed to Blau's 1964 version of emergence to resolve the individual-collective problem: emergence is embedded in interaction, and emergent properties are relational. As in 1979, she explicitly rejected sociological realism: "There is no suggestion that we are dealing with separate entities, only analytically separable ones and ones which it is theoretically useful to treat separately" (1988, p. xiv). Archer's emphasis on time (e.g., 1988, p. xxii) and her claim that current structural conditions were not created by the current actors, but by actors in the past, are foundational to her emergentist accounts of morphogenesis (Archer 1988, 1995).

In 1995, Archer changed her ontological stance. As in her earlier work, she accepted a part-whole concept of supervenience (1995, pp. 173–74), and she argued that emergent properties are "irreducible group variables" (p. 251), but in contrast to her earlier methodological stance, she argued that emergence entailed realism, and she endorsed Bhaskar's realist conception of causal powers (p. 90). Social properties emerge from individual properties that are anterior to the emergent properties; once a property has emerged, it has "relative autonomy" from properties at the emergence base, and "such autonomous properties exert independent causal influences in their own right" (p. 14). This social realism accepts "ontological emergence" (p. 15) and claims

that emergent social properties are just as real as their lower-level supervenience base (p. 63).[6]

Yet this shift to realism resulted in internal contradictions. She continued to make nonrealist statements: "What is being defended is not philosophical dualism but the utility of analytical dualism" (Archer 1995, p. 180). She acknowledged that individuals are the only causal forces in social life and that this fact raised a problem for her claim that emergent structures can also bear causal powers (p. 195). Although realist, she denied that her position reified structure (p. 148). Her continued usage of her older term "analytical dualism" (and also the somewhat oxymoronic "methodological realism," p. 159), along with her failure to explicitly note contrasts with her prior writings, makes it seem that her transition to realism was incomplete.

Archer (1995, p. 183) argued that it is emergence over time (morphogenesis) that makes emergent structural properties real and allows them to constrain individuals. Current social structures emerged from the past actions of individuals, such that they cannot be explanatorily reduced to actions of current individuals (e.g., p. 148). Yet emergence over time does not provide an ontological argument for social causation, as the philosophical account makes clear. Even though social property $S(t)$ is emergent from a process that occurred at $t - 1$ and before, it must nonetheless be supervenient on individual properties at time t, due to token event identity. Rational choice and complexity accounts also require temporality; just because structure represents the consequences of past actions does not mean that it is real or autonomous from contemporary actions or agents. In an artificial society simulation, structure emerges over time, but can only continue to exist through persisting interactions among elements. The supervenience account of token event identity requires a present, synchronous account.

Thus Archer provided an inadequate foundational argument for the ontological independence of emergent properties and how they could exert downward causation. In fact, at several points she made statements endorsing supervenient causation rather than autonomous causation: "Advocates of the morphogenetic perspective do not deny that social interaction is the ultimate source of complex phenomena," only that "we cannot deduce" emergent structural properties from individual action (Archer 1995, pp. 91–92). If one accepts supervenience, the causal power of $S(t)$ must inhere in its individual-level supervenience base at time t; one cannot ground sociological realism in a temporal conception of emergence, even though an explanation of how $S(t)$ came to be may require examination

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[6] Note Archer's early acceptance of Brodbeck's "explanatory emergence" (1979) and her explicit rejection of it later (1995, p. 27).

of what Archer (1982, pp. 475–76) called the "analytical history of emergence." The philosophical account shows that the causal explanation may not be reducible to an individual-level explanation, but this is consistent with ontological individualism and does not require a commitment to sociological realism concerning entities or structures.

Blau, Bhaskar, and Archer used emergence to defend an antireductionist position, one that holds that the social level of analysis results from individual actions, and yet takes on an independent existence. Within the terms of the philosophical account, each of these theories of emergence is shown to be inadequate to ground a nonreductionist argument. They fail to realize that supervenience alone cannot support an ontological argument, they fail to realize that supervenience entails that causal powers be grounded in the supervenience base, and they fail to make an antireductionist argument that is consistent with supervenience. After accepting supervenience and acknowledging these failings, one can move forward and accomplish antireductionist goals by using the multiple realizability and wild disjunction arguments; these can provide both an antireductionist account of social properties and an antireductionist account of social causal laws.

UNRESOLVED ISSUES

I began the article by summarizing the current nonreductionist emergentist consensus in the philosophy of mind. I then reviewed two opposed ways that emergence has been conceived by sociologists: first, in a reductionist fashion by methodological individualists, and second, in an antireductionist fashion by methodological collectivists and sociological realists. I used the philosophical account to evaluate each of these, and I concluded that each has flaws or internal inconsistencies that make its conclusions suspect: reductionist conclusions in the case of individualist emergentists, and realist conclusions in the case of collectivist emergentists. Thus several unresolved issues are brought into focus by the philosophical perspective. Below, I identify four issues facing theories of emergence in sociology: realism, causation, process, and characteristics of irreducible systems.

Realism

One of the major contrasts between reductionist and antireductionist accounts of sociological emergence is whether or not they are realist concerning the social. Individualist emergentists acknowledge the existence of emergent social properties, but nonetheless maintain that these prop-

erties are not real but are merely analytic constructs and thus require an explanation in terms of individuals and their interactions. In contrast, Archer and Bhaskar argue that emergence entails a stratified ontology; yet the philosophical account problematizes this claim. Both accept the supervenience of the social on the individual, while claiming that the social entities or structures are ontologically autonomous. Yet social-individual supervenience is difficult to reconcile with this sort of sociological realism (cf. King 1999, pp. 270–72). Nonreductive materialism does not warrant realist claims concerning higher-level entities; rather, it is an argument that higher-level properties may figure in irreducible causal laws. There remains considerable debate about whether or not nonreductive materialism entails that mental properties are real (e.g., Clarke 1999; Kim 1993a). Sociological realists can draw on these debates to develop an account of how social properties can be both supervenient on individuals and yet ontologically independent of them.

Individualists often criticize sociological realists for proposing a dualist ontology; that is, a world in which both individuals and social entities are autonomous realms of reality. Although individualists can potentially gain some support for this critique from the philosophical account, for the most part they go too far in drawing reductionist methodological conclusions from ontological individualism. Although society is supervenient on individuals, social properties and social laws may not be reducible to individual properties and laws. The philosophical account demonstrates that ontological individualism is not necessarily opposed to methodological collectivism.

Nonreductionist sociologists can respond to such criticisms by being more explicit about their ontological commitments and by being careful to distinguish ontological claims (social entities or properties are real) from methodological claims (the social cannot be meaningfully explained in terms of individuals). Collectivist emergentists do not have to argue for a stratified ontology to make the argument against methodological individualism. For example, Archer's earlier nonrealist statements (e.g., 1979, 1982, 1988) took an epistemologically nonreductionist position in proposing that sociologists must accept an "analytical dualism" when considering both structure and action.

Higher-level realism has not been reconciled with supervenience, as the philosophy of mind debates demonstrate. Sociologists who accept the monistic ontology of supervenience and intend to make an antireductionist methodological claim must show why reductionism is not possible, even though groups consist of nothing more than individuals. Multiple realizability and wild disjunction can potentially provide this argument. Many social properties are multiply realized by wild disjunctions of individual beliefs and dispositions, including "being a church," "being a collective

movement," and "being an act of discrimination." Social laws that contain such social properties are likely to be irreducible to individual laws.

Causation

Closely related to the realism issue is the issue of social causation. Collectivist sociologists propose causal laws in which social properties are the causal antecedents. Social causation has been a definitional assumption in many nonindividualist sociological theories, from Durkheim's social fact to Archer's irreducibly emergent properties. Methodological individualists reject the possibility of such laws in principle.

Realist emergentists defend social causal laws by holding that emergent social entities or properties are ontologically autonomous. If the social is ontologically autonomous, then its causation is not problematic, but this leads to the problems associated with realism—ontological autonomy is difficult to reconcile with supervenience. Yet if the higher level is not ontologically autonomous, then how can it have causal power? Due to such concerns, the status of mental causation is hotly debated in contemporary philosophy of mind (e.g., Andersen et al. 2000; Heil and Mele 1993). If emergentists reject a dualist ontology and at the same time argue that higher-level phenomena have causal force, the argument must root that causal force in their emergence from lower-level components. The position suggested by the philosophical account is supervenient causation: There can be social causal laws that are not lawfully reducible to individual terms and laws even though the causal power of the antecedent lies in its individual supervenience base (Sawyer, in press c).

Note that the token event identity assumption that underlies the supervenience thesis entails that the causal power of an emergent property cannot be attributed to events that occurred in the past. For example, Archer argued that social properties are not supervenient on simultaneous individual properties because their "emergence depended upon the activities of previous 'generations'" (1995, p. 169). Although the explanation of a social property's emergence will require an account of how it developed over time—as even individualist emergentists agree—that social property's (ontological) causal power must inhere in its supervenience base in the present. The fact of temporality cannot be used to defend social property realism; note that artificial society and rational choice models also model emergence processes over time, and yet do not infer any realist claims about the properties that emerge.

Collectivist emergentists simultaneously consider two directions of causation: emergence of the higher-level property from the lower level, and downward causation from the higher level to the lower level. Individualist emergentists are reductionist in emphasizing only the first of these pro-

cesses. Most nonindividualist sociological theorists have emphasized this dialectic process, including the otherwise opposed theories of Giddens and Archer. Yet the philosophical account is subtly different from either position; social causation is a lawful relation between a social property and an individual property, such that the causal force of the social property inheres in its individual-level supervenience base. In this sense, social properties constrain individuals, but at the same time, they are supervenient on the actions and interactions of those very same individuals.

Mechanism and Process

Both individualist and collectivist emergentists agree on the empirical importance of analyzing processes of emergence through time. Theories of this process held by individualists and collectivists are remarkably similar. Archer's diagrams of the morphogenetic cycle (e.g., 1995, pp. 156–58) emphasize that social properties must be explained in terms of the "analytical history of their emergence" from their individual supervenience base (1995, p. 167). Similarly, Bhaskar claimed that the realism of synchronic emergence is compatible with "diachronic explanatory reduction," where higher-order entities are explained in terms of the processes of formation from their composing elements (1998, p. 98). In practice this is hard to distinguish from artificial society models of emergence processes, or from Coleman's rational choice method, which examines a three-stage process of "the macro-to-micro transition, purposive action of individuals, and the micro-to-macro transition" (Coleman 1990, p. 19). Although methodologically individualist, Coleman nonetheless accepted that accounts of the macro-to-micro transition could be valuable in sociology (e.g., "the transmission of information from the macro level to individual actors can greatly affect the actions they take and thus affect system behavior," p. 21). But ultimately macro phenomena should be explained in terms of "micro-level actions, their combinations, the feedback from those combinations that affects further micro-level actions, followed by further combinations, and so on" (1990, p. 20).

In their empirical methods for studying emergence, individualist and collectivist emergentists have the potential to find common ground. Both individualists and collectivists agree that some social properties are reducible; others are not reducible, due to complexity considerations; and the only way to determine which is which is to engage in empirical studies of the temporal mechanisms and processes of emergence that give rise to the social property.

For all emergentists, interaction is central; higher-level properties emerge from the interactions of individuals in a complex system. Thus the empirical study of emergence processes requires a focus on symbolic

interaction. Most sociological theorists working in this area have not connected their theories of emergence to the close empirical study of symbolic interaction in groups. In general, theorists of the micro-macro link have not provided an adequate account of symbolic interaction (cf. Collins 1981; Giddens 1984; Rawls 1990). Many individualist emergentists radically simplify interaction into the formalisms of game theory or rational choice theory. At the same time, collectivist emergentists typically focus on much broader time scales and do not study microinteraction. The types of emergence that are observed in human social systems are likely to result from the unique fact that the participating entities are symbol-generating and interpreting agents. The same sorts of emergence will not necessarily be found in systems that do not consist of symbol-exchanging elements. Due to this unique feature of social systems, general systems theories that attempt to explain all levels of complex dynamical systems using the same formalisms (e.g., Holland 1995; Kauffman 1995) may have limited applicability to social systems.

Fortunately, a focus on symbolic interactional processes has been a major turn in contemporary sociological theory, and emergentists can draw on this work. Various strands of microsociology—largely derived from the interactional emergentism of Mead and Blumer—have focused on emergence in everyday communication. For example, conversation analysts have studied how interactional frames are coconstructed and jointly negotiated (see Sawyer 2001b). Exemplary studies have also been conducted by linguistic anthropologists studying ritualization in oral and literate traditions (Duranti and Goodwin 1992).

Characteristics of Irreducible Systems

Collectivist emergentists accept that not all properties of collectives are emergent and irreducible. The average height of a population is an aggregate, and can easily be reduced to properties of individuals, even though it is a property of the collective.[7] At the same time, individualist emergentists like Watkins accepted the possibility that "some large social facts are simply too complex for a full reduction of them to be feasible" (Watkins 1957, p. 107n1). These qualifications point the way toward a common ground between these versions of emergentism.

The philosophical account of wild disjunction shows how a higher-level property could be supervenient on and yet not reducible to its lower-level base. However, the sociologist cannot assume that any given social property manifests wild disjunction; it must be demonstrated to be wildly

[7] Such distinctions have been widely noted in sociological theory (see Lazarsfeld and Menzel 1969; Liska 1990).

disjunctive through empirical study. Philosophical accounts (e.g., Bechtel and Richardson 1993; Fodor 1974) accept that the issue of whether a reductionist or holist approach is appropriate for any given higher-level property or phenomenon is an empirical issue that can only be resolved via scientific inquiry. Before engaging in such study, we cannot know which social properties can be explained through methodological individualism, and we cannot know which are not explainable or predictable in terms of individual-level descriptions. Thus both individualist and collectivist emergentists face an empirical question with regard to any given sociological property: how must we combine lower-level and higher-level explanation in developing a complete scientific explanation of that property?

A significant problem facing collectivist emergentists is that very few have clearly and explicitly defined the properties of systems that are likely to have irreducible higher-level emergent properties. Failure to resolve this question has contributed to the confusion that has allowed emergentism to be adopted in contradictory fashion by both methodological individualists and by realist sociologists. Fortunately, there are several suggestions along these lines from complex systems theory. In the 1980s and 1990s, complex systems theorists began to identify the characteristics of systems within which wild disjunction was likely to hold between system-level properties and the properties of the system's components.

Nonaggregativity.—Wimsatt equated emergence with nonaggregativity and, as such, argued that it is not necessarily incompatible with reductionism (Wimsatt 1986). Aggregative properties meet four criteria, and most social properties do not satisfy them. First, the system property is not a product of the way the system is organized; the parts are *intersubstitutable* without affecting the system property. In social systems, individualists and collectivists alike agree that individuals and subsystems are not intersubstitutable because the network of relationships among individuals is significant. Second, an aggregative property should remain qualitatively similar under addition or removal of a part from the system. Third, the composition function for the property remains invariant under operations of decomposition and reaggregation of parts. Individualists and collectivists agree that these conditions do not hold of many social systems; for example, many social movements manifest threshold phenomena such that the addition or removal of the Nth individual may result in a qualitative change in the system, even though individuals $N - 1$ and before did not. Fourth, there are no cooperative or inhibitory interactions among the parts; thus, the relation between parts and whole is linear (Bechtel and Richardson 1993, p. 266). Again, individualists and collectivists agree that this condition does not hold of most social systems,

because relationships among individuals are often cooperative or inhibitory.

Most social properties are not aggregative and thus are emergent. But under this definition of emergence, a property could be emergent and nonetheless be reducible; even for nonaggregative properties, there must exist some composition function that relates the emergent property to a decomposition of the system into parts with relationships. This is why individualists can easily accept that social systems are not aggregative. The disadvantage of Wimsatt's account is that it is so general that essentially all properties of complex systems will be nonaggregative (as Wimsatt acknowledged [1997, p. S382]), and because it does not address the issue of reducibility, it fails to speak to the essence of the sociological debate, which centers on whether or not an account in terms of individuals and their interactions will be sufficient. Nonetheless, the characteristics associated with nonaggregativity are likely to contribute to the difficulty of reducing a given system property.

Near decomposability.—Decomposable systems are modular, with each component acting primarily according to its own intrinsic principles. Each component is influenced by the others only at its inputs; its function (processing of those inputs) is not itself influenced by other components (Simon 1969). In such a system, the behavior of any part is *intrinsically determined*: it is possible to determine the component's properties in isolation from the other components, despite the fact that they interact. The organization of the entire system is critical for the function of the system as a whole, but that organization does not provide constraints on the internal functioning of components. This was the concept of system that Parsons borrowed from cybernetics; Parsonsian structural-functionalism assumed decomposability, in its elaborate identification of systems and subsystems, and in its focus on status-role sets as decomposable components of systems (Parsons 1951).

In contrast, in nondecomposable systems, the overall system organization is a significant influence on the function of any component; thus, component function is no longer intrinsically determined. Dependence of components on each other is often mutual and may even make it difficult to draw firm boundaries between components (Bechtel and Richardson 1993, pp. 26–27). Parsons acknowledged this possibility with his concept of "interpenetration" (e.g., Parsons and Shils 1951, p. 109), but this phenomenon remained a challenge to the essentially decomposable emphasis of his systems model. Systems that are not nearly decomposable are likely to have emergent system properties that are wildly disjunctive at the level of description of the components, and such systems are thus less likely to submit to reductionist explanation.

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Localization.—A system is localizable if the functional decomposition of the system corresponds to its physical decomposition, and each property of the system can be identified with a single component or subsystem. Functional localizability was a foundational assumption running through Parson's systems theory. In his AGIL scheme,[8] each of the four major systems is defined in terms of its function. Likewise, the lowest-level components—roles—are defined in terms of the function they serve for the system: "There is the same order of relationship between roles and functions relative to the system in social systems, as there is between organs and functions in the organism" (Parsons 1951, p. 115). Collectivities are likewise conceptualized in role terms, and thus defined in terms of their functions (Parsons and Shils 1951, pp. 190–97). The allocation process—which together with the integration process allows systems to maintain equilibrium—serves the function of allocating functions to roles and to subsystems (Parsons and Shils 1951, pp. 108, 198).

If system properties cannot be identified with components, but are instead distributed spatially within the system, that system is not localizable (Bechtel and Richardson 1993, p. 24). Many social properties are not localizable. For example, "being a church" cannot be localized to any of the individuals belonging to the church, nor to any subnetwork of those individuals. Higher-level properties that are not localizable are likely to have wildly disjunctive descriptions at the level of their components, and such properties are more likely to be irreducible to components (Bechtel and Richardson 1993, p. 228). Such systems are more likely to manifest emergence than the localizable systems proposed by Parsons.

The brain is generally agreed to be nonlocalizable in this sense, and much of the theory about localizability has been inspired by connectionist models of brain function in cognitive science. Connectionist models suggest that the density of network connections is related to localizability and decomposability of the system. Likewise, social systems with a high dynamic density are less likely to be decomposable or localizable, and as such they are more likely to manifest social properties that are wildly disjunctive at the individual level of description. In modern societies, dynamic density increases as communication and transportation technology advance, increasing the number and frequency of network connections among individuals (cf. Durkheim 1964, pp. 114–15).

Complexity of interaction.—In complexity theory, notions of emergence are based on interactions and relations among the component parts. For example, the above criteria of nonaggregativity, nondecomposability, and nonlocalizability are all defined in terms of the complex systemic relations among components. Consequently, several emergence theorists have sug-

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[8] AGIL stands for adaptation, goal attainment, integration, and latency.

gested that the complexity of each interaction among components may be another variable contributing to emergence. Darley (1994) proposed that emergence is a function of both the number of units and the complexity of the rules of interaction, and Baas (1994) suggested that emergence occurs when "the interactions are nonlinear" (p. 522). The additional complexity of human symbolic interaction is another characteristic that contributes to the irreducibility of social properties.

All emergentists agree that interaction is central to micro-macro process accounts, although they have differing models of interaction. In mechanical and biological systems, component relations are relatively well understood and well defined. Because they are inspired by such systems, complex dynamical systems models tend to assume extremely simple interactions. Yet as I noted above, although human communication is qualitatively more complex, emergentists have not connected their theories to the study of symbolic interaction in groups. If there is a qualitative difference in the complexity of this communication and that in natural complex systems, then social theories of emergence may need to incorporate a theory of symbolic interaction (cf. Sawyer 1999, pp. 456–60).

CONCLUSION

The concept of emergence has been repeatedly invoked in sociological theory. However, emergence is a slippery concept; several prominent theorists have subtly shifted their positions on emergence throughout their careers. Homans's earlier emergentism was holist (1941, 1950), but in his canonical 1958 paper he had begun a shift toward psychological reductionism, and by 1964 he explicitly claimed that emergence was compatible with reductionism. During the same period, Blau shifted from an individualist form of emergentism (1955) to a less reductionist form (1964) that yet later led to an explicitly collectivist account of structural sociology (1970, 1977). This confusing situation had not changed by the 1990s. Coleman's 1990 book elaborated a methodologically individualist account of emergence, and Archer's 1995 work presented a realist and nonreductionist account of emergence. Like Homans and Blau, Archer shifted her stance on emergence over her career, from a methodological conception of emergence (1979, 1982, 1988) to a realist one (1995).

This article has been an attempt to clarify these competing accounts of emergence by reference to several decades of analogous theory in the philosophy of mind. Borrowing directly from this tradition, I defined the concepts of supervenience, multiple realizability, and wild disjunction that have been used to argue for nonreductive materialism—the position that mental properties are supervenient on the physical brain and yet not

reducible to physical properties. Likewise, causal laws concerning mental properties may not be reducible to causal laws concerning physical properties.

One can use a parallel argument to show that social properties are supervenient on individual properties and yet not reducible to those properties (Sawyer, in press *b*, in press *c*). This account of emergence suggests that methodological individualists cannot argue a priori that all social properties and laws are reducible to individual properties, relations, and laws, and that at the same time, methodological collectivists cannot argue a priori that a given social property is not so reducible. Whether or not a social property is reducible to individual properties, or a social law reducible to individual laws, is an empirical question that can only be resolved through empirical study. The philosophical account suggests a theoretical stance that is partially compatible with both positions, and an empirical program that can help sociologists to resolve these competing claims.

The balance of the argument leans toward a nonreductionist account of emergentism; after all, the philosophical argument originated to counter physicalist reductionism. Most social properties seem on the face of it to meet the criteria of nonreducibility identified in the previous section. Most social properties are nonaggregative, many social systems are not decomposable, and most are not functionally localizable. If so, wild disjunction holds for many social properties, and the nonreductionist arguments presented in the second section of this article are applicable to sociology.

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