Sociology

A Computational Approach to Sociological Explanations

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The capacity to explain important elements of social life is central both to the development of sociological theory and to teaching sociology. This research seeks to expand our understanding of sociological explanation through a computational approach. Explanations commonly encountered in introductory sociology texts are used to develop a typology of explanatory forms. A computational strategy that represents sociological knowledge using a combination of frames, semantic networks, and procedural rules is described. It is then demonstrated that this approach can generate the full range of these explanations for all logical combinations of conditions and for the full scope of sociological knowledge. This approach is also shown to be capable of identifying appropriate explanations, assessing the quality of explanations, and generating new insights.

Keywords: sociology, semantic networks, research methodology, scientific method

The capacity to explain important elements of social life is one of the central goals of sociological theories (Greer, 1969; A. Kuhn, 1974; Mullins, 1971; Reynolds, 1971; Wallace, 1971; Willer, 1967). The nature of explanation has been the subject of considerable examination by philosophers of science (Braithwaite, 1953; Brodbeck, 1968; Hempel, 1965). Sociological explanations are also important for students learning to think sociologically and to view the world with the sociological imagination (Mills, 1959). Despite all of this, the nature and scope of sociological explanations is not well understood. For example, in this article, we will show that sociological explanations of one type sometimes masquerade as explanations of another type (Gans, 1971), and limitations in the explanatory power of some forms of sociological explanation are often overlooked.

OBJECTIVES

This article focuses on explanations. Explanations are only one form of sociological reasoning. There are other important broad types of reasoning that deserve attention as well but are beyond the scope of this article. Those include interpretation, linking empirical observations to abstract concepts, predictions, logical deduction, and so on. By explanation, we

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mean reasoning in which the thing to be explained—the *explanandum*—is explained by a set of logically related statements that together constitute the explanation—the *explanans* (Abercrombie, Hill & Turner, 1994).

This research uses computational models of sociological reasoning to examine social explanations. These models offer many advantages (Braithwaite, 1970; Brent & Anderson, 1990; Diesing, 1971; Northrop, 1947), including forcing us to be explicit, helping to test the validity of our logic, and providing a powerful means to explore the implications of various assumptions. These computational models offer the promise of helping us to understand how sociologists construct explanations and providing insight by simulating sociological reasoning. These computational models of sociological explanation also offer an opportunity to incorporate dynamic interactive sociological explanations in a wide variety of computerized applications for teaching and research. However, we would not go so far as the postmodern cultural leftist French sociologist, Jean Baudrillard (1983), who, in his examination of Disneyland, argues that the boundary between reality and simulation is false.

In this article, we first develop a typology of sociological explanations commonly found in introductory sociology texts. Then we discuss how those reflect broader sociological reasoning and the ways in which they may limit the scope of this study. Next, we specify a computational approach to representing sociological knowledge. This approach represents sociological knowledge using a combination of frames, semantic networks, and procedural rules. We then demonstrate how this computational approach is capable of automatically generating a number of common explanatory forms. Then we show that the program can effectively address all logically possible Boolean combinations of conditions that might occur for each of those explanations. Next, we show that these relatively few forms of explanation cover a wide range of explanations commonly encountered in introductory sociology texts. Finally, we examine the strengths and weaknesses of this approach, assessing its scope, its capacity to generate new insights and to clarify sociological reasoning, and its use for a range of possible applications.

COMMON SOCIOLOGICAL EXPLANATIONS

Apart from articles focusing on theoretical differences, there is little discussion in the sociological literature of common forms of explanation. Even a typology of some of the more common simple forms of explanation encountered in sociology is not available. Rather than beginning with complex and sophisticated forms of sociological explanations, we begin by examining some of the simple explanations commonly encountered in introductory sociology texts. The objective is to identify common forms of explanation used in sociological reasoning, then to determine if we can generate sensible explanations of each type using a single consistent form of representation of sociological knowledge. Explanations found in introductory sociology textbooks are usually neither subtle nor sophisticated. Often, they consist of very simple assertions connecting the event to be explained to a social fact or trend. They typically lack the richness of qualitative theoretical explanations of a Goffman (1959) or the causal sophistication of a Blau and Duncan (1967). Causal explanations typically involve one or at most a few causes and make little attempt to distinguish the amount of contribution of multiple causes—much less consider issues such as spurious or intervening variable explanations (Blalock, 1961). Theoretical explanations are among the more sophisticated explanations offered by introductory texts, yet these too tend to be simplified versions of the theory expressing only a few basic points.

Nevertheless, expressing sociological explanations such as those found in introductory texts provides a good starting point. Surely, we cannot hope to express more complex and

subtle explanations if we cannot at least explain these. In fact, many more complex explanations are likely to be made up of simple components like these. Another advantage of this approach is that the kinds of explanations found in introductory texts reflect the broad scope of sociology. If we can generate explanations that capture the most common types found in introductory texts, then we are on our way to being able to represent the full scope of sociological thinking computationally.

We examined more than a dozen of the current introductory sociology textbooks on the market. This led us to identify the types of explanations described below. We do not claim that this is an exhaustive listing of sociological explanations. However, it does appear to represent the most commonly encountered explanations found in a typical introductory sociology textbook. We found three broad types of explanation (each having several subtypes) that appear to account for the vast majority of explanations in introductory sociology textbooks. These broad explanatory forms are (a) explanations based on social facts, (b) causal explanations, and (c) theoretical explanations.[1]

Explanations Based on Social Facts

The first broad class of sociological explanations are based on social facts.[2] By *social facts*, we are referring to Durkheim's (1895/1958) use of the term to refer to social phenomena that are independent of the individual and that constrain the individual's behavior. These explanations take the general form of explaining the value of a single variable by its own distribution without reference to any other variables or theories. These include explanations based on a statistical tendency, a trend over time, or diversity.

Statistical tendency. A statistical tendency is a statistic or pattern that expresses a tendency toward uniformity, such as a most common or least common category of a distribution. Statistical tendencies are often (but not always) expressed in terms of statistical measures of central tendency such as the mode (the most common category) or mean (the arithmetic average). For example, "Most people in the United States prefer two children" is a statistical tendency that has been supported in surveys of U.S. respondents, and it describes the tendency for most people in the United States to have a certain attitude. Other examples of statistical tendencies include geographic distributions, such as "Divorce is common in all areas of the United States," or even cross-cultural comparisons, such as "The family is a cultural universal found in every society." Such statistical tendencies or patterns provide an explanation for specific facts that are implied by the general pattern. For example, a strong positive satisfaction with family life might be explained by the common finding that "most people get a great deal of satisfaction from family life."

Trend. Trends explain something based on systematic change over time. For example, the declining size of families during the 20th century in the United States is a trend that may help explain why someone's family is small. Other trends include the increased incidence of sex outside marriage, the tendency for people to postpone marriage until a later age, the increased incidence of births outside marriage, and the increased incidence of cohabitation by unmarried couples. A trend is an example of a structural explanation. The trend is a social fact that exists outside and beyond the control of the individual and that may influence the individual. Whereas explaining something as the result of a trend is fairly common, it is not a terribly sophisticated explanation. For example, the fact that a woman age 27 has never married might be explained in part by the trend for people to postpone marriage until a later age.

Diversity or distribution. A diversity explanation points to diversity to explain something. Examples of diversity that may be invoked in explanations include statements such as "Families in the United States are very diverse." Diversity explanations might involve a geographic distribution, such as "Divorce rates vary substantially by county in the United States," or a cross-cultural comparison, such as "The meaning of family varies greatly from one society to the next." Diversity explanations are relatively weak explanations in the sense that they can be invoked to explain almost anything. The diversity of U.S. families might be cited as an explanation for anything from a gay couple living together to a single-parent family to an extended family. The problem is that arguments that explain almost any outcome can predict almost nothing. The fact that families tend to be diverse does little to help us predict the kind of family a person might have. On the other hand, a diversity explanation does explain something and cannot be used when there is not diversity. The absence of the family as an institution in a society, for example, would be quite unexpected and could not be explained by diversity because virtually every society has some form of family.

Causal Explanations

The second broad class of sociological explanations offers explanations based on a causal relationship (Blalock, 1961) or association among two or more variables. Many of these explanations found in introductory texts do not establish a clear causal relationship but take this basic form.

Cause or prediction. One of the most commonly encountered explanations is based on a causal or predictive relationship between two variables. An example of this type of explanation is "Dual-earner families have much higher incomes on the average than do single-earner families" or "Marital satisfaction decreases with parenthood." In many cases, the predictive relationship between two variables is used without establishing that one actually causes the other. So, in most cases in introductory sociology texts, it is difficult or impossible to cleanly separate causal explanations from those in which one variable can help predict the values of another but causality has not been clearly established. Because of this causal ambiguity, such explanations often look something like the following: "This family has a higher than average income, which may be explained by the fact that this is a dual-earner family and dual-earner families have much higher average incomes than single-earner families."

Multiple causes or predictors. Of course, in sociology there are typically several variables that predict or affect any variable, so it is also not uncommon to find multiple causal explanations in which a single variable is explained by multiple other variables. For example, studies have found several factors to be related to marital satisfaction. Hence, explanations for marital satisfaction might look something like the following: "Marital satisfaction is predicted to be higher because you like your spouse as a person, you view marriage as a long-term commitment, and you view marriage as sacred. However, marital satisfaction is predicted to be lower because you do not agree with your spouse on aims and goals, you do not believe that your spouse has grown more interesting over the years, and you do not strongly want the relationship to succeed."

Association. Explanations based on an association of one variable with another look much like causal or predictive explanations except that they are symmetric. For example, one empirical finding is that people in higher social classes spend less time with kin. Because it is not established whether social class affects time spent with kin or time spent with kin

affects social class, this is an association, not a cause. An explanation based on this association might look like the following: "Little time spent with kin might be explained by the fact that the people involved are in higher social classes, and people in higher social classes spend less time with kin." Because this relationship is symmetric, we could also expect the following explanation to be just as valid: "Being in a higher social class might be explained by the fact that the people involved spend less time with kin and people in higher social classes spend less time with kin."

Theoretical Explanations

Hierarchical relationships. All of the explanations outlined thus far can be described as general covering law explanations (Hempel, 1965; Popper, 1959) having the form of a general conditional statement and statements of conditions required for that statement to apply. Hierarchical relationships go one step further and explain a relationship as a special case of another relationship. For example, the relationship "the family helps train new workers for capitalism" is a special case of the broader and more abstract relationship, "the family helps maintain class differences." Goffman's (1959) dramaturgical theory is an example of one theory that relies heavily on such hierarchical explanations.

Traditional structural-functional theory. Traditional functional theory as exemplified by sociologist Herbert Spencer (1876-1896) emphasizes social order, stability, shared public values, and consensus. This view argues that persistent social structures such as the major institutions in a society (i.e., the legal justice system, the health care system, and the family) survive because they contribute to the stability of the society as a whole. Each major element of society affects the whole society in a system of interrelated parts. Disorganization in the systems leads to change because other components must adjust to achieve stability. Such changes can make things better or worse than they were before. Essentially, the argument is that societies that survive are those with social structures that contribute to the society's survival; hence, if a structure is found to persist over a long time in a society, it must have some positive functions for the society.

Expressing this complete theory would require several concepts and relationships. However, for purposes of this article, let us focus on a pair of related relationships required to model the principle assertion of the theory. One of these relationships asserts that the persistent social structure has some consequence. The second relationship asserts that this consequence, in turn, contributes positively to the continued survival of society. The basic functional argument then may be symbolized by two relationships: X causes Y, and Y benefits society, where X is the social institution to explain and Y is one of the consequences of X. For example, a functional explanation of the family might argue that (a) the family leads to the socialization of children, and (b) the socialization of children helps society to survive by teaching children to perform essential roles for society.

Conflict theory. Conflict theory, as exemplified by the work of Karl Marx (1867/1970), argues that social structures can be understood by examining their consequences for different categories of people and that people with the greatest power will use that power to maintain social structures that benefit them at the expense of people having less power in the society. Specifically, Marx argued that economics is the most important aspect of society, dominating everything else, and society is characterized by class conflict in which the capitalist class controls the production of goods and profits unfairly at the expense of workers. Marx further argues that the dominant class shapes ideas and opinions through the control of

major institutions such as the press, religion, and the legal justice system; hence, beliefs of common people tend to support the dominant class. Social change arises from tensions between classes and will eventually produce a workers' revolt. Social order is maintained by domination, not shared values and consensus. Whereas Marx focused on social class differences, the same broad conflict argument has been applied to gender by his colleague, Frederich Engels (1884), and to race by sociologist W. E. Du Bois (1899).

For example, a conflict theory explanation for a social structure might explain its continued existence because it benefits the rich and powerful even though it may harm subordinate groups having little or no power. This is implemented in the program as two linked relationships. One of these relationships asserts that the social structure has some positive consequence for a powerful group in society. The second relationship asserts that this powerful group acts to maintain this social structure because it is to its benefit. The basic functional argument then may be symbolized by two relationships: X has positive consequence Y for a powerful or dominant group Z, and Z acts to maintain X because it serves its interests. For example, a conflict explanation of the family might argue that (a) the family provides for the passing on of advantages from one generation to the next, thus benefiting the dominant class of people who have great wealth, and (b) the dominant class thus seeks to maintain the family as a social institution because it serves their interests at the expense of the poorer working class.

Interactionist theory. There are many variants of interactionist theory in sociology, each of which emphasizes some aspects of the ways in which people interact with one another on the microlevel, including symbolic interactionism (Mead, 1934), dramaturgical theory (Goffman, 1959), and social exchange theory (Blau, 1964). Interactionist theories argue that actions taken by individuals are often based on their own self-interest, whether to convey a positive self-image or to achieve a fair outcome in an interaction. People interpret social life, and their actions are influenced by those interpretations. Social life is socially constructed. For example, one relationship from social exchange theory asserts that people tend to reward the positive acts of others and punish negative acts. Social exchange theory, then, might explain a negative act by a teenager (accusing his sister of disobeying their parents) in response to a negative act by the sister (pointing out to the parents that he had not done his homework).

THE COMPUTATIONAL APPROACH

The program represents sociological knowledge as a series of frames (Brent et al., 1989; Minsky, 1975) linked in a semantic network (Hayes-Roth, Waterman, & Lenat, 1983) and employing procedural rules for reasoning (Waterman & Hayes-Roth, 1978). A frame is a data structure representing a bundle of related knowledge regarding some entity or object (Minsky, 1975). Each frame consists of several slots, each of which represents a specific type of information. Slots are filled by fillers, which may be specific information, a default value, nothing, or a pointer to another frame (Benfer, Brent, & Furbee, 1991). The frames are linked to one another in semantic networks. For example, a relationship frame will point to the concepts that are linked by the relationship, to any broader relationships for which this one is an example, and so on. Procedural rules implemented using object-oriented modules provide the means for reasoning about the frames to produce specific explanations.

Rather than have a unique frame for each specific concept or relationship, this program attempts to represent the broad scope of sociology with a few general types of frames. Each frame represents a key element of sociological knowledge, and the frames were selected to

TABLE 1
Relation Frame for a Specific Relationship

Slot	*Value*
Relation name	College graduates are more likely to have multiple sex partners
Concepts	Education, sexual partners
Theories	None
Description	College graduates are more likely than high school graduates to have had multiple sexual partners during their life
Conditions	College graduates
Features	Multiple sex partners
Examples	48% (almost half) of college graduates have had five or more sexual partners during their lifetime since the age of 18, compared to only 37% of high school graduates
Generalizations	A special case of families play a reduced role in regulating sexual behavior
Studies	Laumann, Michael, Michaels, and Gagnon (1994)
Type	Causal relationship

reflect sociological thinking. The frames in the system include concepts, relationships, theories, researchers, studies, and instances. This general representation scheme was designed to provide a flexible computational structure that could be used for many different purposes. In this article, we will limit discussion to the issue of generating explanations for observed events.[3] For this purpose, we need only consider the frames for relationships. One advantage of representing sociological knowledge by these general frames is that we can generate rules for generic types of explanations and apply those rules to any of hundreds or thousands of specific relationship frames. Thus, this approach is very general yet provides powerful sociological reasoning.

The Relationship Frame

The relationship frame includes slots for the relation name (a phrase describing the relationship), concepts that are related to one another by this relationship, the theories (if any) that include the relationship, a description of the relationship, conditions required for the relationship to hold, features, examples or instantiations, generalizations (a more abstract relationship for which this relationship is a special case), studies that provide empirical evidence or theoretical support, and the relationship type. Table 1 shows the relation frame for a specific relationship.

Explanation Rules

Specific explanations are generated by procedural rules operating on the values found in slots of the relationship frame. We illustrate explanation rules here in pseudocode for two kinds of explanations: causal explanations and structural-functional explanations (see Tables 2 and 3).

As an example, for the relationship in Table 1, "College graduates are more likely to have multiple sex partners," when the condition *college graduates* is true and the feature *multiple sex partners* is also found, the program generates the following explanatory phrase: Multiple sex partners may be explained because we are talking about college graduates, and college graduates are more likely to have multiple sex partners.

TABLE 2
Causal Explanations

```
Examine each relationship in the knowledge base
  Examine each feature for a relationship
    If the feature is present in the data
    Then
      If the condition(s) for the relationship are also present
      Then
        Add to the explanations list the phrase
        "[Feature] may be explained because we are talking about [condition] and [relation]."
      Endif
      If the condition(s) for the relationship are not present
      Then
        Add to the explanations list the phrase
        "[Feature] could be explained by the [relationship type], [relation] if there was evidence of
          [condition].
        "However, we find no evidence of [condition], so we cannot explain [feature]."
      Endif
    Endif
    If the feature is NOT present in the data
    Then
      If the condition(s) for the relationship are present
      Then
        Add to the explanations list the phrase
        "The absence of [feature] is surprising since we are talking about [condition] and
          [relationship]."
      Endif
    Endif
```

TABLE 3
Functional Explanations

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If one relationship of type "causal relation" has as its consequence concept X
  And a second relationship is of the type causal relation
  And the second relationship has X as the independent variable and society as the dependent
    variable
Then
  [Explain this concept by its functions for society]
  Add to the explanations list the phrase "[Concept] can be explained by the positive function(s) it
    has for society."
  Repeat for each function of the concept
    Add to the explanations list the phrase "[Relationship1]"
    Add to the explanations list the phrase "[Concept] contributes to the survival of society
      because it"
      Repeat for each feature of the second relationship
        Add to the explanations list the phrase "[Feature]."
      Endrepeat
  Endrepeat
Endif
```

An example structural-functional explanation generated by the program explaining the family is as follows:

> *Family* can be explained by the positive function(s) it has for society. Families are a major agent of socialization for children. Socialization contributes to the survival of society because it helps

prepare people to perform essential functions for society and prepares children to survive in society. Families regulate sexual behavior and reproduction. Regulated sexual reproduction contributes to the survival of society because it helps assure children will be provided with material and emotional support and it helps reduce the spread of sexually transmitted diseases.

THE SCOPE OF THIS APPROACH

The scope of this computational approach to sociological explanations can be assessed in several ways. First, can it handle all logically possible conditions? Second, can it be used for the full scope of substantive topics in sociology? Third, does it handle the diversity of sociological theories? Related to this is the issue of whether it privileges any area over others.

Logically Exhaustive

To be successful, the program must be able to generate appropriate explanations for all logically possible combinations of conditions encountered. For example, consider the relationship "Births to teenagers are more common among Blacks." There are four possible sets of circumstances that might be found for this relationship:

1. Blacks are present, and births to teenagers are present;
2. Blacks are present, and births to teenagers are not present;
3. Blacks are not present, and births to teenagers are present; or
4. Blacks are not present, and births to teenagers are not present.

The explanations generated by the program, with an accounting of why those are appropriate, are found in Table 4.

In general, the program is capable of generating appropriate explanations for all logically possible combinations of conditions for each explanatory form. This is important because it means the program not only can generate such explanations but also detect when they apply and when they do not.

Substantive Diversity: General Frames

The strategy of representing sociological knowledge as generic frames for fundamental elements of sociological knowledge (such as concepts and relationships) pays great dividends when we want to generalize the explanations to widely different content. The same general rules described here can be applied to relationship frames regardless of the substantive area of sociology expressed by those relationships. This means that the same functional explanation rules used to generate the explanation of the functions of the family above could just as easily be used to explain the functions of religion, deviance, the political system, or any other element of sociology. This approach can generate the same explanatory forms for the full range of sociological content.

If there is any meaningful limitation to the program, it is not in the content as expressed in frames but in the varieties of explanations implemented. Certainly, we could imagine additional forms of reasoning not yet expressed in the program. It appears likely the program could implement a wide range of explanatory forms, and certainly we could test this capacity on specific explanatory forms. However, there is no way to prove that it can adequately express all explanatory forms that might be identified in the future.

TABLE 4
Explanations Generated by Computational Approach

Condition	*Feature*	*What the Program Does*	*Generated Phrase*
Blacks are present	Births to teenagers are present	Explain the feature "teenagers are present" by the condition "Blacks are present" and the relationship "Births to teenagers are more common among Blacks"	Births to teenagers may be explained because we are talking about Blacks, and births to teenagers are more common among Blacks
Blacks are not present	Births to teenagers are present	Identify the relationship that might explain births to teenagers but then point out that the antecedent condition is not fulfilled	Births to teenagers could be explained by the causal relationship "births to teenagers are more common among blacks" if there was evidence of Blacks. However, we find no evidence of Blacks, so we cannot explain births to teenagers.
Blacks are present	Births to teenagers are not present	Point out that the feature could be explained by the condition; however, this feature is not reported	The absence of births to teenagers is surprising because we are talking about Blacks, and births to teenagers are more common among Blacks
Blacks are not present	Births to teenagers are not present	The program can say nothing because neither the condition nor the feature are present	No phrase is generated

Theoretical Diversity: Structure Versus Agency

Of course, explanations depend greatly on one's theoretical perspective. One of the most important issues that must be faced in developing models of sociological explanation is the issue of structure versus agency. Structuralism, on the one extreme, views life as largely determined by social structure, with individual agency affected by structure but having little or no effect on structure. This perspective is exemplified by some forms of structural functionalism or Althusserian Marxism. At the other extreme stand methodological individualism and perspectives such as phenomenology and ethnomethodology, all of which stress the importance of agency over structure. Methodological individualism, in its most extreme form, argues that all sociological explanations must begin and end with the individual. In the middle are efforts such as that of Giddens (1984), who argues for a duality of structure in which structure is simultaneously both the medium and the outcome of the conduct it recursively organizes. The ability of this program to provide appropriate explanations for structural theories such as structural-functionalism and conflict theory as well as for interactionist theories such as social exchange theory, dramaturgical theory, and symbolic interactionist theory demonstrates that this program is capable of representing very diverse theoretical perspectives.

Theoretical bias: Does this approach favor some approaches over others? Our exploration of this approach to date has disclosed no apparent biases favoring some forms of theory over others. However, these models require explicit representation of reasoning in the form of procedural rules. On one hand, this might suggest the approach is better for expressing well-developed and clearly articulated theories where there is a consensus regarding their

explanatory forms and may be less useful for new perspectives still under development. That would suggest this modeling strategy would best serve the interests of established theories and normal science rather than innovative new theories and revolutionary science (T. S. Kuhn, 1970). On the other hand, because these models force us to be explicit in our theoretical development, they may help identify problems and anomalies in existing theories and thus lead to revolutionary science. If there is a lack of consensus in the discipline regarding the nature of specific explanations based on different theoretical perspectives, then this computational framework provides a means to explicitly articulate different views and make those arguments accessible for examination by others. Similarly, the explicitness and precision required for these models may provide a rigorous means to test and refine new theories as well.

CLARIFYING THINKING AND ASSESSING REASONING

Where Does Theory Lie?

This program raises the question of at what level theory lies in our sociological knowledge. For example, a causal relationship asserting that families socialize children is part of the functional explanation described in this article. Yet, that same causal relationship might also be part of a conflict explanation that argues such socialization leads to reproducing the existing class structures. In this case, the structural-functional explanation includes two or more relationships that are components of the explanation. Together, those relationships constitute a functional argument. Alone, this particular causal relationship does not constitute a functional argument. But it might, in combination with still other relationships, be part of an explanation offered by one or more other theories.

Building Blocks for More Complex Theory and Explanations

The fact that components of knowledge can be used as elements of different theoretical explanations highlights another important advantage of this approach to modeling sociological explanations. Individual elements of knowledge can be used as components of more complex arguments to generate more complex explanations. This is important because it means this work, which focuses on some of the simpler explanations found in introductory sociology texts, may provide a foundation for later addressing more complex and sophisticated explanations. Perhaps one day it can even be used to express sociological explanations as complex if not more complex than those of the most sophisticated sociological theory. This computational approach to explanations might help sociologists examine phenomena more complex and subtle than we are capable of conceptualizing today.

Assessing Whether an Argument Fits a Particular Theoretical Perspective

In a 1971 article, sociologist Herbert Gans employed what he described as a structural-functional approach to examine poverty. Gans began with Merton's (1957) extension of structural-functional theory that recognized both functions (positive consequences) and dysfunctions (negative consequences) of a social structure. But then Gans (1971) departs from Merton (1957) significantly. Where Merton defined functions as "those observed consequences which make for the adaptation of adjustment of a given system" (p. 20), Gans

identified functions for particular interest groups. Gans argued that "few phenomena are functional or dysfunctional for the society as a whole, and that most result in benefits to some groups and costs to others" (p. 20). Gans went on to identify 13 economic, social, and political functions of poverty for nonpoor groups in American society. For example, he argued that "because the poor are required to work at low wages, they subsidize a variety of economic activities that benefit the affluent" (p. 21) and "the poor, being powerless, can be made to absorb the costs of change and growth in American society" (p. 22). However, if we try to model this explanation explicitly in our program, we see that it much more closely resembles the conflict perspective than the structural-functional perspective, because consequences of poverty more often benefit specific groups rather than society as a whole.

SUMMARY AND DISCUSSION

This article describes a method for using computer models to generate a wide range of sociological explanations often encountered in introductory sociology texts. Those explanations take three general forms: explanations based on social facts, causal explanations, and theoretical explanations. By representing sociological knowledge as general frames describing relationships among concepts and by implementing each explanatory strategy by procedural rules, the computational strategy described here is able to generate explanations taking any of these explanatory forms. This approach handles all logically possible situations, represents the full diversity of sociological theories, and can be used to provide explanations related to any substantive topic in the discipline. The approach has a number of benefits. It recognizes that specific events may be subject to multiple explanations, some of which may be more powerful than others. It permits specific relationships to be components of explanations offered by competing theoretical perspectives. It permits more complex explanations to be built up from simpler components. It also helps clarify the theoretical provenance of specific explanations. Because this approach implements sociological explanations within a computer program, it makes such explanations available for a wide variety of applications, including teaching, theory building, research, and practice.

NOTES

1. Other explanations commonly encountered in sociology texts, including geographic distributions, cross-cultural comparisons, and norms, can be subsumed as special cases of these explanatory forms. For example, a norm can usually be handled as a statistical tendency explanation (e.g., the norm "People should get married and raise a family" helps explain why marriage is so common), a diversity explanation (e.g., the norm "People have a right to determine their own attitudes toward political issues" helps explain the diversity of political attitudes), or a causal explanation (e.g., the norm "A person should marry someone of the opposite sex" helps explain why most couples are heterosexual couples).

2. Technically, other types of explanations discussed below could also be based on social facts, particularly if they emphasize structure over agency. However, those explanations are better characterized by other elements of their approach, such as causal or theoretical explanations. Here, the social facts explanations are those that cannot be further characterized.

3. Elsewhere, we will discuss using this computational approach to automatically generate questions, answers, and explanations for study guides and tests; to generate different graphical and conceptual views of sociological knowledge; to interpret empirical observations as instances of abstract concepts or relationships; and to create interactive learning experiences and simulations for students. Those other objectives, however, are beyond the scope of this article.

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