

# AXIOMATIC THEORY CONSTRUCTION: LAGS AND LEAPS

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*A balanced and grounded appraisal of Zetterberg's axiomatic method as a tool for sociological theory construction reveals: (1) that the advantages of Zetterberg's method include its (a) insistence on differentiated analytic and synthetic assertions; (b) enhancement of conceptual and propositional clarity and precision; (c) demand for attention to empirical matters; (d) facilitation of communication about theories; and (e) (indirect) responsibility for refining notions about deductive explanation and related topics; (2) that realization of these advantages requires precise application of its components and careful exposition of results; (3) that most sociological theories share the dominant positivistic assumptions underlying the method; (4) that the method's limitations — (a) enormous cost in analytic time and effort; (b) evocation of sociologists' resistance to "reworking" their colleagues' work and to "further formalization"; and (c) lack of determinate formation and transformation rules for performing the method's operations — offset the expectation of the feasibility and fruitfulness of its continued use; and (5) that these limitations suggest that exploration of the symbolic-logical predicate calculus for utilization within the method would be the next step.*

In the twenty-five years since Zetterberg (1954, 1963, 1965) first proposed his axiomatic method of constructing sociological theories, his procedure has received scant attention, despite widespread advocacy of verbal-level deductive systematization as a theory-building strategy (e.g., Bell, 1978; Blau, 1977; Catton, 1978; Cicourel, 1964; Homans, 1974; Meehan, 1968; Merton, 1968; Parsons, 1949; Turner, 1978b). Only eight attempts to use Zetterberg's approach—most of them seriously limited—have appeared in the literature (Bartz and Nye, 1970; Catton, 1961; Cook, 1977; Hage, 1965; Kinch, 1967; Schwirian and Prehn, 1962; Travers, 1976; Zetterberg, 1957).<sup>1</sup> Efforts to criticize the method and axiomatizers' works have also been uneven (Alessio, 1979; Bailey, 1970; Barton, 1966; Blalock, 1969; Costner and Leik, 1964; Duncan, 1963; Fernan, 1966; Gibbs, 1972; Hage, 1966; Kinch, 1967; Movahedi and Ogles, 1973; Prehn and Schwirian, 1963; Turner and Wilcox, 1974). A tho-

rough assessment of the method and its applications has not been provided. Instead, energies have been diverted to proliferating ostensibly alternative approaches, and these have evoked less attention than Zetterberg's (e.g., Berger et al., 1962; Blalock, 1969; Chafetz, 1978; Coleman, 1964; Dubin, 1969; Freeman, 1971; Gibbs, 1972; Glaser and Strauss, 1967; Hage, 1972; Maris, 1970, 1971; Morris, 1977; Movahedi and Ogles, 1973; Nisbet, 1976; Strasser, 1972).

The present study offers a balanced and grounded, though preliminary, appraisal of Zetterberg's strategy. To explore the method's prospects for continued use, this investigation summarizes the components of his procedure, inspects existing applications and criticisms, and develops five major conclusions about the method's strengths and weaknesses.

## *The Method*

Zetterberg's axiomatic procedure calls for analysis of a formulation in terms of three interrelated operations:

1. identification of the formulation's logicals and extralogicals;

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2. examination of extralogicals as concepts and variables, including: classification and ordering of minimum and borrowed primitives and nominal and real derived concepts, evaluation of definitions, and elaboration of variables; and
3. construction of a postulate set of noncontradictory, independent, and nonsuperfluous propositions, from which all other propositions of the formulation (theorems) can be deducted on the basis of "... the derivation rules implied in ordinary language" (Zetterberg, 1954:17).

An application of these operations represents an instance of axiomatization-as-process, designed to reveal the extent of a formulation's theoretic explicitness, to suggest directions for further explication, and to codify the formulation by situating it in relation to others. When the analyzed formulation contains the requisite propositions, this process also yields an axiomatization-as-product, a rendering of the formulation in an axiomatic format. To clarify and illustrate briefly some facets of Zetterberg's method, Chart 1 outlines major features of the only application, to date, of *all* components of the procedure.<sup>2</sup> The note in the chart discusses central methodological concepts underlying the present study.

#### Chart 1

#### OUTLINE OF MAJOR OPERATIONS AND RESULTS OF THE ZETTERBERGIAN AXIOMATIZATION OF HOMANS' THEORY<sup>a</sup>

1. Extrication and inventory of all 119 propositions (the "Homans propositions," *hPs* 1-119) discursively embedded in Homans' (1961) *Social Behavior* and identification of their logicals and extralogicals.
2. Examination of extralogicals as concepts and variables, including: establishment of extralogicals' definitions; location of 20 primitives (*hNs*) and 76 derived concepts (*hDs*); discernment of 11 conceptual orders among *hDs* and of 22 real (vs. 54 nominal) *hDs* embracing 13 synthetic assertions (empirically falsifiable "truth-claims," *hTCs*) hitherto hidden in Homans' "conceptual scheme" (cf. Bierstedt, 1959); identification of the *hNs*' sources in Skinner (esp. 1938, 1953, 1957, 1959); and elaboration of the *hPs*' variables.
3. Identification of 2 types of relations—27 reversible and 92 irreversible ones—asserted in the *hPs*, all 119 of which were found to be otherwise alike in expressing stochastic, sequential, contingent, and substitutable relations.
4. Construction of a *postulate* set of 14 noncontradictory, independent, and non-superfluous *hPs*, from which all other *hPs* (*theorems*) were shown to be derivable.
5. Exposition of the axiomatic rendition obtained, in charts displaying: the *hNs* and their sources; the *hDs*, their definitions and orders, and the *hTCs* uncovered; and the *postulate-hPs* with their relation-types.

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<sup>a</sup>Present space allows only this brief outline. The axiomatization's many, intricate details (technology of its operations, evidence for them, etc.) are fully set forth in Travers (1976). However, a few comments are in order here.

The application summarized in Chart 1 is also the first to be accompanied by an account of the axiomatic process—steps followed, difficulties encountered, and solutions adopted. The many intricacies of this process, the rendition, and Zetterberg's strategy are detailed elsewhere in a monograph (Travers, 1976). Besides furthering explication and codification of Homans' (1961, 1974) exchange theory, this axiomatization substantially amplifies existing information on Zetterberg's mode of theory construction, permitting comprehensive, data-based evaluation of method, applications, and criticisms—the task of the following section.

### *Applications and Criticisms*

For convenience, subheadings which keynote six putative advantages of Zetterberg's method organize the discussion in this section: the method's alleged (1) insistence on differentiated analytic and synthetic assertions, (2) fostering of conceptual clarity and precision, (3) direction of attention to propositional relations and contingencies, (4) enjoining consideration of empirical matters, (5) facilitating communication about formulations, and (6) prompting refinement of notions about deductive explanation in sociology. *Pari passu*, limi-

The axiomatization of Homans' (1961) theory occupied a four-year period of intensive analysis, proceeded independently of Homans' "postulate-theorem claims," and was completed just before publication of Homans' (1974) similarly discursive version. However, there is nothing in the latter calling for modification of considerations developed in this paper.

A *discursive* theory is one presented in "ordinary prose," the typical mode of sociological theory elaboration (Gibbs, 1972). *Theories* or *formulations* are written statements which are products of sociological inquiry and whose import is neither virtually solely empirical nor exclusively methodological, technical, or "expressive" (Rudner, 1966). Like Homans', formulations may to some degree warrant designation as "theoretic formulations." A *theoretic formulation* is an empirically falsifiable set of logically interrelated propositions together with a conceptual scheme; formulations consisting only of definitions or containing in addition to the latter at least one synthetic (empirically falsifiable) assertion, but no proposition, are *nontheoretic formulations*. A *proposition* is a synthetic assertion of a relation between at least two variables; a *variable* is a concept which can exhibit a range of quantitative or qualitative values on the property(ies) comprehended by the concept; and a *concept* is a term (word or phrase) referring to one or more properties common to the members of an at least putatively universal ("open" or spatio-temporally unbounded) class of objects or events. The proposition's operationalized counterpart is the *protocol sentence* or *operational-level proposition* which expresses a "closed" (spatio-temporally bounded) assertion and permits decisions which can be intersubjectively corroborated about its empirical falsification or verification (Braithwaite, 1953; Carnap, 1958; Caws, 1965; Galtung, 1967; Nagel, 1961; Park, 1971; Popper, 1968; Zetterberg, 1965). Throughout this paper, "proposition" or "conceptual-level proposition" refers to the *open* assertion, "operational-level proposition" being used when a protocol sentence is meant.

Rudner (1966) and Zetterberg (1965) discuss the *logical* and *extralogical components* of theories. Extralogicals which are undefined in a theory, although their intended meanings (about which consensus is assumed) may be conveyed by circumlocution and/or example, are the *primitive concepts* of the theory. The latter's *derived concepts* are its extralogicals which are defined via its primitives (possibly with the aid of logicals). Derived concepts defined solely in terms of one or more primitives (plus any necessary logicals) are *first-order* (derived) concepts. Definitions of *second-order* concepts contain one or more first-order concepts, though one or more primitives may also be present. A *third-order* concept is defined via at least one second-order concept; but one or more primitives and/or first-order concepts may also appear in the definition. *Fourth-order* concepts are defined in terms of one or more third-order concepts, in possible combination with one or more primitive, first-, and/or second-order concepts. The procedure may be repeated for *fifth-, sixth-, . . . , and nth-order* concepts, the total number of orders depending on the "logical requirements" of successively defining all of the derived concepts (Schwirian and Prehn, 1962). Ascending conceptual orders represent descending levels of conceptual generality, with primitives taken as zero- or lowest-order concepts. A given proposition is "of higher order" than another proposition, if at least one of the concepts in the former has a higher order than the highest-order concept in the latter. On *propositional relation-types* and attributes of *postulates* and *theorems*, see Carnap, 1958; Galtung, 1967; Kleene, 1967; Nagel, 1961; Popper, 1968; Stoll, 1961; Zetterberg, 1965.

tations and criticisms of Zetterberg's strategy are examined in the light of available data on its use. To guide future inquiry, a later section will assemble these considerations of merits, limitations, criticisms, and applications into five conclusions about the method's problems and prospects.

### *Differentiated Analytic and Synthetic Assertions*

As a benefit of Zetterberg's procedure, Kinch (1967), Schwirian and Prehn (1962), and Zetterberg (1965) point to the method's insistence on clearly distinguishing between a formulation's analytic expressions (logicals, extralogicals, definitions) and its synthetic assertions (propositions). The distinction is crucial, particularly since most sociological formulations are discursive—a type of exposition in which the two sorts of assertions are often blurred and confounded with rhetoric, argumentation, and other extraneous matters (Gibbs, 1972). Both refinement of the logical structure of theoretic formulations and their systematic empirical scrutiny are likely to be impeded until the ordinary conduct of sociological inquiry generally honors the distinction (Abrahamson, 1973; Black, 1961; Catton, 1961; Gray, 1972; Scott, 1971). In a discursive formulation, connotations of terms are more readily confused with denotations; and synthetic expressions may go untested because they are improperly treated as parts of conceptual definitions or otherwise hidden within the exposition. Logical relations among propositions can hardly be traced until propositions have been clearly located and concepts and variables, delimited.

To date, experience with Zetterberg's procedure indicates that his method *does* direct attention to differentiating analytic and nonanalytic assertions *when* application of his strategy utilizes the components of his method *fully and circumspectly*. This was the case in the application Chart 1 summarizes. However, the work of the other axiomatizers tends not to reflect the analytic-synthetic advantage because

their applications have generally been incomplete or careless.

For example, Kinch's (1967) self-concept formulation treats as propositions statements which do not even qualify as such. He does not identify his logicals, primitives, and derived concepts. The latter are not ordered, nor are their definitions examined for nominality-reality. Instead, his conceptual scheme remains largely implicit in the discursive discussion that accompanies his so-called axiomatic rendition. Surprisingly, Zetterberg's (1957) own use of his method to axiomatize a compliant-actions formulation is similarly crude. Though Catton's (1961) work on ethnocentrism's functions and dysfunctions is more exacting, it contains a heavily discursive interlarding, which casts serious doubt on whether synthetic expressions have been singled out. Catton gives no assurance to this effect, either in the form of a search for real concepts or otherwise. A similar deficiency characterizes Schwirian and Prehn's (1962) "axiomatic theory" of urbanization which is, in most other respects, a rather precise and comprehensive application of Zetterberg's strategy. Bartz and Nye (1970) present what are intended as propositions summarizing scattered data from research on early marriage. However, since Bartz and Nye do not state definitions for the ostensibly derived concepts articulated in the variables of their so-called propositions, it is questionable whether the latter are, in fact, propositions. Cook's (1977) work on collective behavior and Hage's (1965) "axiomatic theory" of organizations have the same weakness. Paradoxically, neglect of the conceptual components of Zetterberg's method appears to have hindered reaping the analytic-synthetic benefit.

When application of the method and exposition of results are thorough, Zetterberg's strategy not only differentiates analytic and synthetic assertions; it also yields other, related benefits, to be discussed shortly. As will be seen, the method-properly-used holds promise for explication. By wresting a formu-

lation from its discursive embeddedness, the method recasts the formulation into a shape which is a necessary first step toward explication via more rigorous modes of formalization, for example, mathematics and symbolic logic (Blalock, 1969; Blau, 1971; Coleman, 1964; Galtung, 1967; Hage, 1966; Martindale, 1963).<sup>3</sup> Such recasting is possible at least with discursive formulations sharing the positivistic methodological assumptions which underlie Zetterberg's procedure and dominate contemporary sociology—a positivism calling for deductive explanation of empirically testable propositions via preferably highly formalized theoretic formulations (Wilson, 1970). Most discursive formulations not only share this position; they are also detailed enough to make application of the procedure seem feasible and fruitful (Turner, 1978a; cf. Blumer, 1969; Caws, 1965; Gibbs, 1972; Kaplan, 1964; Rudner, 1966). Such considerations are important, if advantages expected from axiomatizing any given discursive formulation are to compensate for the substantial cost in time and effort likely to be required (recall n. a, Chart 1).

In addition to the expense, other objections can be raised. Since sociologists' commitment to cumulating knowledge by reworking their colleagues' work often amounts to mere lip-service and since explication is foreign to sociological tradition, Zetterbergian axiomatization is likely to meet resistance, if not neglect (Feldman, 1971; Gibbs, 1972). However, chances are good that Zetterberg's method may yet be more widely employed, since his procedure does not involve so radical a break with the sociological tradition of humanistic discursiveness as do other proposals for substantially more formal strategies (e.g., Blalock, 1969; Harary et al., 1965). Some investigators have objected that axiomatization à la Zetterberg may stultify the sociological imagination; yet, in view of the latter's perennial vigor and of the insights axiomatization can produce, the likelihood that use of Zetterberg's method will repress creativity in sociological conceptualization seems remote (Blau, 1971; Kuhn, 1964;

Nisbet, 1976; Rose, 1969; Travers, 1976). The strategy does not mandate particular substantive contents for formulations; use of the method *requires* imagination; and no one is in any event contending that all energies must be devoted solely to explication. Another objection might be that Zetterberg's method may be employed "to manufacture pretentious theories," although use of the method seems equally likely to expose mere pretensions in discursive formulations (Gibbs, 1972:10). Moreover, there may be concern that axiomatic formulations will be uninteresting. But Zetterbergian axiomatization does not rule out conventional styles of presentation. In the same publication, a formulation can be set forth axiomatically and discursively. Whether readers find the discursive exposition dull or engrossing, attempts at further explication (via empirical scrutiny or otherwise) should probably be focused on the axiomatic version (Gibbs, 1972; Zetterberg, 1965).

However, there are two potentially serious problems with Zetterberg's method that the literature has so far failed to confront. First, with most discursive formulations, direct application of his procedure will not be practicable. Extensive preliminary work will frequently be needed to extract relevant discursive materials for appropriate treatment (cf. Chart 1). Such preparation is consequential. At this stage, basic distortions may be introduced, for example, by unwittingly providing the later axiomatic operations with materials which have different meanings or emphases (or are not even included) in the discursive exposition. Available "process information" on applications of Zetterberg's methods is insufficient to permit delineation of general criteria for satisfactory propaedeutics. As already pointed out, only one axiomatization gives details on process. However, this information does suggest that preliminaries ought at least to be explicit. When they are, their adequacy can be independently assessed; and the origins, patterns, and consequences of possible distortions can be specified.

Second, Zetterberg's strategy provides no guidance on what is to be done with any non-propositional synthetic assertions which might be found. His method does not handle these statements, even though it can locate them. The axiomatization outlined in Chart 1 uncovered such assertions; so did Kinch, albeit by default; and there is a reasonable expectation of a high incidence of such assertions in future applications of Zetterberg's method. To be amenable to his operations, these statements must be transformed into propositions (Travers, 1976). However, this is not always possible; and given the great variety of nonanalytic statements used in contemporary sociology, the anticipation that all nonpropositional form does not seem realistic (Gibbs, 1967; 1972). In the axiomatization summarized in Chart 1, the category of "empirical presuppositions" was created to accommodate the nonpropositional synthetic assertions found in Homans' formulation. Although these statements—hitherto hidden away in Homans' "conceptual scheme"—could not be transformed into propositions, this accommodation at least identifies them as the nonanalytic statements that they are (but had not been recognized to be) and points to an area where further explication of Homans' formulation will await advances in knowledge enabling appropriate transformation. A similar expedient may be helpful in future axiomatizations.

### *Conceptual Clarity and Precision*

Advocates of Zetterberg's method have maintained that its use fosters clarity and precision of the concepts in sociological formulations (Catton, 1961; Kinch, 1967; Zetterberg, 1965). As indicated earlier, the second operation of Zetterberg's procedure includes several components which, if used, would very likely do what the proponents claim. Application of these components to Homans' formulation did significantly enhance the latter's conceptual clarity and precision (Chart 1). As shown in detail elsewhere (Travers, 1976), succinct, specific definitional statements were exhibited for Homans' extralogicals, whose conceptual re-

lations indicated for rectifying deficiencies identified in some of Homans' definitions. Moreover, by classifying Homans' primitives as minimum or borrowed, their roots in Skinner's work (as *the* source of Homans' extrapolation) were clearly revealed. The resulting appreciation of the Skinnerian base of Homans' formulation led to recommendations for further explicating the formulation—recommendations which included novel suggestions regarding empirical scrutiny of the formulation.

However, other axiomatizers have not realized the conceptual benefits attributed to Zetterberg's procedure, since these axiomatizers have generally ignored the components of his method which are most likely to produce these advantages. Bartz and Nye, Cook, Hage, and Kinch do not use these components. Zetterberg identifies the primitive and derived concepts of his compliant-actions formulation but presents his concepts and definitions discursively. Catton's work on ethnocentrism is slightly more thorough. Largely discursive, it devotes a footnote to a nondiscursive statement of its conceptual scheme but furnishes only vague suggestions about how the intended meanings of its primitives might be construed. Schwirian and Prehn are more conscientious. Their primitive and derived concepts are differentiated and ordered. Definitions are expressed non-discursively, although assurances are not offered regarding their nominality or their fulfillment of other Zetterbergian criteria of satisfactory definition. Some effort is made to circumscribe primitives' intended meanings, which, however, remain vague. None of the reports identifies primitives as minimum or borrowed, or provides information for a consensus on their intended meanings. Nevertheless, the importance of such meanings cannot be underestimated. They provide a formulation with its "interpretative context" which is crucial to, for example, locating tautologies, operationalizing propositions, and codifying formulations (Gibbs, 1972; Travers, 1976).

"Precision per se is a dubious and boring

virtue" (Zetterberg, 1965:64). However, precision aimed at developing conceptual consensus, refining concepts, facilitating operationalization, and otherwise expediting cumulation of knowledge is hardly a vice, particularly in sociology (Gross, 1959; Kaplan, 1964; Merton, 1968; Smelser, 1968, 1973; Warshay, 1975). Zetterberg's procedure can further these ends—at least to the extent that its users can carefully apply its relevant operations. However, his method is no panacea for the discipline's conceptual schemes, it does not provide solutions to *substantive* problems of sociological conceptualization—problems concerned with questions about, for example, sociology's proper subject matter, the applicability of hypothetico-deductive theorizing to human social phenomena, and the universality (vs. the cultural or historical specificity) of sociological concepts (Blumer, 1969; Gibbs, 1972; Glaser and Strauss, 1967; Nagel, 1961; Wilson, 1970).

#### *Relations and Contingencies*

Barton (1966), Bartz and Nye (1970), Gibbs (1972), Kinch (1967), and Zetterberg (1965) have suggested that Zetterberg's method fosters delineation of the relations propositions express and of contingencies for propositions, thus enhancing *propositional* clarity and precision on sociological formulations. As shown in detail elsewhere, his procedure is designed to handle conceptual- (vs. operational-) level propositions which are causal and bi (not multi-)variate restrictions which the literature on his method has hitherto not recognized (Travers, 1976).

Of all the existing applications of his procedure, only that outlined in Chart 1 offers any assurance about whether its synthetic assertions are amenable to his method. Kinch's nonanalytic statements are not propositions. Zetterberg's compliant-actions rendition fails to provide clues about the relation-types of those nonanalytic statements of this formulation which are propositions. Barton (1966) has properly criticized Hage's "axiomatic theory" for not having clearly indicated the nature of

its propositional relations. Cook's work also ignores this dimension of Zetterberg's strategy. Schwirian and Prehn, who seem to treat their propositions as simple associations, say nothing about relation-types—except to note that they did not bother to establish them for their propositions though it would have been preferable to do so. Bartz and Nye claim that their propositions are stochastic, but other propositional relation characteristics are not suggested. Catton designates all of the relations in his propositions as stochastic and posits that some of the relations are also irreversible; but he gives no specification of their other attributes. Moreover, although the propositions in the axiomatic renditions of Bartz and Nye, Catton, Cook, Hage, Schwirian and Prehn, and Zetterberg are ostensibly bivariate, very little attention is devoted to supplying and appropriate *ceteris paribus* caveats (Simon, 1978). Also, the sense in which many propositions can be regarded as conceptual-level ones is often dubious, particularly in the reports of Bartz and Nye, Cook, Hage, and Zetterberg, who devote little or no attention to their formulations' conceptual schemes. Further, Bartz and Nye, Catton, Cook, Hage, Kinch, Schwirian and Prehn, and Zetterberg do not provide enough information about their synthetic assertions to permit conversion of the latter into the kinds of propositions Zetterberg's procedure calls for.

A similar picture emerges when the axiomatizers' attention to contingencies for their propositions is examined. When appropriately used, Zetterberg's method does prompt systematic delineation of endogenous and exogenous contingencies or parameters (Blalock's 1961; 1968). This is amply demonstrated in the axiomatization of Homans' formulation, where materials are presented which clearly contradict Blalock's (1969) contention that Zetterberg's method deflects attention away from considering the impact of various combinations of a formulation's variables on particular bivariate propositions (Travers, 1976). Indeed, although the method is designed to be applied

to bivariate propositions, multivariate propositions can be generated, once an axiomatic rendition has been obtained (Travers, 1976; cf. Hage, 1977). However, such attention to contingencies and to multivariate propositions embodying them is not a hallmark of other axiomatizations. Catton's and Zetterberg's reports ignore endogenous and exogenous contingencies altogether. Hage and Schwirian and Prehn—to simplify their tasks—explicitly refuse to consider any parameters. But, while Hage (1965:293 and 307) intimates that his bivariate propositions may be endogenously contingent on "variations in organizational effectiveness," Schwirian and Prehn evince no awareness of the possibility of endogenous conditions. Bartz and Nye and Cook merely allude to the importance of eventually taking contingencies systematically into account. And—in an abortive effort to illustrate how axiomatization can facilitate scrutiny of contingencies—Kinch (1967:236-37 and 239-40) adduces, ad hoc, five "factors" which, he says, may affect the "accuracy" of his so-called "proposition 3." However, despite Kinch's belief that his five factors constitute exogenous contingencies, they do not. The factors are not variables; the ways in which they might affect "accuracy" are not traced; a meaning for "accuracy" is not specified; and Kinch's "proposition 3" is not a proposition.

Preliminary inspection of the discursive formulations in contemporary sociological theory suggests a reasonable expectation that their propositions will, in the main, be amenable to Zetterberg's method. Most of the propositions seem to be conceptual-level ones, which are also bivariate or can be made so with the *ceteris-paribus* clause. In addition, the propositions generally appear to assert relations which are more than merely simple associations. However, difficulties can be anticipated in efforts that will have to be made to determine under which (if any) of Zetterberg's thirty-two propositional relation-types the propositions may fall, since information needed to make these determinations may frequently be

absent from the discursive formulations (Blacklock, 1969; Travers, 1976). And, even if the determinations can readily be made, there will remain a problem with Zetterberg's relation-types per se, which is discussed below. In any event, the efforts that can be made should be revealing both about Zetterberg's method and about the formulations to which it is applied. In addition, some welcome order and clarity may be introduced into the welter of contingencies mentioned in discursive formulations.

### *Empirical Matters*

As another advantage of Zetterberg's procedure, several authors have pointed to the method's insistence that empirical concerns be addressed as an integral part of its utilization (Catton, 1961; Gould and Scharag, 1962; Hage, 1965; Kinch, 1967; Maris, 1970; Scharag, 1959; Schwirian and Prehn, 1962; Zetterberg, 1954, 1965). Notwithstanding the view of Glaser and Strauss (1967) an empirical orientation is inherent in Zetterberg's method, which requires that distinctions be made, for example, between synthetic and analytic assertions, theoretic and nontheoretic formulations, and operational — and conceptual-level propositions. Thus, proponents have claimed that the method: affords a systematic, parsimonious summary of obtained or anticipated research findings; enhances the possibility of uncovering by logical generation hitherto unexpressed ("novel") propositions which may be more amenable to empirical scrutiny than propositions already stated; aids in identifying strategic propositions; points to gaps in existing research; expedites discernment of sources and implications of difficulties for propositions not meeting empirical tests; enhances attention to verificational (overdescriptive) studies; permits concepts, variables, and propositions to be more carefully examined in terms of untapped or overlooked potentials for developing rules of correspondence; and fosters accumulation of empirically grounded knowledge.

Compared to the benefits of Zetterberg's



procedure already discussed, the empirical-thrust advantage is widely reflected in the axiomatizers' reports. Catton undertook his axiomatization to establish a basis for a program of empirical inquiry of ethnocentrism. Zetterberg illustrates his compliant-actions formulation with research. Kinch's brief paper cites an impressive array of relevant empirical studies and points to data-gaps and areas of accumulation. Cook's propositions reflect empirical generalizations on collective behavior. Bartz and Nye summarize and cumulate a wealth of early-marriage research in twelve propositions which also point to areas requiring empirical scrutiny. Hage employs his axiomatic rendition to pull together research on organizations; to identify empirically neglected propositions; to raise questions about contingencies, variations in operational definitions, and lack of precise measures; and to generate novel propositions for future research. Schwirian and Prehn's work on urbanization was developed in close conjunction with their analysis of census data. Similar empirical considerations pervade the axiomatization of Homans' formulation. However, not many of these axiomatizations identify strategic propositions or develop potentials for systematic operationalization via explicit, carefully wrought correspondence rules (Blalock, 1968; Sjoberg, 1959; Willer and Webster, 1970; Wilson and Dumont, 1968).<sup>4</sup>

The fact that strategic propositions are not used to focus empirical concerns of these reports may be a clue to the axiomatizers' inattention to aspects of the logical fertility of their renditions (cf. Maris, 1970). For example, although most of the reports take certain non-analytic assertions as Zetterbergian postulates, most of the axiomatizers have employed propositional reduction almost exclusively, thus neglecting the additional propositions that might be derived by definitional and definitional-propositional reduction.<sup>5</sup> Consequently, only a relatively small number of propositions appear, with a concomitantly diminished reliance on strategic propositions.

These deficiencies do not characterize

the Zetterbergian axiomatization of Homans' work, which took pains to show that its postulates were postulates a la Zetterberg and to utilize propositional, definitional, and definitional-propositional reduction (Travers, 1976). Such efforts enhanced logical fertility and provided aid in identifying novel and strategic propositions. There is a reasonable suspicion that, if similar efforts are expended in axiomatizing other formulations, similar fruits will be produced. Also, the report on Homans did scrutinize his formulation for developing systematic operationalizations through explicit, carefully constructed rules of correspondence. The other reports' lack of attention to such rules appears to have three sources. First, these axiomatizers have typically ignored conceptual analysis a la Zetterberg. Concepts and conceptual definitions have tended to remain embedded in discursive contexts; and directions for ascertaining the intended meanings of primitives have been minimal and vague. Without greater conceptual clarity and precision, questions about internal validity—an issue at the heart of developing explicit correspondence rules—can hardly be satisfactorily addressed (Zetterberg, 1965); Second, it may be that acceptable measures simply cannot be developed at a particular stage of knowledge in certain areas. As a result, tendencies may arise to employ available "indicators" on ad hoc or intuitive grounds and to stress further work as a worthwhile endeavor—tendencies often manifest in the axiomatizers' reports. Moreover, although most of the axiomatizers call for further work in the form of verificational studies, none of these calls has been answered. Subsequent efforts to build on or refine the axiomatic renditions, conceptually or empirically, have not been made. Third, unlike the axiomatization of Homans' formulation, the other axiomatic renditions have been set forth in journal articles, where space is at a premium and where axiomatizers' objectives and the richness of detail that might be provided have correspondingly been restricted. The limits set by axiomatizers who have reported their work in articles are understandably quite narrow.

### *Communication About Formulations*

Typically problematic in sociology, communication about formulations is often vitiated by ambiguities and misunderstandings (Turner, 1978a). As Kinch (1967) suggests, application of Zetterberg's method to discursive formulations might overcome these barriers by forcing such communication to make clear, precise, and documented statements focused on specified aspects of formulations being discussed; to restrict consideration of "related" topics to those that are both carefully delimited and demonstrably related; and to elucidate criteria employed for critical appraisal of formulations. To date, communication about the axiomatic formulations at issue in this paper has appeared in a number of sources (Barton, 1966; Duncan, 1963; Ferman, 1966; Hage, 1966; Prehn and Schwirian, 1963; Travers, 1976). These support the contention that the method can facilitate communication about formulations. For example, in these communications, grounds for criticisms are spelled out. Specific, documented questions, objections, and replies are traded which focus on the logical validity of particular derivations, the nature of relations expressed in certain propositions, etc. Misconceptions, vagaries, and misplaced criticisms are not introduced. Nebulous, rambling controversies are avoided. Axiomatizers and critics understand one another and the issues raised. Experience thus prompts the expectation that such advantages might be realized in communication about discursive formulations, once they have been subjected to Zetterberg's procedure. Facilitation of such communication is an important objective, given the proliferation of discursive formulations, the need for their codification, the imposing volume of literature concerned with them, their frequent empirical sterility, and signs of the increasing fragmentation and polycentrism of sociology (Gouldner, 1970; Smelser, 1973; Travers, 1976; Turner, 1978a).

### *Notions About Deductive Explanation*

Cross-cutting the advantages and limi-

tations already discussed, there is a problem with Zetterberg's method which arises from its status as an informal axiomatic procedure (Carnap, 1958; Movahedi and Ogles, 1973; Stoll, 1961). For performing operations, the method relies on "everyday discourse" and "rules implied in ordinary language" (Zetterberg, 1954: 17), not on symbolization and determinate formation and transformation rules (Rudner, 1966). The treacheries of the language and logic of ordinary discourse are well known (Davis, 1962). Thus, the results of existing Zetterbergian axiomatizations may be more apparent than real, though this cannot be ascertained on the basis of implied ordinary-language rules, which are not and are not likely to become explicit or systematic (Caws, 1965; Movahedi and Ogles, 1973; Wallace, 1969). Although application of Zetterberg's method to a discursive theoretic formulation may provide a useful first step or necessary prelude to further formalization, conclusions reached through the application cannot be accepted as firm unless supported by results obtained in such formalization.

Paradoxically, the method's informality has also been advantageous. As Bailey (1970) shows in detail, efforts made to rectify the deficiency have begun though indirectly to refine notions about deductive explanation in sociology. For example, Costner and Leik (1964) have enunciated a "sign rule" for explicitly deducing propositions within Zetterberg's scheme (cf. Barton, 1966). Though often quoted, this rule has been criticized on several grounds (Alessio, 1979; Duncan, 1963; Gibbs, 1972; Maris, 1970; Turner and Wilcox, 1974). The central objection has been that, although the Costner-Leik rule may be useful for interrelating correlational protocol sentences (*operational*-level propositions), the rule is *not applicable to conceptual*-level propositions and their logical interrelationships, with which Zetterberg's method is concerned (Bailey, 1970; Galtung, 1967; Movahedi and Ogles, 1973). Other efforts have also underscored the utility of analytically distinguishing the conceptual-

logical and the empirical aspects of formulations in the context of Zetterberg's method (Blalock, 1968, 1969; Coleman, 1964; Gross, 1959). Subsequent attention has focused on the conceptual-logical aspects of Zetterberg's procedure—especially, on the problem of locating a determinate set of explicit deduction rules. Discussion by Bailey (1970), Gibbs (1972), Movahedi and Ogles (1973), and Turner (1971) suggests three areas of agreement on this problem.

First, it appears that the scope and accuracy of both traditional Aristotelian syllogistic reasoning and the modern symbolic-logical sentential calculus are simplistic when weighed against the manifold deductions made in sociology's theoretic formulations and in envisioned applications of Zetterberg's method (Caws, 1965; Copi, 1965; Kleene, 1967; Maris, 1971). Second, although Zetterberg's propositional relation-types represent the most systematic analysis to date of propositional relations in sociology, determinate formation and transformation rules (or "calculi") specifically handling the 32 types of their possible deductive interrelations do not exist, and "everyday logic" is inadequate to this task. Third, despite the possibility that utilization of symbolization and calculi may introduce analytic problems into sociological theorizing and applications of Zetterberg's method, such tools seem to be indispensable adjuncts to further progress, although *no total* replacement of ordinary by formal language and logic is advocated.

In the light of these considerations, however, the as-yet-unassayed suggestion can be offered that the contemporary symbolic-logical *predicate* calculus may be provisionally adequate for use with Zetterberg's method (Kleene, 1967; Turner, 1971). Developed by logicians specifically for greater scope and accuracy in dealing with complexities surpassing the capabilities of other logistic systems, the predicate calculus handles irreversible *and* reversible or "symmetrical" propositional relations and is applicable to bi- and multi-variate

propositions, as well as to conceptual-level synthetic assertions in nonpropositional form (Caws, 1965; Copie, 1965; Kleene, 1967). Although the calculus is restricted to deterministic relations and requires the not unfamiliar simplifying assumption of a logically closed theoretical system (whose substantive composition remains modifiable, on, for example, empirical grounds), stochastic propositions might be temporarily converted into deterministic ones through a strong interpretation of the *ceteris-paribus* clause—until suitable calculi specific to Zetterberg's relation-types can be developed. Indeed, provisional use of the predicate logistic might expedite development of such calculi. Moreover, the predicate calculus contains formation and transformation rules which can be used to order concepts, ascertain nominality-reality, generate definitions for derived concepts, elaborate and articulate variables, distinguish permissible and impermissible analytic and synthetic assertions, locate postulates, derive theorems, and establish tautologies—economically, rigorously, and with intra- and inter-subjective communicability and verifiability, though perhaps also with reduced "conversion power outside a limited circle of colleagues" (Galtung, 1967: 462). Finally, developments in electronic computer programming and technology suggest that, with provision of adequate instrumentation for the predicate calculus, the speed and accuracy of performing—and verifying—the extensive and complicated steps in Zetterberg's method are likely to be vastly enhanced (Kleene, 1967, 1969; Wang, 1960).

As Maris (1970:1069) has noted, ". . . many sociologists remain unconvinced of the utility of symbolic logic . . . [for sociological theorizing]. . . ." This may be so, because sociologists have barely begun to tap the resources of symbolic logic (e.g., Alessio, 1979; Anderson and Moore, 1957; Maris, 1970; Movahedi and Ogles, 1973). The suggestion regarding utilization of the predicate calculus in conjunction with Zetterberg's method deserves attention as the *next* step to be taken with his procedure. The present investigator has a research in progress on this step.

### Conclusions

Five major conclusions arise from the considerations developed above. *First*, advantages of Zetterberg's method include its: insistence on differentiated analytic and synthetic assertions; enhancement of conceptual and propositional clarity and precision; demand for attention to empirical matters; facilitation of communication about theories; and (indirect) responsibility for refining notions about deductive explanation and related topics. *Second*, realization of the method's advantages requires precise application of its components and careful exposition of results—conditions that have seldom been attained. *Third*, most sociological theories share the dominant positivistic assumptions underlying the method.

The feasibility and fruitfulness of its continued use thus seem indicated. However, *fourth*, this expectation is offset by the method's limitations, including its: enormous cost in analytic time and effort; evocation of sociologists' resistance to "reworking" their colleagues' work and to "further formalization"; and lack of determinate formation and transformation rules for performing the method's operations. *Fifth*, these limitations suggest that exploration of the symbolic-logical predicate calculus for utilization within the method would be the next step. This calculus, the symbolization it presumes, and appropriate computerization may increase the economy, scope, rigor, and verifiability of the method's operations and thus enhance the method's utility for theory construction in sociology.

### Notes

<sup>1</sup>Formulations systematized into "postulate-theorem formats" *independently* of Zetterberg can also be found in the sociological literature (e.g., Blau, 1979, 1977; Gibbs and Martin, 1964; Gould and Schrag, 1962; Kitahara, 1970; Smith, 1977).

<sup>2</sup>Of course, all of the method's components may not be applicable to a particular formulation in a given state of its development — in which case the inapplicable components can pinpoint existing deficiencies and suggest remedies. However, of the eight axiomatic reports cited on p. 11, only one (Travers, 1976) assays such possibilities.

<sup>3</sup>If Maris' (1970) attempt to logicize Homans' (1961) formulation had attended to this first step a la Zetterberg, Maris (1971) might not have been forced to have so many "second thoughts" about his attempt.

<sup>4</sup>According to Zetterberg (1965:157-58), strategic propositions—i.e., those "... which have the greatest pay-off value in the form of deduced additional propositions" — deserve preferred empirical attention, since life is short but the research enterprise, complex and tedious."

<sup>5</sup>*Propositional* reduction logically manipulates propositions; *definitional* reduction uses definitions; *definitional-propositional* reduction combines the two prior deductive modes (Zetterberg, 1965).

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