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Testing a Structural Model of Perception: Conformity and Deviance with Respect to Journal Norms in Elite Sociological Methodology

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The importance of invisible colleges among scientists active in research and publication has been demonstrated repeatedly by sociologists of science (see for example, Price, 1963; Price and Beaver, 1966; Griffith and Miller, 1970; Griffith and Mullins, 1972; Crane, 1972; Mullins, 1973; Gaston, 1973; Mulkay et al., 1975). An invisible college provides a scientist with a social context comprised of colleagues working on similar problems. Within this social context a scientist is in personal communication with other college members directly and/or indirectly through college leaders (see for example, Crane, 1972, pp. 49–56; Gaston, 1973, pp. 151–152) [1]. The important coordinating function provided by leaders within an invisible college has been recognized for some time (see Mullins, 1973, for several examples in sociology, and Mulkay, 1976, for a more general discussion). This recognition has been given renewed emphasis by recent developments in network analysis operationalizing the status/role set in terms of structural equivalence. In this work, invisible colleges are described as stratified systems in which individual scientists occupy positions (Breiger, 1976; Mullins et al., 1977; Burt, 1978; Lenoir, 1979; Hargens et al., 1980). A scientist occupies a prominent position in a college to the extent that she is acknowledged as a source of ideas and advice within the college, which is in turn a function of her publications in reputable journals [2]. This observation is not new but it does correspond to other lines of research showing that scientists' publications in reputable journals affect their personal income (Tuckman and Leahey, 1975), research funding (Liebert, 1976), and overall scholarly prominence in a cumulative process over the course of their careers (Merton, 1968; Cole and Cole, 1973, pp. 237–247; Allison and Stewart, 1974; Reskin, 1977; Gaston, 1978, chaps. 7,8). These results add detail to the widely held view of reputable journals as the fundamental institution in science (see Hagstrom, 1965, chap. 1; Ziman, 1968, chap. 6; Zuckerman and Merton, 1971).

In short, scientists are organized in terms of stratified invisible colleges, and their positions in that stratification are strongly determined by their publications in reputable journals. While this is a straightforward argument it is seriously incomplete, as it is not at all clear what constitutes a reputable journal. In the absence of clear rules declaring which journals are reputable, it is necessary to understand how the reputations of journals are established.

A journal's reputation is determined by the interest maintained in it by a scientific community. At the individual level, a scientist can be expected to be interested in a particular journal as a source of ideas, and as an outlet for his own work, to the extent that he *perceives* the journal to be publishing work more significant than that published in other journals purporting to publish the same type of work. His time spent in reading journals will be allocated accordingly; more time will be given to journals perceived as publishing the most significant work, less to the comparatively trivial journals, and some journals will be ignored altogether. Commenting on his life as a physicist, John Ziman referred to this as a "sort of law of specialization":

> "There are good journals and bad ones, so that we only keep in touch with those likely to contain good papers by reputable authors. There is a sort of law of specialization that ensures that the number of journals containing significant papers on one particular subject does not increase; one simply narrows one's field of vision to keep the influx constant."(Ziman, 1978, p. 119).

At an operational level we claim that the more scientists within an invisible college are interested in a particular journal, then the more "reputable" it will be and the more will publications in it contribute to the prominence of the positions occupied by its contributors within the college.

However, like "reputable", significance is a very ambiguous quality to perceive in an argument. There is nothing inherent in a journal's articles that guarantees them significance such that they stimulate scientists' interest. At best, significance is judged by individuals in terms of consensual standards. Like most such standards, those defining significance have a taken-for-granted nature. They are known, but difficult to articulate. In discussing the ambiguity of excellence, certainly a component of significance, Merton (1960, p. 422) noted that: "Many of us are persuaded that we know what we mean by excellence and would prefer not to be asked to explain". This ambiguity is not confined to the social sciences. Commenting on inference and research, Peter Medawar, a biologist, humorously noted the typical scientist's inability to articulate standards by which research is to be conducted:

> "Ask a scientist what he conceives the scientific method to be, and he will adopt an expression that is at once solemn and shifty-eyed: solemn, because he feels that he ought to declare an opinion; shifty-eyed, because he is wondering how to conceal the fact that he has no opinion to declare." (Medawar, 1969, p. 11).

This empirical ambiguity of significance criteria suggests that scientists do not judge significance completely independently of their colleagues. When evaluating an article, the individual assesses its significance by use of his colleagues as a reference group. As emphasized in Ziman's (1968) essay: "...he does not say, 'Can I believe this?' but rather, 'Would they be convinced by this evidence?'. Far from being impersonal he tries to be omnipersonal in his judgment." (Ziman, 1968, p. 79) [3]. In the process of making such evaluations and being exposed to evaluations made by his colleagues under similarly ambiguous conditions, the scientist comes to be interested in specific journals as the most probable outlets for significant work on a given subject. We suggest that interest in journals is maintained by a social mechanism operating within an invisible college.

Knowledge of this social mechanism is of interest for its own sake. Moreover, such knowledge is important for an understanding of stratification in science. We know that scientists active in research and publication are organized in stratified invisible colleges. Further, the positions they occupy within those invisible colleges are determined in large part by their publications in reputable journals. However, journal reputations are consensual standards maintained by some social mechanism by the very people they help stratify. One side of the reciprocally causal connection between the stratification of scientists and the stratification of journals will be explored in this paper.

In contrast to discussions building on Merton's (1942) description of evaluative norms in science generally, for example, universalism, we are concerned with the social psychological problem of how any norm might be maintained within a scientific community. We describe a social mechanism by which scientists' interest in a journal is maintained as a journal norm, where the journal norm is regarded as a level of interest expected of scientists because of their positions in the social structure of the college [4]. The social mechanism we propose is a special case of a network model of perception. Its adequacy is assessed by considering both conformity and deviance with respect to journal norms in elite sociological methodology as of 1975. While the empirical focus is restricted, this research on journal norms has an importance that extends beyond the sociology of science to structural theory generally. It addresses the fundamental question of how networks of relations among people determine their perceptions of empirically ambiguous objects.

Theory: Network Models of Perception

Following Ziman's metaphorical law of specialization, we wish to account for the extent to which a particular scientist is interested in a particular journal among a set of core journals [5]. A scientist will be interested in a particular journal to the extent that she has evaluated the significance of work on a subject of interest to her, and has concluded that significant work does appear in the particular journal. However, we claim that this evaluation is not made in isolation from other scientists; it results from the operation of a social process. She reaches her evaluation through an omnipersonal social process in which scientific colleagues are combined to define a generalized other for her own perception of significance. The evaluation she could expect from her colleagues as a generalized other, a collegial alter to her ego, constitutes a journal norm. If her evaluation is consistent with that of her generalized alter she will conform to consensual standards of significance.

A model of the social mechanism by which an individual constructs such an alter specifies which others are combined to form the generalized alter. With a generalized alter constructed, a journal norm is then defined as the level of interest in a journal to be expected of a scientist as a reflection of those others the model specifies as having been used to construct the generalized alter. To the extent that the scientist's interest in journals is a result of the modeled social mechanism, her expressed interest should be similar to the normative interest predicted by the generalized alter. The correspondence between expressed and predicted interest, or lack thereof, provides a criterion for assessing the adequacy of the model of the social mechanism. We consider two alternative models.

Traditional sociometry suggests a *relational* model of the social mechanism responsible for an individual selecting particular others as alters. By communicating their uncertainties to one another regarding some empirically ambiguous object, people socialize one another so as to arrive at a consensual evaluation of the object. The study of student attitudes as consensual group standards by Festinger et al. (1950) is a classic analysis setting the tone for subsequent research within this perspective. These authors distinguished between facts, as answers to questions about empirically unambiguous objects in physical reality, and social attitudes, as consensual answers to questions about empirically ambiguous objects:

> "The 'reality' which settles the question in the case of social attitudes and opinions is the degree to which others with whom one is in communication are believed to share these same attitudes and opinions." (Festinger et al., 1950, p. 169).

They showed that those sets of student dwellings grouped together in a court so as to face one another, and occupied by students who tended to choose one another as friends, tended to have fewer individuals expressing attitudes different from the typical court attitude than did courts occupied by individuals with low levels of in-court friendship relations [6]. In a sentence, they found a negative correlation between the density of in-court sociometric friendship citations and the frequency of deviance from court norms. Building on this work, Coleman et al. (1966) found that doctors began prescribing a new antibiotic at about the same time as those doctors whom they cited as sources of medical advice. In words strongly reminiscent of the Festinger et al. study, Coleman and his colleagues reasoned that:

> "When a new drug appears, doctors who are in close interaction with their colleagues will similarly interpret for one another the new stimulus that has presented itself, and will arrive at some shared way of looking at it." (Coleman et al., 1966, pp. 118–119).

A different method of researching the idea of pair homophily has been used in the study of occupational and educational aspirations. Haller and Butterworth (1960) argued that the social context in which such aspirations are made affects them, so that the aspirations expressed by a student's peers are likely to be reflected in his own aspirations. Pursuing this idea, Duncan et al. (1968) compared a student's aspirations to those of the student he cited as his best friend. They used a simultaneous equation model to hold constant socioeconomic background differences between students, and showed that a high-school student's educational and occupational aspirations are strongly associated with those expressed by the person he cites as his best friend.

Building on this tradition, a relational model of the social mechanism responsible for journal norms would construct scientists' collegial alters from those of their colleagues within an invisible college who are likely to communicate to them personally comments which would influence their work within the college. The model is relational in the sense that all that is needed in order to predict homophily between two scientists is a knowledge of their relations with one another. Their overall patterns of relations with other colleagues in their invisible college are not necessary to the prediction.

Let Y_{jk} be a proportion expressing the extent to which scientist J is interested in journal K as a forum for work on a given subject. This proportion will be high if the scientist tends to confine her attention to this journal and low if she pays little attention to it. Let Y^*_{jk} denote the normative interest in journal K that is predicted from the interests of the other scientists making up her generalized alter. Under a relational model, Y^*_{jk} is constructed from other scientists having relations with J. Let z_{ji} be scientist J's tendency to have her work, within an invisible college, influenced by comments personally communicated from scientist I who is also a member of the college. The magnitude of z_{ji} expresses the strength of the tie between J and I. Under a relational model, J would be expected to construct a generalized alter from those of her colleagues I for whom z_{ji} is large. Following the models utilized by Coleman, Duncan and their colleagues, the interest that one scientist expresses in a journal should be very similar to another person's interest in the journal to the extent that this other person is a source of influential comments on the scientist's work: Y_{jk} should equal Y_{ik} to the extent that z_{ji} is strong. Operationally, for a relational model Y^*_{jk} is constructed from those Y_{ji} for which z_{ji} is strong, with those scientists I whose ties to J are strongest contributing more to the construction of Y^*_{jk}. Such a model is constructed below.

Relational models provide a useful reference against which alternative models can be compared, as they have been fruitful in past substantive research [7]. Having made inroads into the substantive research, theory and methodology of an era, relational models can be seen as the dominant representation of the social mechanisms underlying the maintenance of journal norms in an invisible college. However, we propose here an alternative model that provides a more adequate description of empirical data and clarifies systematic errors made by the relational model.

We employ a network model of "structural interests" discussed in detail elsewhere [8] (Burt, 1980a; 1982, chap. 5). This model defines a *positional*, rather than relational, social mechanism responsible for individual scientists selecting particular colleagues to form an alter underlying journal norms. The model takes networks of relations among all actors in a system as input and predicts the extent to which each pair of actors should have similar attitudes. In brief, two scientists should have similar interest in a journal to the extent that they perceive one another as occupying the same position within an invisible college producing work for the journal. The homogeneity arises from the two people each putting themselves in the position of the other and symbolically evaluating the journal as if he were the other. Communication between the two people may or may not be a part of the process. A modicum of algebra and the temporary assumption that journal significance can be measured in terms of empirical criteria can clarify the social mechanism by which journal norms should be maintained as a structural interest.

Imagine that a scientist evaluates journal significance impersonally in some asocial process independent of her colleagues, and that journal significance can be measured empirically. Let τ^*_{jk} be the significance of work in journal K to which scientist J is actually exposed. Of course, τ^*_{jk} could never actually be measured, since significance is empirically so ambiguous. But it is convenient to assume, for the moment, that it could be measured. Assuming that the scientist reads journals in order to obtain significant knowledge and publishes in them, she should derive high utility from a journal to the extent that she perceives it to be publishing significant work. Let u_{jk} be scientist J's (perception of the) utility of journal K as an outlet for significant work. In other words, u_{jk} is the subjective perception of the hypothetical concrete stimulus τ^*_{jk}.

At this point an empirical generalization from psychophysical research is useful. There is considerable evidence that subjective perceptions of a concrete stimulus are related to the intensity of the stimulus by a power function which, in this case, would define u_{jk} as a function of τ_{jk}^* (see for example, Stevens, 1957, 1968):

$$u_{jk} = \mu\left(\tau_{jk}^* - \tau_0^*\right)^{\nu} = \mu\left(\tau_{jk}\right)^{\nu} \quad (1)$$

where τ_0^* is a threshold level of significance below which significance cannot be perceived, so that τ_{jk} is the extent to which the actual level of stimulus exceeds the threshold. The constant μ is determined by the units in which the stimulus is measured, and the exponent ν varies across types of stimuli, ranging from about 0.33 for brightness to about 3.5 for electric shock (see Stevens, 1968, p. 125, for alternative values of ν). There is in addition empirical support for the power function in regard to less easily measured responses, such as the perception of prestige derived from levels of education or economic achievement (Hamblin, 1971, 1974).

The increase in utility that scientist J would perceive in journal K as a result of a small increase in the concrete significance of the journal to which he is being exposed is given by the partial derivative of eqn. (1) with respect to τ_{jk}—assuming that he makes this evaluation independently of his colleagues:

$$\partial u_{jk}/\partial \tau_{jk} = \nu\mu\tau_{jk}^{\nu-1} = \nu\left(\mu\tau_{jk}^{\nu}\right)/\tau_{jk} = \nu\left(u_{jk}\right)/\tau_{jk} \quad (2)$$

For $0 < \nu < 1$, this states a marginally decreasing perception of utility. A small increase $\partial\tau_{jk}$ in exposure to significant work in journal K would yield decreasing increases ∂u_{jk} in the journal's utility as existing exposure τ_{jk} to significant work in the journal increases. For values of ν greater than one, scientist J's perception of significance in the journal would increase exponentially with unit increases in exposure to significant work in the journal [9].

The evaluative process implied by eqn. (2) is emphasized here. For all values of ν, the criterion against which increased exposure to significant work is evaluated is the scientist's current level of exposure, the denominator in the equation. Other scientists are considered nowhere in the equation.

Given the importance of evaluations of journal significance and their ambiguity, however, it seems eminently reasonable for a scientist to ask those of her colleagues who influence her work within an invisible college for their opinions regarding the significance of a journal or a specific article in it. This would lead to a relational model of scientist interest in a journal. The communication with some colleague I would result in J's evaluation of journal K being based on the significant work to which she has been exposed (τ_{jk}) as well as the significant work to which the colleague I has been exposed (τ_{ik}) to the extent that z_{ji} is strong. It seems likely that such a process could occur from time to time within an invisible college. Such a process could not be responsible for evaluations of journal significance generally, however, because of limitations of legitimate opportunities for communicating evaluations. Time is a precious commodity among scientists active in research and publication. Consequently, there is little time in a scientist's schedule for negotiating consensual standards of excellence with her colleagues. Acknowledging this scarcity of time, members of an invisible college can be expected to refrain from badgering one another with questions regarding an idea's significance every time such a question arises for a member. The members are aware of the limited number of such questions they can legitimately ask a colleague to respond to, not to mention the limited number their colleagues will tolerate. In addition to limited opportunities, there are often prohibitions against communicating significance evaluations until they are complete. The idealized referee process contains one or more reviewers within an invisible college who render an impersonal evaluation of the significance of a paper being considered for research funding or publication. In making this evaluation, a referee is explicitly prohibited from discussing the evaluation with colleagues either because they are closely associated with the paper's author or because they too are being asked to evaluate its significance impartially.

In the face of these constraints on actual communication during a scientist's evaluation of significance, the ambiguity of significance itself calls for some form of symbolic communication between the scientist and his colleagues. We return to Ziman's (1968) remark on scientific evaluation: "...he does not say, 'Can *I* believe this?' but rather, 'Would *they* be convinced by this evidence?'" (emphasis added) and argue that scientists can place themselves in the position of a colleaque and ask "How would I evaluate this object's significance if I were my colleague?". This symbolic role-taking between members of an invisible college allows a scientist to take the position of any other member as an alter in terms of which he may evaluate significance by pretending to be that person for a moment during the evaluation. But this role-taking occurs in the context of a stratified invisible college. Members of the college are not equal, some being more prominent than others. When scientist *J* evaluates the significance of a piece of work it is not immediately obvious which position will be adopted for the evaluation. Under the network model of perception-generating structural interests proposed here, a scientist will respond as the occupant of his position in the network of influence relations among members of the invisible college. Given their image of this network, together with the flow of interpersonal influence within the college, individual scientists can locate themselves. For evaluating significance, an alter is selected by a scientist according to the extent to which he is structurally equivalent (within the invisible college) to the scientist making the selection.

The question "Would they be convinced by the evidence?" becomes

"Would a scientist of my standing within the college be convinced?". Operationally, "of my standing" is treated here as "structurally equivalent to myself".

The extent to which two scientists within an invisible college are involved in different patterns of influence relations within the college is given by the distance between them in the overall network of such relations within the college [10]. The two scientists are identically involved in influence relations, that is, they are structurally equivalent, to the extent that this distance equals zero (see Burt, 1980b, pp. 100–107, for a review and references on structural equivalence in network models). Let $d\max_j$ be the maximum distance separating scientist J from any member of the invisible college for which distances have been defined. This quantity minus her distance from scientist I, $d\max_j - d_{ij}$, measures the similarity between the relational patterns in which I and J are involved within the college.

This structural similarity is an objective condition that can be perceived in different ways by different members of the college. According to the perceptual model in eqn. (1), scientist J's perception of his structural similarity to scientist I is a power function of the actual similarity between I and J: $\mu(d\max_j - d_{ij})^{\nu}$. Since distances are meaningful only in comparison to other distances within the same system, this perception of similarity can be normalized by the extent to which scientist J sees himself as similar to all scientists in the college. This gives the extent to which scientist J perceives scientist I as the only other scientist structurally equivalent to J:

$$l_{ij} = (d\max_j - d_{ij})^{\nu} / \sum_{q}^{N} (d\max_j - d_{qj})^{\nu} \tag{3}$$

These structural-proximity coefficients vary between zero and one, summing across all persons I to equal one. The extent to which scientist I is perceived by J as similarly involved in influence relations within the college is given by the extent to which l_{ij} is greater than zero. The exponent allows perceived similarity to vary for different kinds of perceptions. Its magnitude determines the extent to which scientists involved in relational patterns different from J's are perceived (by J) as similar; the higher ν is, the more those differences are emphasized [11].

The above ideas come together in a network model of perception. The partial derivative in eqn. (2) states that scientist J perceives increased utility (∂u_{jk}) in journal K with increased exposure ($\partial \tau_{jk}$) to significant work in the journal with respect to her existing exposure (τ_{jk}, the denominator in the equation) to significant work in the journal. In the social context of a stratified invisible college, this evaluation is affected by those colleagues perceived to be structurally equivalent in the sense that they are similarly involved in the flow of interpersonal influence within the college. The extent to which scientist J perceives I as a colleague in this sense is given by l_{ij} in eqn. (3). As an extension of eqn. (2), the following linear composite states that scientist J will evaluate significance as if J were each other member I in an invisible college to the extent that J perceives herself as structurally equivalent to I in terms of influence relations within the college:

$$\begin{aligned} \partial u_{jk}/\partial \tau_{jk} &= l_{lj} \nu u_{jk}/\tau_{lk} + l_{2j} \nu u_{jk}/\tau_{2k} + \ldots + l_{Nj} \nu u_{jk}/\tau_{Nk} \\ &= \sum_{q}^{N} l_{qj} \nu (u_{jk})/\tau_{qk} \\ &= \sum_{q}^{N} l_{qj} \nu (\mu \tau_{jk}^{\nu})/\tau_{qk} \end{aligned} \tag{4}$$

In essence, this equation has scientist J take each member I of an invisible college as an alter in terms of whom J might evaluate significance. Note that each component summed in the equation corresponds to eqn. (2) with a weight given by l_{ij} for the ith component. In place of the one denominator τ_{jk} (scientist J's own exposure to significant work in journal K) in eqn. (2), eqn. (4) has J consider the exposure τ_{ik} experienced by each other member of the college. The relative importance of scientist I's exposure to J's final evaluation is given by l_{ij}, the extent to which J perceives I as a structural peer within the college. The network model of perception from which eqn. (4) would have been derived is given by integrating the equation [12]. This yields

$$u_{jk} = \left[l_{jj} + \sum_{q}^{N} \nu l_{qj} \tau_{jk}/\tau_{qk}(\nu + 1) \right] \mu \tau_{jk}^{\nu} \quad q \neq j \tag{5}$$

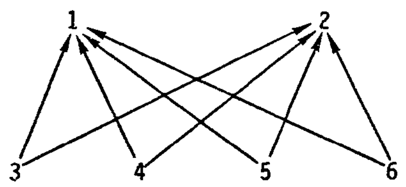
The bracketed term in this equation is a modification of the empirical generalization from psychophysics given in eqn. (1). When scientist J is structurally unique (i.e., alone) within an invisible college, the social context of evaluation disappears, since the bracketed term equals one (l_{ij} is zero for all I except τ, $l_{ij} = 1$). In this situation, eqn. (5) reduces to eqn. (1). When scientist J occupies a position in a stratified invisible college, however, J's evaluations will be interdependent with those of the other members perceived by J to be structurally equivalent to J in terms of interpersonal influence within the college. More specifically, scientists I and J will have identical evaluations of a journal's utility to them as an outlet for significant work under whatever conditions result in u_{jk} being equal to u_{ik}.

It can be shown that this equality occurs only if the two scientists are structurally equivalent and currently experiencing identical levels of exposure to significant work in the journal [13]. But exposure to significant work in the journal is a hypothetical measure which we introduced in order to explain the role-taking behavior implied by the model. In the case of a stimulus which has no clear empirical reality by which it can be measured, all persons have equal exposure to the stimulus, since there is no concrete stimulus. In this case, the critical condition for two scientists I and J to perceive equal utility in a journal in terms of its significance is the extent to which they perceive one another as structurally equivalent. When I and J are structurally equivalent, u_{jk} will equal u_{ik} for all journals K publishing work pertinent to their invisible college. Accordingly, they should be similarly interested in any one journal K as the journal publishing the most significant work in the college. In other words, Y_{jk} will equal Y_{ik} as a function of u_{jk} being equal to u_{ik}, which is in turn determined by scientists I and J perceiving one another as structurally equivalent within their invisible college (i.e., $l = l_{ij} = l_{ji} = l_{ii} = l_{jj}$).

As a social mechanism responsible for journal norms, this positional model states that a scientist constructs a collegial alter from those of his colleagues within an invisible college whom he perceives to be his structurally equivalent peers in the flow of interpersonal influence within the college. In contrast to a relational model, in which J would be expected to construct an alter from those colleagues I for whom z_{ji} is high because of I communicating influential comments to J, this positional model expects J to construct an alter from those colleagues I for whom l_{ij} is high because of J symbolically taking the positions of J's structural peers within the college during J's evaluations of significance. The model is positional in the sense that in order to predict homophily between two scientists it is necessary to know the entire pattern of influential communication relations connecting them with each member of an invisible college. In contrast to the relational model, predictions cannot be made if it is only the relations between the two scientists that are known.

While the positional and relational models are related conceptually, they are also distinct and their different empirical predictions can be illustrated by a simple example. Consider an invisible college composed of six key members and a variety of other persons randomly attached to these six. Two of the six key members are intellectual prima donnas responsible for initial advances in the subject addressed in the invisible college. These two scientists hold positions in the same university department. They trained the remaining four key members who have since taken positions at separate universities. In response to a sociometric question asking each key member to name those persons with whom she has personal communication whose comments have the highest influence on her work in the college, the two senior figures each say that no such person exists and each of the four other members claims such a relation to the two senior figures. The resulting sociogram for the college appears in Fig. 1. If relations are treated as binary, values of z_{ji} are as given in the adjacency matrix presented in the figure. Distances between members and structural-proximity coefficients can then be computed from these relations: d_{ij} and l_{ij} are presented in Fig. 1, where ν, for the purpose of this illustration, has been set equal to one. How would interest in a journal be distributed in such a system?

Under a relational model, Y_{jk} will equal Y_{ik} to the extent that z_{ji} is strong. In other words, the four erstwhile students would be expected to be influenced by their communication with the two senior figures and so reflect similar interest in a journal as an outlet for significant work in the college. This is a center–periphery model of journal norms in the sense that significance evaluations by the two leading figures at the structural center of the college determine interest in journals as journal norms for the whole college.



0	0	0	0	0	0	
0	0	0	0	0	0	
1	1	0	0	0	0	$= \{z_{ji}\}$
1	1	0	0	0	0	
1	1	0	0	0	0	
1	1	0	0	0	0	

0.0	0.0	2.4	2.4	2.4	2.4	
0.0	0.0	2.4	2.4	2.4	2.4	
2.4	2.4	0.0	0.0	0.0	0.0	$= \{d_{ij}\}$
2.4	2.4	0.0	0.0	0.0	0.0	
2.4	2.4	0.0	0.0	0.0	0.0	
2.4	2.4	0.0	0.0	0.0	0.0	

.50	.50	.00	.00	.00	.00	
.50	.50	.00	.00	.00	.00	
.00	.00	.25	.25	.25	.25	$= \{l_{ij}\}$
.00	.00	.25	.25	.25	.25	
.00	.00	.25	.25	.25	.25	
.00	.00	.25	.25	.25	.25	

Fig. 1. Stratification Among the Six Key Members of a Hypothetical Invisible College.

Under the positional model, Y_{jk} will equal Y_{ik} to the extent that l_{ij} is greater than zero. The results in Fig. 1 show that the two leading figures are structurally equivalent to one another ($d_{12}=0$, $l_{11}=l_{22}=l_{12}=l_{21}=0.5$), and the four erstwhile students are structurally equivalent to one another (again, they are separated by zero distance and have equal proximity coefficients with one another). In other words, the two leaders would be expected to use one another as an alter in making significance evaluations. Even though their rival leadership prevents them from communicating with one another, they constitute a reference group for one another as leading figures in the invisible college. Similarly, the four second-generation members would be expected to use one another as alters, since they too occupy the same position within the college. When making a significance evaluation as a second-generation member of the college, each of them would be expected to put herself in the position of each of the other second-generation members to imagine how the evidence being evaluated might appear to that significant other. In short, the positional model predicts that the two leaders will adhere to one set of journal norms and their four erstwhile students will adhere to their own set of journal norms. This may or may not appear as a center–periphery model of journal norms, since similarity in the interests of the leaders and the remaining four members is merely an empirical question under the postional model. If the leaders do not adhere to the same journal norms, however, or if the four second-generation members of the college do not adhere to the same journal norms, then the positional model is wrong. If all members of the college adhere to the same journal norms, then the positional and relational models are correct. If the leaders adhere to one set of journal norms and those norms are different from the ones to which the second-generation members adhere, however, the relational model is wrong and the positional model is correct.

Data: Elite Sociological Methodology

We here describe the nature of the data used to test the theoretical ideas generated in the previous section. Elite experts were located as follows. An initial sample of 59 persons was obtained by selecting names from a list of editors and readers between 1973 and 1974 for nine prominent journals in the area. Each sampled person listed either mathematical sociology or methods/statistics as an area of special competence in the 1973 American Sociological Association (ASA) *Directory of Members*. Also, each person received a high number of citations of their work according to the *Social Science Citation Index* for 1973 and 1974. Each of the initial sample of experts was sent a questionnaire asking for the names of three persons with whom he or she had personal communication whose comments had the highest influence on his or her methodological or mathematical work. Respondents gave zero to five names. If a person outside the positional sample was cited by more than one respondent, the outsider was also sent a questionnaire. In this manner, the initial sample was snowballed to include all persons likely to exercise influence in the area. Of the 75 persons finally identified, 16 from the initial sample were not cited by other experts and made no citations of other experts. These individuals were deleted, leaving 59 persons as elite experts in sociological methodology. Questionnaires from 52 persons provided complete information for the present analysis (88% completion rate). The (52,52) asymmetric matrix of sociometric choices among these respondents was then raised to successive powers to locate the shortest chain of choices required by each expert to reach each other expert and then normalized so that z_{ji} would vary from zero to one according to the extent to which expert J could reach expert I in a smaller number of steps than he required to reach other experts (see Burt, 1976, pp. 118–119).

Perceptions of journal significance as a desirable outlet for each expert's work were operationalized in the following three steps.

(1) Respondents were asked to name those journals "which you believe publish the articles having the most significance for sociologists working in the area of ———", where "methods and statistics" or "mathematical sociology" was inserted depending on the respondent's special competence listed in the 1973 ASA *Directory of Members*. This established the domain of journals in which the respondent was interested.

(2) Respondents were then asked to indicate "the level of your interest in publishing articles concerning the area of each journal... Use articles in the *American Sociological Review* (ASR) as a reference point. Let your interest in publishing an article in the area in ASR equal 10. A level of interest of 5 for a journal below indicates that you are half as interested in publishing in that journal as you are in ASR concerning the subject matter. A level of 20 for a journal indicates that you are twice as interested in publishing in that journal as you are in ASR concerning the subject matter." [14]. This procedure, borrowed from Glenn (1971), determined each respondent's relative interest in the journals he or she named.

(3) These rating were normalized so that comparisons could be made across respondents. Each respondent's raw ratings were normalized by the range of his or her perceived domain of significant journals. Not only are separate journals perceived as differentially significant in comparison to ASR, experts differ in the number of journals that each perceives to be publishing significant work. Imagine that expert A named ASR and the *American Journal of Sociology* as the only outlets for significant work, while expert B named many journals in addition to these two. Even if the two

experts gave equal ratings to the two journals, they do not have equivalent perceptions of journal significance. Expert A allocates a higher proportion of her total interest to publishing in the *American Journal of Sociology* than does expert B, owing to the larger domain of journals that B perceives to be publishing significant work. To borrow Ziman's pithy phrase, A is operating under a more restrictive "law of specialization" than is B. In order to hold these inter-expert differences constant, Y_{jk} is analyzed as the proportion of expert J's total publishing interest that is allocated to publishing in journal K: $Y_{jk} = Y^{\dagger}_{jk} / \sum_{k=1}^{k_j} Y^{\dagger}_{jk}$ where $Y^{\dagger}_{jk}$ is actor J's raw rating of his interest in publishing in journal K in comparison to ASR, and k_j is the number of journals he perceives to be publishing significant work in sociological methodology.

Across the 52 respondents, 31 journals were named as publishing significant work, 23 of which were named at least twice. Averaging Y_{jk} across respondents suggested that there are eight core journals in sociological methodology. Routine statistical inference using t-tests allows the null hypothesis of no interest ($\bar{Y}_k = 0$) to be rejected beyond the 0.001 level for only the following journals: the official journal of the American Sociological Association—the *American Sociological Review* (ASR), the *American Journal of Sociology* (AJS), the annual methodology volume sponsored by the American Sociological Association—*Sociological Methodology* (SM), the *Journal of the American Statistical Association* (JASA), *Sociological Methods and Research* (SMR), *Social Forces* (SF), the *Journal of Mathematical Sociology* (JMS), and *Social Science Research* (SSR).

We have described to procedure for identifying the members of the invisible college, the interest of the journal to these experts, and the core journals of the invisible college. As described in the estimation section (below) data were also needed for two additional variables: publishing activity in and editorial control over the core journals. The number of manuscripts each expert had authored or co-authored since 1969 (the beginning of the rapid rise of the invisible college) to the middle of 1976 (to account for manuscripts in press as of 1975) was obtained by coding past issues of the eight core journals [15]. Respondents to the question eliciting names of journals publishing significant work were also asked to "indicate the number of papers you have been sent for review during the past two years for each journal". These data were used to compute measures for each journal K expressing the proportion of sociological methodology manuscripts refereed by each of the elite experts [16].

Structural Models

The arguments in the theoretical section do not fully specify the relational or positional models. We do so here with a view to establishing an estimable model of the perception and distribution of journal norms. Three distinct issues are considered.

The first of these is the construction of a journal norm as the level of interest to be expected of a scientist J because of the interests of a collegial alter. There are at least three types of models which could be used to construct a journal norm Y^*_{jk} as the interest in a journal expressed by J's collegial alter. These are actor alter models, group alter models, and generalized alter models.

An actor alter model would state Y^*_{jk} in terms of the interest in journal K expressed by the *one* other person I most likely to be a collegial alter for J:

$$Y^*_{jk} = Y_{ik}, \text{ for some } i \tag{6}$$

Under a relational model, this one colleague would be the person I with whom J has the strongest personal communication relation in terms of influencing J's work within an invisible college. Under the positional model, the one colleague I would be the person J perceives as most structurally equivalent to J in terms of being similarly involved in the intracollege flow of interpersonal influence.

A group alter model defines Y^*_{jk} as the mean interest in journal K expressed by the subset of other persons I most likely to be collegial alters for J:

$$Y^*_{jk} = \sum_{i}^{T} Y_{ik}/T \tag{7}$$

where T is the number of persons in the subset for scientists J. Under a relational model, this group of colleagues would be the other members of a clique containing scientist J who socialize one another through their strong communication relations. Under a positional model this group of colleagues would be those scientists with whom J is structurally equivalent within the invisible college [17].

Under a generalized alter model the interest in journal K to be expected of scientist J is a weighted composite of the interests expressed by each other member of the invisible college:

$$Y^*_{jk} = \sum_{i}^{N} w_{ji} Y_{ik} \tag{8}$$

where the weights are proportions ($0 \leqslant w_{ji} \leqslant 1$, $\Sigma_i^N w_{ji} = 1$). The individual J is excluded from J's collegial alter by setting w_{jj} equal to zero. Under a relational model, the weight w_{ji} would be non-zero to the extent that colleague I is a close source of influential comments for scientist J. A direct definition of weights under a relational model, for example, would be the extent to which I is the only source of influential comments for scientist J:

$$w_{ji\mathrm{r}} = z_{ji} / \sum_{q}^{N} z_{jq} \quad q \neq j \tag{9}$$

where the subscript r refers to a weight consistent with a relational model. Under the positional model, the weight w_{ji} would be non-zero to the extent that J perceives colleague I as a structurally equivalent peer within the invisible college. This perception is given by the structural-proximity coefficient l_{ij}, so that weights under the positional model could be defined as the extent to which I is the only other member of the college that J perceives to be his structural peer:

$$w_{ji\mathrm{p}} = l_{ij} / (1 - l_{jj}) \tag{10}$$

where the subscript p refers to a weight consistent with the positional model.

The second issue concerns the use made of Y^*_{jk}. Let $\mathbf{Y}_k = (Y_{1k}, Y_{2k}, \ldots, Y_{jk}, \ldots, Y_{Nk})$ be the vector of actual interest in journal K for all N members of the invisible college. Similarly let $\mathbf{Y}^*_k = (Y^*_{1k}, Y^*_{2k}, \ldots, Y^*_{jk}, \ldots, Y^*_{Nk})$. Both the relational and positional models claim a positive relation between $\mathbf{Y}_k$ and $\mathbf{Y}^*_k$; moreover, $\mathbf{Y}^*_k$ is seen as a determinant of $\mathbf{Y}_k$. However, network-generated norms are not the sole determinant of perceptions of journal quality. In any modeling strategy, it seems important to take into account personal differences which might bias a specific individual's expression of a norm. In the case of scientists' interest in a journal, such differences consist of differences in the publishing and editing activities of individuals. A healthy self-concept should result in a scientist perceiving significant work in a journal publishing her own work. Similarly, she can be expected to perceive significant work in a journal over which she exercises editorial control, since she is responsible for the work appearing in the journal. Let $\mathbf{X}_{1k}$ be the variable, editorial control of journal K, where the jth element is the proportion of manuscripts submitted to journal K from the invisible college which are reviewed by scientist J. Let $\mathbf{X}_{2k}$ be the variable, publication in journal K, where the jth element is the number of papers published by J in journal K. A population model can now be posited in which scientists' interest $\mathbf{Y}_k$ in a journal K results from journal norms as collegial alters' interests $\mathbf{Y}^*_k$ in the journal result from individual editorial control over the journal or from publishing activity in the journal:

$$\mathbf{Y}_k = \beta_0 + \beta_{nk}\mathbf{Y}^*_k + \beta_{1k}\mathbf{X}_{1k} + \beta_{2k}\mathbf{X}_{2k} + \epsilon_k \tag{11}$$

where β_0 is an intercept term and ϵ_k is random error in measuring interest in journal K. The effect of journal norms (β_{nk}) should be positive, showing that scientist J is interested in journal K in proportion to the interest expressed by J's collegial alter, and the effects of personal involvement (β_{1k} and β_{2k}) should be positive or negligible. This formulation allows the effects of individual characteristics to be separated from the effects of the social context of the invisible college.

The third issue is the choice of the construction of Y_j^* given the use of the kind of model specified in eqn. (11). For the alter model $Y_{jk}^* = Y_{ik}$, where i is the specific alter to J. The analyses of Coleman, Duncan and their colleagues use this alter actor model. Duncan et al. (1968) have offered the most sophisticated statistical model. In the context of high-school students' aspirations, they defined an alter as a person's best friend and posited reciprocal causation between a respondent's expressed aspiration and the aspiration of his best friend as an alter. In the context of an invisible college this approach also leads to a simultaneous equation specification. For scientists I and J the equations are

$$Y_{jk} = \beta_{0(e)} + \beta_{nk(e)} Y_{ik} + \beta_{1k(e)} X_{j1k} + \beta_{2k(e)} X_{j2k} + \epsilon_{jk} \tag{12a}$$

$$Y_{ik} = \beta_{0(a)} + \beta_{nk(a)} Y_{jk} + \beta_{1k(a)} X_{i1k} + \beta_{2k(a)} X_{i2k} + \epsilon_{ik} \tag{12b}$$

where the subscript (e) indicates an effect on ego's journal interest and the subscript (a) indicates an effect on the alter's interest in the same journal. The coefficients in eqn. (12) can be estimated as a standard simultaneous equation problem (see for example, Goldberger, 1964), or the effects on ego and alter can be assumed to be equal and estimated as a restricted covariance structure (e.g., $\beta_{nk} = \beta_{nk(e)} = \beta_{nk(a)}$, $\beta_{lk} = \beta_{lk(e)} = \beta_{lk(a)}$, and so on; see for example, Joreskog, 1973). It is important to note that these effects will be estimated as if a single individual defines a scientist's collegial alter, which is a distinct disadvantage.

Group alter models are the basis for analysis of variance and analysis of covariance models describing contextual effects (see Hauser, 1969, 1974; Farkas, 1975). In this case, a scientist J's network subgroup defines the context for J's significance evaluations. Equation (12) can be re-specified by setting β_{nk} equal to 1, β_0 equal to zero, and replacing Y_{jk}^* by the group alter interest in eqn. (7). The re-specified equation is an analysis of covariance model in which the overall mean is contained in group means:

$$Y_{jk} = \sum_{i=1}^{L} Y_{ik}/L + \beta_{1k} X_{j1k} + \beta_{2k} X_{j2k} + \epsilon_{jk} \tag{13}$$

This model states that scientist J's expressed interest is given by the mean interest expressed by those of J's colleagues who affect J's significance evaluations ($Y_{jk}^* = \Sigma_i^L Y_{ik}/L$), plus adjustments for J's personal involvement in the journal, plus a random error. If differences in scientists' interest in a journal are more a result of differences between network subgroups than they are a result of random errors, a significant contextual effect will be obtained as a significant F-test for differences in mean network subgroup interest in the journal. Unfortunately, these differences will be assessed as if the boundaries of the network subgroups are clearly defined. In fact, it is often difficult to determine where one subgroup ends and another begins. Actors in a system are distributed in a continuous-distance stratification space, and network subgroups are densely occupied points in that space. Boundaries of positions jointly occupied by structurally equivalent actors, and especially boundaries of cliques, are difficult to determine with certainty (see Burt, 1980b, pp. 96–109). Further, the group alter model weakens the notion of social structure to the aggregation of a property over an aggregate of actors.

A generalized alter model avoids the typically erroneous assumption of clear network subgroup boundaries by stating Y^*_{jk} in terms of the actual distribution of potential alters in a system's stratification space. Obviously, such a model avoids the restriction of the collegial alter being defined by only one other scientist. Finally, it does not weaken the notion of structure to the simple aggregation of individual properties [18,19]. For these reasons we much prefer the generalized alter model and the specification contained in eqn. (11). The specification of eqn. (11) is completed by noting the constructions of Y^*_{jk} under the relational and positional formulations. Under the relational formulation $Y^*_{jk} = \Sigma w_{ji\mathrm{r}} Y_{ik}$. Letting $\mathbf{W}_\mathrm{r}$ denote the $N \times N$ matrix of weights $w_{ji\mathrm{r}}$, we can write $\mathbf{Y}^*_k = \mathbf{W}_\mathrm{r}\mathbf{Y}_k$. Under the positional formulation $Y^*_{jk} = \Sigma w_{ji\mathrm{p}} Y_{ik}$ and in matrix form $\mathbf{Y}^*_k = \mathbf{W}_\mathrm{p}\mathbf{Y}_k$, where $\mathbf{W}_\mathrm{p} = [\mathrm{w}_{ji\mathrm{p}}]$. In general discussions we refer to the weight matrix as $\mathbf{W}$ when the context makes it clear which type of weight is being considered.

Estimation of Generalized Alter Models

A maximum likelihood estimation (MLE) procedure is available for the generalized alter model expressed in eqn. (11). The following outline of the procedure is based on the account in Doreian (1981) [20]. In obvious notation [21], eqn. (11) can be expressed in matrix form as

$$\mathbf{Y} = \beta_n \mathbf{W}\mathbf{Y} + \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\epsilon} \tag{14}$$

where $\boldsymbol{\epsilon}$ is specified as independent multivariate normal $(\mathrm{IN}(0,\sigma^2))$. Such an equation is estimated for each journal K.

The joint likelihood of the $\boldsymbol{\epsilon}$ is given by

$$L(\boldsymbol{\epsilon}) = \left(1/2\pi\sigma^2\right)^{N/2} \exp\left(-\boldsymbol{\epsilon}\boldsymbol{\epsilon}/2\sigma^2\right) \tag{15}$$

However, $\mathbf{Y}$ is observed rather than $\boldsymbol{\epsilon}$. Let $\mathbf{A} = \mathbf{I} - \beta_n \mathbf{W}$, where $\mathbf{I}$ is the identity matrix. Then from eqn. (15), $\boldsymbol{\epsilon} = \mathbf{AY} - \mathbf{X}\boldsymbol{\beta}$. The Jacobian of the transformation from $\boldsymbol{\epsilon}$ to an observed $\mathbf{Y}$ is given by $|\mathbf{A}|$, the determinant of $\mathbf{A}$. The joint likelihood of the observed $\mathbf{Y}$, denoted $\mathbf{y}$, is given by

$$L(\mathbf{y}) = |\mathbf{A}|(1/2\pi\sigma^2)^{N/2} \exp\{-(1/2\sigma^2)[\mathbf{Ay} - \mathbf{X}\boldsymbol{\beta}]'[\mathbf{Ay} - \mathbf{X}\boldsymbol{\beta}]\} \quad (16)$$

and the log likelihood function is given by

$$l(\mathbf{y}) = \text{const.} - (N/2)\ln\omega - (1/2\omega)[\mathbf{y}'\mathbf{A}'\mathbf{Ay} - 2\boldsymbol{\beta}'\mathbf{X}'\mathbf{Ay} + \boldsymbol{\beta}'\mathbf{X}'\mathbf{X}\boldsymbol{\beta}] + \ln|\mathbf{A}| \quad (17)$$

where $\omega = \sigma^2$ to simplify notation. The MLE's are obtained by taking the partial derivatives of l with respect to the parameters being estimated and setting the resulting expression equal to zero. For ω we have

$$\hat{\omega} = \hat{\sigma}^2 = (1/N)(\mathbf{y}'\mathbf{A}'\mathbf{Ay} - 2\boldsymbol{\beta}'\mathbf{X}'\mathbf{Ay} + \boldsymbol{\beta}'\mathbf{X}'\mathbf{X}\boldsymbol{\beta}) \quad (18)$$

Taking the partial derivative of l with respect to $\boldsymbol{\beta}$ and setting the result to zero gives

$$\hat{\beta} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{Ay} \quad (19)$$

which can be viewed as the OLS estimate obtained from regressing $\mathbf{Ay}$ on $\mathbf{X}$. Substitution of eqn. (19) into (18) gives

$$\hat{\omega} = (1/N)(\mathbf{Ay})'\mathbf{M}(\mathbf{Ay}) \quad (20)$$

where $\mathbf{M} = \mathbf{I} - \mathbf{X}(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'$. However, neither eqn. (20) nor eqn. (19) can yet be used, as they depend on β_n, which is an unknown parameter. It can be shown (Doreian, 1981, pp. 369–370) that $\hat{\beta}_n$ is the value of β_n that minimizes

$$-(2/N)\sum \ln(1 - \beta_n \lambda_i) + \ln(\mathbf{y}'\,\mathbf{My} - 2\beta_n \mathbf{y}'\,\mathbf{MWy} + \beta_n^2(\mathbf{Wy})'\mathbf{M}(\mathbf{Wy})) \quad (21)$$

where λ_i are the eigenvalues of $\mathbf{W}$. This estimation is done numerically either by a direct search procedure or by an iterative method (Doreian, 1981; Ord, 1975).

It is possible to obtain the asymptotic variance–covariance matrix $\mathbf{V}$ of the estimators, $\mathbf{V}^{-1} = -E[\partial^2 l/\partial\theta_r \partial\theta_s]$, where θ_r and θ_s denote pairs of parameters to be estimated (Kendall and Stuart, 1967, p. 55) and E is the expectation operator. Using the notation $B = WA^{-1}$ and $\alpha = -\Sigma\lambda_i^2/(1 - \beta_n \lambda_i)^2$ it is possible to obtain (Ord, 1975; Doreian, 1981, Appendix A) the variance–covariance matrix for the estimators as

$$\mathbf{V}(\hat{\omega}, \hat{\beta}_n, \hat{\beta}) = \omega^2 \begin{bmatrix} N/2 & \omega \mathrm{tr}\mathbf{B} & \mathbf{0}' \\ \omega \mathrm{tr}\mathbf{B} & \omega^2(\mathrm{tr}\mathbf{B}'\mathbf{B} - \alpha) + \omega\boldsymbol{\beta}'\mathbf{X}'\mathbf{B}'\mathbf{BX}\boldsymbol{\beta} & \omega'\mathbf{X}'\mathbf{BX}\boldsymbol{\beta} \\ \mathbf{0} & \omega(\mathbf{X}'\mathbf{BX}\boldsymbol{\beta})' & \omega\mathbf{X}'\mathbf{X} \end{bmatrix}^{-1} \quad (22)$$

On the basis of this, standard errors of the estimates can be obtained, t-ratios constructed and inferential procedures employed. Of particular interest are the estimate of β_n and the standard error of this estimate, which are used to assess network effects under the relational and positional formulations.

The generalized alter model has been estimated for the definition of journal norms for elite experts in sociological methodology as of 1975. In a comparative assessment of relational versus positional processes responsible for journal norms we deal with two contrasting perspectives. First, we deal with conformity to these norms in terms of the estimated generalized alter models, and second, we examine patterns of deviance from these norms.

Empirical Results

CONFORMITY TO JOURNAL NORMS

Using the generalized alter model specified in eqn. (14) there are definite expectations concerning its parameters. For a given journal, **WY** is the expected distribution of normative interest in that journal, according to the network process considered. If scientists tend to conform to the distribution of norms then **WY** and **Y** will correspond. Given the specification in eqn. (14), $\boldsymbol{\beta}_n$ is a feedback coefficient representing mutual structural impacts among scientists and should be non-negative. This can be buttressed further. The endogenous feedback process suggests that **Y** and $\beta_n\mathbf{Y}^*$ correspond. In particular, if complete conformity holds, $Y_j = \beta_n Y_j^*$ for each j. Suppose, for the moment, that we adopt a variant of the perspective of structural control (Doreian and Hummon, 1976) for a network process. If a normative process is at work then there is a movement of Y_j towards Y_j^* whenever a discrepancy exists. The movement is determined by the discrepancy $(Y_j^* - Y_j)$ and a positive sensitivity-parameter γ which is dimensioned as the reciprocal of time. If ΔY_j is the change that occurs in an increment Δt of time then $\Delta Y_j = \gamma(Y_j^* - Y_j)\,\Delta t$. Suppose that in a unit period a scientist is moved into conformity; then $Y_j = \gamma(Y_j^* - Y_j)$. Equivalently, $Y_j = (\gamma/(1+\gamma))Y_j^* = \beta_n Y_j^*$, and β_n should be positive. If β_n were estimated as a negative value this would indicate a polarization process (Erbring and Young, 1979, p. 413), the very opposite to what would be expected under conformity.

For both the relational model and the positional model the matrix **W** was constructed so as to have row sums of unity. This leads to two further interpretive properties. First, the maximum eigenvalue of **W** will be 1, and as $\hat{\beta}_n$ is bounded above by the reciprocal of the maximum eigenvalue (Doreian and Hummon, 1976, chap. 6; Erbring and Young, 1979) we know that $\hat{\beta}_n \leqslant 1$. Second, this row normalization means that the metric of the endogenous variable is preserved by the endogenous feedback term. Thus β_n can be interpreted as the share of Y_j determined by structural as opposed to individual mechanisms. The coefficients for the variables expressing editorial control and publishing activity should be non-negative.

The results of estimating the generalized alter models for each journal are given in Table I. The relational and positional models were estimated separately and are shown as distinct panels in Table I. For all models the estimates of β_n are positive, as anticipated in the above argument: structural normative effects are present. However, there are differences across journals and between models. Under the relational model, the normative effects are significant beyond the 0.05 level of confidence for four journals: SM, SMR, JMS and SF. Under the positional model the normative effects are significant beyond the 0.05 level of confidence for four journals: JASA, SMR,

TABLE I

Results of Estimation for Generalized Alter Models (t-ratios in parentheses) [a]

Core journal	Relational model			Positional model		
	Y^*_{kr}	E_k	P_k	Y^*_{kp}	E_k	P_k
American Sociological Review	0.16	0.21	0.01	0.26 *	0.31	0.01
(ASR)	(1.1)	(0.4)	(0.8)	(1.4)	(0.5)	(0.9)
American Journal of	0.09	0.65	0.02	0.21	0.59	0.01
Sociology (AJS)	(0.6)	(1.2)	(1.0)	(1.1)	(1.1)	(1.1)
Sociological Methodology	0.27 **	0.49 *	0.10	0.25 *	0.55 *	0.02
(SM)	(1.9)	(1.3)	(1.0)	(1.4)	(1.4)	(1.0)
Journal of the American	0.15	0.39	0.01	0.45 **	0.31	0.00
Statistical Association	(0.9)	(0.8)	(0.6)	(3.0)	(0.7)	(0.1)
(JASA)						
Sociological Methods and	0.36 **	0.50 *	0.01	0.29 **	0.46 *	0.01
Research (SMR)	(2.6)	(1.6)	(0.5)	(1.7)	(1.4)	(0.7)
Journal of Mathematical	0.31 **	0.69 **	0.05 **	0.31 **	0.74 **	0.05 **
Sociology (JMS)	(2.6)	(2.7)	(2.6)	(2.1)	(2.8)	(2.7)
Social Science Research	0.06	0.27 **	0.03 **	0.26 *	0.27**	0.03 **
(SSR)	(0.4)	(3.0)	(3.2)	(1.5)	(3.0)	(3.3)
Social Forces (SF)	0.42 **	0.10	0.03 **	0.54 **	0.27 *	0.04 **
	(3.0)	(0.5)	(2.2)	(4.5)	(1.5)	(2.9).

[a] Conformity under the relational and positional models has been estimated separately: Y^*_{kr} is the interest in journal K expected under the relational model and Y^*_{kp} is the corresponding journal norm under the positional model. E_k is the proportion of editorial control the college has over journal K, which is exercised by an expert. P_k is the number of papers published in the journal since 1969. Parentheses contain t-ratios and effects significantly greater than zero are marked with asterisks (* for the 0.01 level, ** for the 0.05 level).

JMS, SF. For JASA there is a positional normative effect but no relational normative effect, whereas for SM there is a relational normative effect but no such positional effect. Otherwise, the two lists of journals are identical. If the level of confidence is liberalized to the 0.1 level there are three additional instances of a positional normative effect: for ASR, SM and SSR. Overall, these results suggest that the positional model is stronger than the relational model as a model of the network determinants of journal norms and conformity to those norms. There is an important difference between the more prominent and the less prominent journals [22]. The network process of structural perception is more manifest for the less prominent journals. This fits neatly with our theoretical arguments, as these journals have greater ambiguity as an external reality.

When the exogenous variables of editorial control and publishing activity are considered there is a marked distinction between the more prominent and the less prominent journals. For the more prominent journals the normative process is universal, in the sense that the perception of journal significance is dependent neither upon individual editorial control (with only one exception at the 0.1 level of confidence) nor on individual publishing activity. By contrast, for the less prominent journals, the perception of journal significance is clearly a function of individual editorial control over and publishing activity in them. These results hold regardless of which network model is employed.

These results show that there are network determinants of journal norms and conformity to those norms. As such they form a foundation for further analysis. The positional model appears superior to the relational model but the difference is far from overwhelming. A more comprehensive understanding is obtained by considering deviance from the journal norms as predicted by the relational and positional models.

DEVIANCE FROM JOURNAL NORMS

Additional insights are obtained by analyzing the manner in which expressed interests deviate from normative interests. Normative interest is obtained from the generalized alter models, where, for all experts, **WY** gives the distribution of normative interest. For expert J under the relational model this is $\sum_i w_{ji\mathrm{r}} Y_i$ and under the positional model it is $\sum_i w_{ji\mathrm{p}} Y_i$. Table II is a typology of qualitative differences between expressed and normative interest in a journal. The three columns distinguish a scientist exposed to norms not prescribing a journal (one whose normative interest lies in the lowest 25% of the college), from one exposed to norms prescribing some but not high interest in the journal (one whose normative interest lies in the

TABLE II

Typology of Scientists According to Their Expressed Versus Normative Interest in a Journal [a]

Expressed interest	Normative interest		
	Journal is not prescribed (lowest 25%)	Journal has some interest	Journal is prescribed (highest 25%)
Journal is ignored (zero)	conservatives (conformers)	moderates (conformers)	rebels (deviants)
Journal is given some interest	moderates (conformers)	moderates (conformers)	moderates (conformers)
Journal is important (highest 25%)	eccentrics (deviants)	moderates (conformers)	conservatives (conformers)

[a] Normative interest for scientist J is either Y_{jmr} or Y_{jmp}, as discussed in the text; his or her expressed interest in Y_{jm}, as discussed in the text.

interquartile range for the college), from one exposed to norms actually prescribing the journal as significant (one whose normative interest lies in the top 25% of the college). While arbitrary, the choice of 25% is useful for two reasons. It distinguishes those members of an invisible college with very high versus very low normative interest in a journal while ensuring a sufficient number of persons in each category to allow comparisons among members exposed to extreme norms. The three rows in Table II distinguish a scientist expressing the highest interest in a journal as a significant outlet for work (Y_{jk} lies in the top 25% of her college), from one expressing some but not high interest in the journal (Y_{jk} greater than zero, but not in the top 25% of her college), from one who completely ignores the journal as significant ($Y_{jk} = 0$). Five of the nine cells in Table II are labelled "moderates" and refer to scientists who themselves or whose significant others express some interest in a journal without expressing extreme interest. Moderates neither violate nor endorse an explicit norm of journal significance. While important in a quantitative comparison of expressed and normative interests, such persons are of secondary importance to the focus here on deviant scientists.

If a scientist is exposed to high normative interest in a journal, then his significant others can be viewed as prescribing the journal to him as an outlet for important work within an invisible college. The third column of Table III distinguishes three manners in which he can respond. He can mirror the normative interest by expressing high interest in the prescribed journal (and so be a conservative) or he can express some interest without being committed to especially high interest (and so be a moderate). Either of these responses represents conformity to a norm in the sense of not signaling its violation. But if a scientist responds to a prescribed journal by completely ignoring the journal as an outlet for significant work, then he is explicitly violating normative interest in the journal. More than merely deviating from normative interest, such a person is undermining consensus within the invisible college in a particularly egregious way. He is, in effect, "rebelling" against normative interest in the journal as a bastion of reputable knowledge within the college. For the preservation of such scientists as members of the college, such persons would be expected either to keep opinions to themselves or to change their perception of the journal, or to find new significant others before alienating those they have. Whichever options are taken, there should be few, if any, rebels in an invisible college, so that the network model under which the smallest number of such scientists occurs is preferable in understanding the network basis for social norms [23].

The first column of Table II distinguishes three manners in which scientists can respond to low normative interest in a journal. They can idealize this interest by completely ignoring the journal (and so be a conservative) or they can express some interest in the journal without expressing especially high interest (and so be a moderate). But if for some reason they perceive the journal to have high significance despite its low normative significance, then they are not conforming to journal norms. Their deviation, however, is more fittingly discussed as eccentric than rebellious. They are merely scientists highly interested in having their work appear in a journal to which their significant others give little or no credence. Nevertheless, they are explicitly not conforming to norms of journal significance. As with the rebels, the network model under which the smallest number of eccentrics occurs is preferable in an understanding of the network basis for social norms [24].

The prevalence of rebel deviants is given in Table III. For each of the core journals, three percentages are presented, with unit test statistics: the percentage of the college failing to mention the journal as an outlet for significant work in the college, the percentage of experts having no interest in the journal when it is prescribed by their significant others under the relational model, and the percentage of experts having no interest in the journal when it is prescribed by their significant others under the positional model [25].

If rebels occur at random, then the three percentages should be equal; experts having no interest in a prescribed journal should occur with the same frequency that experts in the overall college express no interest in the journal. This is clearly not the case here. There are differences in the extent to which experts have no interest in the core journals: ASR, AJS, SM and JASA are much less likely to be ignored by an expert than are SMR, SF, JMS or SSR. But for each journal individually, under the positional model

TABLE III

Prevalence of Rebel Deviants [a]

Core journal	Percentage not citing journal as significant		
	Whole college	Prescribed by relational model	Prescribed by positional model
American Sociological Review	9.6	7.7 (0.0)	0.0 (−0.7)
American Journal of Sociology	28.8	33.3 (0.7)	21.4 (−0.7)
Sociological Methodology	44.2	33.3 (−0.9)	15.4 ** (−2.2)
Journal of the American Statistical Association	40.4	15.4 ** (−2.0)	21.4 ** (−1.7)
Sociological Methods and Research	59.6	31.3 ** (−2.7)	36.8 ** (−2.3)
Social Forces	76.9	68.8 (0.2)	46.2 ** (−1.7)
Journal of Mathematical Sociology	67.3	61.5 (0.1)	28.6 ** (−2.4)
Social Science Research	75.0	78.6 (1.2)	55.6 (−0.9)

[a] Rebel deviants are defined in Table II and unit normal test statistics are given in parentheses. A negative test statistic equal to or lower than 1.7 fails to reject a hypothesis at the 0.05 level of confidence. Effects significant at the 0.05 level are marked with asterisks (**).

there tend to be fewer rebels than under the relational model. For example, one in ten experts has no interest in ASR (9.6%). Under the relational model, for those experts whose significant others prescribe ASR as important this ratio drops to slightly less than one in ten (7.7%). Under the positional model, however, the ratio drops to zero. Similarly, four in ten experts are not interested in SM (44.2%), dropping to a ratio of three in ten under the relational model (33.3%), but dropping still further to a ratio of two in ten under the positional model (15.4%). The unit test statistics show that only under the positional model are rebel deviants from normative interest in SM significantly unlikely to occur at the 0.05 level of confidence [26]. This pattern is repeated across the eight core journals to varying extents. With the exception of JASA and SMR, journals for which rebel deviants are significantly unlikely under either network model, rebel deviants are less likely under the positional model than they are under the relational model. For SM, SF and JMS, this difference is statistically significant. Moreover, the relational model generates *more* rebel deviants than would be expected by random chance for AJS and SSR.

For each core journal, Table IV presents the same data [27] for eccentrics that Table III presents for rebels, namely, the percentage of the college expressing high interest in the journal, the percentage of experts exposed to low normative interest under the relational model whose high interest makes them eccentrics, and the percentage of experts exposed to low normative interest under the positional model whose high interest makes them eccentrics. Neither of the network models is accurate in predicting the absence of eccentric deviants. With two exceptions, the test statistics in Table IV are negative. Eccentrics do tend to occur less often than would be expected from the distribution of high interest in the college. However, their absence is by and large what could be expected by random chance. The sole exception is the significant tendency for eccentrics to be absent under the relational model for JMS. At the 0.05 level of confidence, finding one significant

TABLE IV

Prevalence of Eccentric Deviants [a]

Core journal	Percentage giving journal high significance		
	Whole college	Ignored under relational model	Ignored under positional model
American Sociological Review	28.8	14.3 (−1.3)	25.0 (−1.5)
American Journal of Sociology	25.0	13.3 (−1.2)	23.1 (−0.2)
Sociological Methodology	26.9	7.7 (−1.5)	12.5 (−1.6)
Journal of the American Statistical Association	25.0	21.4 (−0.4)	21.4 (−0.3)
Sociological Methods and Research	25.0	15.4 (−0.7)	7.7 (−1.3)
Social Forces	23.1	12.9 (−0.7)	0.0 (−1.6)
Journal of Mathematical Sociology	25.0	7.1 ** (−1.8)	21.4 (0.0)
Social Science Research	25.0	29.2 (0.5)	20.0 (−0.2)

[a] Eccentric deviants are defined in Table I and unit normal test statistics are given in parentheses. A negative test statistic equal to or lower than 1.7 fails to reject a hypothesis at the 0.05 level of confidence. Effects significant at the 0.05 level are marked with asterisks (**).

percentage in sixteen is almost itself attributable to random chance.

These findings are not excessively surprising, given the comparative substantive meanings of "eccentrics" and "rebels" as deviants within an invisible college. The latter constitute a more serious threat to consensual perceptions of significant knowledge in the college and are accordingly rare, given the distribution of interests in the whole college. This is particularly true under the positional model in comparison to the relational. There are never more deviant experts under the positional model than would be expected from the distribution of interests in the college, and rebel deviants have a statistically significant tendency to be absent. More experts tend to be deviant under the relational model and in some cases with a frequency greater than would be expected from the distribution of interests in the college. Overall, these results again suggest the positional model as preferable to the relational in understanding the network basis for norms—at least in this invisible college. This suggestion is greatly strengthened by considering more closely the conditions under which experts are deviant.

The relational and positional models differ in a manner that suggests some deviance to result from the pattern of relations defining an expert's network position. Under the positional model, followers in a college can differ from their leaders in perceiving significance, as argued in the theory section of this paper. Leaders would be expected to perceive significance similarly to the extent that they are structurally equivalent with one another. The same is true for followers. Since leaders are not structurally equivalent with their followers, there is no prediction that leaders and followers perceive journal significance similarly. The relational model, in contrast, predicts that followers perceive significance in emulation of their leaders, since the latter are their sources of influential comments [28]. In short, the crucial difference between the two network models for perceptions by elite experts in sociological methodology concerns those experts who rely on persons structurally non-equivalent to themselves for influential comments. That model which is erroneous in defining the significant others of such experts will label a spuriously high number of such experts as deviants.

These arguments can be illustrated using an example. Table V shows data for six experts drawn from the college. Weights are presented describing the extent to which each expert relies on the others as significant others. The first three experts are leaders while the second three are followers, in the sense that the first three are the object of unreciprocated relations from the last three and cite only one another as sources of influential comments. Notice that the weights for the relational model show that the leaders take one another as equally significant others, but ignore follower perceptions (i.e., $w_{12r} = w_{13r} = 0.5$, while $w_{14r} = w_{15r} = w_{16r} = 0$). The followers rely extensively on the leaders as significant others; they largely ignore one another

TABLE V

Illustrating the Leader–Follower Dichotomy with Six Experts

Parameters and data [a]	Experts in sociological methodology					
	1	2	3	4	5	6
Weights for relational model	—	0.50	0.50	0.00	0.00	0.00
(w_{jir})	0.50	—	0.50	0.00	0.00	0.00
	0.50	0.50	—	0.00	0.00	0.00
	0.20	0.40	0.40	—	0.00	0.00
	0.13	0.13	0.38	0.38	—	0.00
	0.11	0.22	0.22	0.44	0.00	—
Weights for positional model	—	0.69	0.31	0.00	0.00	0.00
(w_{jip})	0.56	—	0.43	0.00	0.00	0.00
	0.38	0.60	—	0.01	0.00	0.00
	0.00	0.01	0.12	—	0.01	0.85
	0.00	0.00	0.06	0.83	—	0.11
	0.00	0.00	0.00	0.99	0.01	—
Expressed and normative interests in JASA						
Y_{jk}	0.55	0.99	0.25	0.00	0.00	0.12
	(H)	(H)	(S)	(N)	(N)	(S)
Y_{jkr}	0.62	0.40	0.77	0.61 [b]	0.30 [b]	0.33
	(H)	(H)	(H)	(H)	(H)	(H)
Y_{jkp}	0.76	0.42	0.80	0.15	0.03	0.00
	(H)	(H)	(H)	(S)	(L)	(L)

[a] Given the z_{ji} among these six experts the weights for the relational model are computed as given in eqn. (10). The l_{ij} are computed from distances as $(d\text{max}_j - d_{ji})^6/[\Sigma_i(d\text{max}_j - d_{ji})^6]$, from which the weights for the positional model are as computed in eqn. (11). Normative interest under the relational model is given by $Y_{jk} = \Sigma w_{jir} Y_i$ and under the positional model by $Y_{jk} = \Sigma w_{jip} Y_i$. Qualitative interest is given in parentheses as coded in Table II for the whole college.

[b] These are rebel deviants as defined in Table II.

(reliance on expert 4 notwithstanding). This patterning of significant others changes under the positional model. The weights for the positional model also show that the leaders take one another as significant others. The extent to which any leader serves as a significant other for the remaining two leaders varies, since the structural equivalence varies. However, shared unreciprocated relations to the leaders now make the followers structurally equivalent (under a weak criterion) so that they take one another as significant others. Expert 4 relies most heavily on the perceptions of expert 6 ($w_{46p} = 0.85$), while experts 5 and 6 both rely on perceptions by expert 4 ($w_{64p} = 0.99$, $w_{54p} = 0.83$). The bottom three rows of Table V present each expert's expressed interest in JASA (Y_{jk}) and the normative interests under the two network models (Y_{jkr}, Y_{jkp}) (recall that in the conformity section above there was a clear positional normative process for JASA and no relational effect). The qualitative interest implied by each quantitative interest is given in parentheses. For example, the second expert allocates 0.99 of his interest to publishing in JASA (which puts him in the top 25% of the college, so that his qualitative interest in the journal is high, "H"). Consider the first three columns of interests. These entries refer to the leaders. Since they cite one another and are structurally equivalent with one another, the relational and positional models make similar predictions. There are no deviant experts among the leaders. Both network models correctly predict their high interest in JASA. This is not true for the last three columns of interests. Experts 4 and 5 do not perceive JASA as a significant outlet for work in the college, but the relational model predicts that they will emulate the leaders' high interest. Both experts are rebel deviants under this model. Since the positional model does not predict high interest in JASA among the followers, none are deviants under that model. In this example the positional model is preferable.

Moving back to the whole college, Table VI presents a cross-classification of rebel and eccentric deviance by the relational pattern defining an expert's network position. Distinguished by column in Table VI are "nonfollowers" and "followers". These two categories are sharply distinguished in the college by a large gap in the distribution of the continuous variable used to measure

TABLE VI

Network Positions and Deviance

Deviance across all core journals	Network position			
	Non-followers		Followers	
	N	(%)	*N*	(%)
Under the relational model				
never deviant	5	(25.0)	4	(12.5)
rebel	4	(20.0)	21	(65.6)
eccentric	6	(30.0)	2	(6.3)
rebel eccentric	5	(25.0)	5	(15.6)
Under positional model				
never deviant	9	(45.0)	10	(31.3)
rebel	6	(30.0)	11	(34.4)
eccentric	2	(10.0)	6	(18.8)
rebel eccentric	3	(15.0)	5	(15.6)

the extent to which experts rely on others structurally equivalent to themselves for influential comments [29]. Followers are those experts who rely on persons structurally non-equivalent to themselves for influential comments. Non-followers are those whose only sources of influential comments are structurally equivalent to themselves. Among the non-followers are cliques of leaders, such as the first three experts in Table V, and isolated cliques composed of a few members who rely on one another for comments. Pooling the extent to which an expert deviates from normative interest in all eight journals under one of the network models, four types of experts are distinguished by rows in Table VI: those who never deviate from normative interests, those who are rebels in regard to one or more journals but never eccentrics, those who are eccentrics in regard to one or more journals but never rebels, and those who are rebels in regard to some journal(s) as well as eccentrics in regard to some other journal(s).

The two types of deviance occur independently. Rebels have no statistically significant tendency to be eccentrics. The chi-square statistic for the hypothesis of no interaction between being a rebel deviant in regard to one or more journals and being an eccentric deviant in regard to one or more journals in 0.68 for both network models. With two degrees of freedom, this is negligible.

There are differences, however, in the tendencies for an expert to be deviant if she is a follower rather than a non-follower. This is clearest in the case of rebel deviance. Twenty experts have sources of influential comments who are structurally equivalent to themselves. Under both network models, about half of these experts are rebel deviants in regard to at least one of the core journals (9 out of 20 experts, or 45%). As observed for the first three experts in Table V, the similar results obtained under the two network models is to be expected, since each expert's source of influential comments here also constitutes his or her structurally equivalent peers in the college. This is not true for the followers in the college. Under the positional model, the same rate of deviance is observed among followers as is observed among non-followers. Half of the followers are rebel deviants in regard to at least one core journal (16 out of 32, or 50%). It is not surprising, then, to find no interaction between either type of deviance under the positional model for followers versus non-followers. The chi-square statistic of no interaction is 1.16, with three degrees of freedom. Under the relational model, however, this statistic increases to 11.44, which is significant at the 0.01 level of confidence. The rate of rebel deviance is much higher among followers than non-followers under the relational model. While 45% of the non-followers are rebel deviants under this model, 81.2% of the followers are rebel deviants. As illustrated in Table V, experts who rely on persons structurally non-equivalent to themselves for influential comments have an increased tendency to be rebel deviants. This link with network position is reversed for eccentric deviance. Followers have a lower tendency to be eccentric deviants than do non-followers. While four out of five followers are never eccentric deviants under the relational model, half of the non-followers are eccentrics under the same model in regard to at least one core journal.

In short, followers do not perceive journal significance in emulation of leaders within the college. Rather, they share the perceptions of their structurally equivalent peers—even if they do not use those peers as sources of influential comments. More specifically, they tend not to be interested in the journals most valued by their sources of influential comments (i.e., they tend to be rebels under the relational model) yet they tend not to be highly interested in the journals to which these same sources give low credence (i.e., followers tend not to be eccentrics under the relational model).

Beyond supporting the positional model as preferable to the relational, Table VI suggests that some experts are deviant for personal reasons. For one thing, there is no contingency between rebel deviance and eccentric deviance. There is no class of experts who tend to be deviant in one way as well as the other. Further, most experts are deviant in regard to only one or two journals. If there were some experts whose network positions were prone to deviance, then there should be some experts who are deviants in regard to many journals. Yet most experts are deviant in regard to few, if any, journals. No expert is an eccentric in regard to more than two journals and few are rebels in regard to more than two journals. Under the positional model one expert is a rebel deviant in regard to three journals, and under the relational model six are rebels in regard to more than two journals.

If experts are deviant in regard to a journal for personal reasons, perhaps the most likely reason is publishing or editing articles in the journal. An expert who publishes articles in a journal or serves as an editor or recent referee might be biased toward perceiving more significance in it than do others in the college.

Personal involvement, however, is not responsible for elite experts in sociological methodology holding deviant perceptions of significance. For each core journal, Table VII presents chi-square statistics for the hypothesis that there is no interaction between an expert's tendency to be a deviant expert and his involvement in the journal. Involvement is operationalized in terms of two dichotomous variables: whether or not he or she had published in the journal during the rapid development of sociological methodology as an invisible college (either an article or research note between 1969 and the middle of 1976, so as to include in-press publications known within the college as of 1975), and whether or not he or she had recently served the journal in some editorial capacity (either on the board or as a referee between 1973 and 1975). With one exception, the chi-square statistics are

TABLE VII

Personal Involvement and Deviance

Core journal	Test for lack of contingency between publishing/editing and deviance [a]			
	Relational model		Positional model	
	χ^2	P	χ^2	P
American Sociological Review	0.26	>0.5	0.50	>0.5
American Journal of Sociology	1.81	>0.5	3.87	>0.5
Sociological Methodology	5.93	~0.43	4.11	>0.5
Journal of the American Statistical Association	1.55	>0.5	1.13	>0.5
Sociological Methods and Research	3.35	>0.5	2.33	>0.5
Social Forces	9.09	~0.17	4.03	>0.5
Journal of Mathematical Sociology	2.21	>0.5	4.93	>0.5
Social Science Research	17.17	~0.01	8.92	~0.18

[a] Chi-square statistics are distributed with six degrees of freedom for the three-way tabulation described in the text.

negligible [30]. In short, as might be expected, to the extent that universalistic criteria are used to evaluate the significance of a core journal, experts are deviants from journal norms not because of their personal involvement with the journal. Whatever the reasons for experts tending to be deviant only in regard to one or two of the core journals, it is not their differential tendencies to publish or edit articles in those few journals.

Summary and Discussion

Our conclusions from this analysis fall into two main categories. The first details the findings of our analysis of the interests of elite experts in sociological methodology as of 1975 with respect to core journals publishing such work, while the second concerns the theoretical and methodological implications of our analysis.

The elite experts were viewed as forming a stratified invisible college and attention was focused on the distribution of interest in the core journals of this invisible college. We accounted for this distribution of interest in terms of a network process and the individual involvements of experts in the production of specific journals. The journals were partitioned into prominent and less prominent journals. We found a tendency for an expert's personal involvement with a journal, his level of publishing and/or editing the journal, to increase his interest in it above that expressed by his significant others as a collegial alter. However, this tendency was most pronounced for the less prominent of the core journals. We found that the expressed interests of the elite experts in journals as outlets for significant work in sociological methodology are a reflection of journal norms systematically maintained by the network of interpersonal influences among the experts. Moreover, the effect of personal involvement with a journal was found only in the presence of a network normative effect on expressed interest. For this reason we concentrate primarily on the network effects and their representation.

In order to discuss such network effects it is necessary to specify a social mechanism responsible for the generation of journal norms for this group of elite experts in sociological methodology. We considered two such mechanisms: one a traditional relational model, the other a positional model of structural interests. The relational model states that an expert should express interests similar to those expressed by persons from whom she acknowledges influential comments on her methodological work. The relational model offers two basic predictions in this context: experts connected by strong relations in what is commonly termed a clique should share journal interests, and followers tied to those experts as sources of influential comments should emulate the interests of those experts as leaders. This second prediction was found to be quite in error for the invisible college for elite sociological methodology. Followers tend not to be interested in the journals highly valued by their leaders (yet they show no tendency to be highly interested in the journals to which their leaders gave low credence) [31]. The positional model predicts homophilous interests among structurally equivalent experts jointly occupying the same position in the network of influence relations. This homophily is expected as a result of each expert symbolically role-playing the position of her structural peers in the college when she evaluates the significance of a journal article. Freed of the requirement that expert interests are determined only by actual communication between experts, the resulting positional model predicts that structurally equivalent experts would share the same interests as a journal norm whether or not they actually communicate with one another. This prediction seems to have been shown true. Not only does the positional model do as well as the relational model in predicting the absence of deviant experts among non-followers, it goes on to predict equally well the absence of deviant experts among followers, i.e. among experts who have no direct relations with one another but whose unreciprocated relations to the same other experts within the college make them structurally equivalent to one another.

In short, the key issues indicating the superiority of the positional model are accuracy and scope. The positional model is more accurate in predicting conformity to journal norms and more accurate in predicting the absence of deviance, in particular avoiding the systematic error of the relational model predicting homophily between structurally non-equivalent experts tied by strong influence relations. If the relational model is restricted to its prediction of intraclique homophily, the two network models have equal accuracy. However, this means that the positional model has greater scope than the relational model, since the positional model explains the interests of experts within cliques as well as those unconnected to one another who have in common their unreciprocated relations to others.

A second general conclusion concerns the substance of conformity and deviance in a network analysis of journal norms. Non-conformity with norms of journal significance does not in and of itself constitute deviance from those norms. Experts who did not acknowledge the significance of a prescribed journal were distinguished as "rebel" deviants, while those who were highly interested in journals to which their significant others gave little attention were discussed as "eccentric" deviants. On a surface level, these two types of deviation from a journal norm differ merely in the direction of quantitative difference between expressed interest and normative interest; eccentrics overestimate normative interest and rebels underestimate that interest. This interpretation is implicit in a regression model using normative interests to predict expressed interests. Such a model is the basis for the analysis of conformity to journal norms. But there is more here than variation in conformity to journal norms. Rebels are actually rejecting the significance of a normatively prescribed journal. A comparable overestimation of journal significance would be the case of an expert who perceived high significance in a normatively prescribed journal, a journal in which an article is a stigma on the author in the eyes of his significant others. In practice, such journals rarely exist. Rather, there are journals that an academic and his significant others prescribe for one another. Non-prescribed journals are merely unimportant. An article in a non-prescribed journal is not a stigma on its author (unless he makes a practice of publishing there); rather, it simply does not contribute to his prominence in the eyes of his significant others. Accordingly, the eccentric expert does not constitute a threat to consensual knowledge published in prescribed journals. This interpretation is reinforced by the analysis of deviant interests. An expert who was a rebel deviant had no significant tendency to be an eccentric deviant. In other words, eccentrics were not experts who had rejected prescribed journals in favor of non-prescribed journals. There were merely experts with an unexpected interest in a journal, an interest not based on their publishing or editing articles in the journal nor an interest shared by their significant others. In contrast to the rebel's violation of journal norms, the eccentric is merely incongruent with those norms. The methodological point to this is that testing network models of social norms should distinguish between a simple lack of conformity to norms and their actual violation. It is the prevalence of the latter that best tests a model's adequacy [32].

For the empirical context of elite sociological methodology circa 1975, viewed as a stratified invisible college, a positional network model of actor interests outperformed the traditional relational model of such interests. It is important to stress that both conformity to, and deviance from, journal norms were considered in reaching this conclusion. We conjecture that the same result will hold for other invisible colleges when the generalized alter model is considered.

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Notes

1 A key property of the invisible college is that any two members are mutually reachable via paths of personal communication in the usual graph-theoretic sense.

2 This is not to say that occupying a prominent position cannot have its own effect on successful publication activities subsequent to achieving the position (Hargens et al., 1980, pp. 65–67). However, available evidence stresses the importance of publications in reputable journals for achieving a prominent position in the first place.

3 While "they" in Ziman's statement refers to all scientists, we shall later restrict this to certain subsets of scientists.

4 Note that, as a level of interest expected of position occupants, a journal norm can vary across positions within an invisible college in the sense that different scientists in the college adhere to different norms. Further, this idea of a journal norm does not require a description of the actual significance criteria used to justify a norm.

5 The procedure for determining the core journals is described in Burt (1978). Even with a set of core journals a scientist's interest is not distributed uniformly over these journals.

6 They also distinguished three characteristics of this general phenomenon: the presence of strong relations among group members serving as communication channels on group-relevant objects; reinforcement of group consensus and perceptions of objects consequential for the group; and increased likelihood of enforcement of group consensus to the extent that perceptions have an ambiguous basis in reality.

7 People who communicate with one another often share the same attitudes toward empirically ambiguous objects, as the above-cited studies demonstrate. Relational models have a high face-validity, stemming from their consistency with classic concepts of communication in face-to-face primary groups as the socializing unit in society. Further, such primary groups have been captured in a proliferation of network models of cliques as a set of actors connected by strong relations. Clique members have been shown to socialize one another along these strong relations so that clique members can be expected to have similar attitudes and beliefs as evaluations of empirically ambiguous objects. See Burt (1980b, pp. 97–100) for a review of network clique models.

8 Interest in a journal is a special case of the model, the model being stated for the general process of individuals evaluating the utility to themselves of control over a resource.

9 This seems to be the manner in which years of education translate into prestige, a year of college education yielding a higher increase in prestige than the increase provided by a year of primary-school education (Hamblin, 1971).

10 Given influence relations as z_{ji}, the distance between two scientists J and I in terms of differences in their influence relations with all N scientists in an invisible college is given as $d_{ij} = [\sum_{q}^{N} (z_{jq} - z_{iq})^2 + \sum_{q}^{N} (z_{qj} - z_{qi})^2]^{1/2}$.

11 For example, under a threat from outside the invisible college minor differences in the relations involving I and J might dissolve as negligible (i.e., ν would be low). If the two scientists were competing for the same university chair, on the other hand, minor differences in their relational patterns might be exaggerated in order to emphasize their respectively unique positions in the college (i.e., ν would be high).

12

$$
\begin{aligned}
u_{jk} &= \int \left(\partial u_{jk} / \partial \tau_{jk} \right) \partial \tau_{jk} \\
&= \int l_{jj} \nu \mu \tau_{jk}^{\nu-1} \partial \tau_{jk} + \sum_{q \neq j}^{N} \int \left(l_{qj} \nu \mu \tau_{jk}^{\nu} / \tau_{qk} \right) \partial \tau_{jk} \\
&= \left[l_{jj} + \sum_{q}^{N} \nu l_{qj} \tau_{jk} / \tau_{qk} (\nu + 1) \right] \mu \tau_{jk}^{\nu} \qquad q \neq j
\end{aligned}
$$

13 These conditions are discussed elsewhere as sufficient conditions for the maintenance of social norms (Burt, 1980b; 1982, eqn. (5.12) ff).

14 Three statisticians in the sample had no interest in ASR, so a second questionnaire was sent to them using the *Journal of the American Statistical Association* as a reference point. Most respondents who had low interest in ASR, however, indicated their perceptions by giving three-digit ratings to other journals.

15 Book reviews were ignored since they are usually not refereed and since some of the journals do not publish book reviews. Articles have been coded in all issues of ASR from February 1969 to June 1976, AJS from January 1969 to May 1976, SM from 1969 to 1976, JASA from March 1969 to June 1976, SMR from August 1972 to May 1976, JMS from 1971 to 1974 (issues in 1976), SSR from April 1972 to March 1976, and SF from March 1969 to June 1976.

16 This measure of editing assumes that an expert who does not perceive a journal as publishing significant work in sociological methodology exercises negligible editorial control over the journal. This need not be true. But since core journals were not known prior to mailing questionnaires, the assumption was forced on the analysis. The seven experts who did not return questionnaires present a problem here, since they too exercised editorial control over the core journals. Measures of editorial control exercised by the respondents could be biased by a failure to consider the levels exercised by missing experts. In order to minimize this bias, the numbers of manuscripts reviewed by respondents were used to estimate the average number of methodological/mathematical manuscripts an expert refereed per year for each of the core journals according to the type of editorial position he or she held with each journal; reader, associate editor, or head editor. Means for these positions in each core journal are given elsewhere (Burt, 1978, p. 152). Since the editorial positions of the missing experts between 1973 and 1975 are published in each journal, these results allow an estimate of the probable number of methodological/mathematical manuscripts each missing expert refereed for a journal as a function of the editorial positions he or she occupied between 1973 and 1975. If e_{jk} is the estimated number of sociological methodology manuscripts that expert J refereed for journal K between 1973 and 1975, the proportion of such manuscripts refereed by all elite experts in the college for which J was personally responsible is given by $e_{jk}/(\sum_{j=1} e_{jk})$, where the summation is across all 59 elite experts I including the seven members not responding to the questionnaire.

17 Under the relational model, the outcome of the mutual socialization is the adherence to the same journal norms. Under the positional model scientists jointly occupying a position in the college tend to use one another as a criterion in terms of which significance is evaluated, so that they come to have the same interest in a journal as a journal norm.

18 We note that the actor alter and group alter models can be viewed as special cases of the generalized alter model. If the (N,N) weight matrix $\mathbf{W}$ is binary, where all w_{ji} are zero except one w_{ji} in each row and column $(j \neq i)$ of the matrix, which is equal to one, then each person j has a single unique alter i and the simultaneous equation model (13) is obtained under the restriction that corresponding effects on ego and alter are identical (i.e., $\beta_0 = \beta_{0(e)} = \beta_{0(a)}$, $\beta_{nk} = \beta_{nk(e)} = \beta_{nk(a)}$, and so on). If the weights in row j of the weight matrix equal zero unless I is a member of a network subgroup with J, whereupon $w_{ji} = 1/(T-1)$ where T is the number of people in their subgroup, then a model very similar to the analysis of covariance model, eqn. (14), is obtained. The major differences are that levels of mean subgroup interest will be used to predict levels of individuals' interest and the individual whose interest is being predicted will be deleted from his or her subgroup's mean interest.

19 A slight digression can be taken. As emphasized by Crane (1972) and Gaston (1973), an invisible college is stratified into leaders and followers, the former receiving a high proportion of sociometric citations as sources of influential communication. One might therefore expect a center–periphery pattern of norms as described critically by Shils (1961). Persons most prominent in the college would embody its norms of journal significance while persons at its periphery would be most likely to deviate from these norms. This idea does not work well in describing the data on elite experts in sociological methodology. Four experts received an unusually high number of citations as sources of influential comments. They each received an average of eight citations while the next highest recipient received five. The average perception across these four leaders was assumed to represent normative interest in each journal at the "center" of the college, and the absolute value of this interest minus that expressed by an expert in the college was taken as the expert's deviation from normative interest in the journal. For each of the eight core journals, an expert's deviation from normative interest was correlated with his choice status, i.e., the proportion of the college citing him as a source of influential comments. With one exception, the correlations were not significant even at the 0.10 level of confidence. The one exception is *Sociological Methods and Research* (SMR), for which the correlation was significant at the 0.01 level. Since the interest in this journal expressed by the four prominent experts was low, the observed negative correlation ($r = -0.35$) shows that experts at the center of the college were less likely to be interested in SMR than those at its periphery. Across the eight core journals, however, the center–periphery conception of norms is not accurate. It assumes too simplistic a picture of stratification in the college. Instead of one center, there are multiple centers, each with its constituent leaders and followers. In sociological methodology there are three centers, defined by a social statistics elite, a social psychology elite and a mathematical sociology elite (Burt, 1978). These multiple centers are reflected in the above correlations. Instead of a negative correlation between deviation and prominence in the college, the correlation was positive (but statistically negligible) for three of the eight core journals. In other words, there was a statistically negligible tendency for some experts at the center of the college to have the highest deviations from norms defined by other experts at the center of the college. We note that multiple centers can be handled quite naturally in the generalized alter model.

20 The procedure was first developed by Ord (1975) for spatially distributed data. Its use for network models was suggested by Doreian (1980b).

21 In eqn. (11), $\mathbf{Y}$ denotes $\mathbf{Y}_k$, $\boldsymbol{\beta} = [\beta_0, \beta_1, \beta_2]$, $\mathbf{X}$ is $[1, X_1, X_2]$ and $\boldsymbol{\epsilon}$ denotes $\boldsymbol{\epsilon}_k$.

22 The more prominent journals are the *American Sociological Review*, the *American Journal of Sociology*, the *Journal of the American Statistical Association*, and *Sociological Methodology*.

23 This could be expressed in terms of hypotheses falsified by the frequent occurrrence of rebels in an invisible college. For the relational model if $Y_{jk_{\mathrm{r}}}$ is high then Y_{jk} should not be zero, and for the positional model if $Y_{jk_{\mathrm{p}}}$ is high then Y_{jk} should not be zero.

24 Again hypotheses can be presented. For the relational model if $Y_{jk_{\mathrm{r}}}$ is low then Y_{jk} should not be high, and for the positional model if $Y_{jk_{\mathrm{p}}}$ is low then Y_{jk} should not be high. Frequent occurrences of eccentrics would falsify these hypotheses.

25 The exponent ν used to convert objective distances into subjective perceptions of distance for the positional model is 6. Values lower than this yield weaker correlations between Y_{jk} and $Y_{jk_{\mathrm{p}}}$ for the whole college, while an exponent of 7 yields slightly weaker or no better correlations.

26 The test statistics in Table III are based on a 3×3 table for each core journal under one of the two network models in the form of Table II. The test statistic for the prevalence of

rebel deviance is the significance of the interaction between having high normative interest in a journal and low expressed interest in the journal (cell (1,3) in Table II). The unit normal test statistic itself is the value of the log–linear coefficient expressing either of these effects divided by its standard error; these values have an approximately normal distribution (see for example, Goodman, 1970, p. 229).

27 The test statistic for the prevalence of eccentric deviance is the significance of the interaction between having low normative interest in a journal and high expressed interest in the journal (cell (3,1) in Table II).

28 Of course, when leaders and followers do perceive similar significance in a journal, there is no difference in predictions by the two network models.

29 To the extent that expert J acknowledges influential comments only from experts structurally equivalent to J, the index $[\Sigma_i(1-z_{ji})d_{ji}]/[\Sigma_i d_{ji}]$ will be close to one (Burt, 1976, p. 116). For the experts in the follower category of Table VII, this index varies without discernable gaps between 0.65 and 0.85. For non-followers, it ranges from 0.94 to 1.0 without missing any two-digit decimals inbetween these extremes. Thus, the two groups are clearly distinguished by this index.

30 The one exception is SSR, for which there is significant interaction between deviance and involvement at the 0.01 level of confidence. However, holding involvement constant and re-estimating the unit normal tests in Tables III and IV does not change the inferences made there. Rebel deviants occur with slightly more than expected frequency under the relational model (test statistic of 1.43) and slightly less than the expected frequency under the positional model (test statistic of -1.00). These effects are stronger than those reported in Table III for SSR, but still negligible. Controlling for publishing and/or editing SSR has no effect on the test statistics describing the prevalence of eccentric deviants.

31 While the predicted homophily between leaders and followers is clearly implied in the network models utilized by Coleman et al. (1966) and Duncan et al. (1968), since they make no effort to exclude follower to leader relations, it is not a feature of the original empirical analysis by Festinger and his colleagues. The original analysis simply shows that the prevalence of deviant group members declines with the density of strong relations among members of the group. It could be argued that the relational model should be restricted to the original argument.

32 Note the relative clarity of the substantive findings here concerning rebel versus eccentric deviants. Rebels occurred less often than would be expected by chance under the positional model and systematically occurred more often than would be expected by chance among followers under the relational model. Rebel deviants nicely distinguish the adequacy of the two network models. Eccentric deviants, in contrast, occurred with a frequency to be expected by chance. Their comparatively innocuous non-conformity to journal norms does not distinguish the two network models at all well.