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A tool kit for practice theory☆

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Abstract

This is a study in the analysis of correspondences. I consider a quantitative technique frequently used by Pierre Bourdieu and the mathematics developed by James Coleman for the foundations of his social theory, with respect to each other, from the respective analysts' points of view, and from my concern with developing more sturdy relations among the methodological tools in a practice theorist's kit. Specifically, I treat both frameworks as implementing in innovative ways the concept of 'duality', the co-constitution of elements at one level and relations at another (higher or lower) level of social action. I show that there is a remarkable homology, at the level of their formal practices, between the mathematical techniques of Bourdieu and those of Coleman. New ways to implement Galois lattice analysis are among the gains of this inquiry. Applications are to relations among the justices of the U.S. Supreme Court. I identify and discuss several of the larger questions that this study raises about practical methods and methodological practice.

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1. Introduction

A productive formulation in the sociology of culture (Swidler, 1986) holds that culture influences action not by providing the ultimate values toward which action is oriented, but by shaping a repertoire or 'tool kit' of habits, skills and styles which people use in constructing strategies of action. What then can be said about *analysts* of culture and in particular of *methods* for cultural analysis? Since cultural analysts too are people engaged in constructing strategies of action (for understanding strategies of action), it would seem worthwhile to define methodological technique, whether applied to cultural studies or more generally, not as a privileged sphere of autonomous logic but as an example of the use of cultural symbols which, as Swidler (1986: 283) well argues, "can be understood only in relation to the strategies of action they sustain".

In such a spirit of reflexivity I consider in this paper a variety of methods and models that are used in the study of 'practice theory'. Less a well-formed theory than a project, practice theory has its origins in diverse strands of the writings of Bourdieu, Giddens, Geertz, Sahlins, and de Certeau (Ortner, 1996: 1–20). For my purposes the 'key argument' of practice theory is that the material world (the world of action) and the cultural world (the world of symbols) interpenetrate, and are built up through the immediate association of each with the other (Mohr and Duquenne, 1997: 309). The techniques on which I focus have in common an emphasis on the 'duality' or co-constitution of elements at one level and relations at another (higher or lower) level of social action (as in my formulation; Breiger, 1974). I have the most to say about the assemblage of what Mohr and Duquenne (1997: 308) refer to as the recent "proliferation of formal theories, applied methods, and software routines ... that allow the structural properties of social phenomena to become visible in [new] ways". This restriction to relatively formal techniques is useful for the understanding and further elaboration of an evolving and very real subculture of cultural analysis, which is my main goal. At the same time, restriction to formal techniques is self-limiting if it reinforces the tendency of this very branch of practice theory to veer back toward the structuralist modes of analysis from which it arose, rather than forward toward dialogue with students of the more locally-based emphasis on action – including disruptive and challenging activities – associated with the analysis of discursive practices (Duranti and Goodwin, 1992) and with the development of practice theory from the points of view of feminist and subaltern scholarship (Ortner, 1996). In fact the relation of a formal, structural version of practice theory to a more action-oriented, processual, framework (see also Emirbayer, 1997) provides some of the tension underlying the arguments of this paper.

1.1. Materials

As a mold or a matrix for casting the tools for the working practice theorist's kit, consider Pierre Bourdieu's "convenient instrument of construction of the object: the *square-table of the pertinent properties of a set of agents or institutions*" (Bourdieu, 1992 [1988]: 230; original italics). "If, for example, my task is to analyze various

combat sports (wrestling, judo, aikido, boxing, etc.), or different institutions of higher learning, or different Parisian newspapers", Bourdieu (1992 [1988]: 230) tells his graduate students, "I will enter each of these institutions on a line and I will create a new column each time I discover a property necessary to characterize one of them". This very simple table (in which the number of rows and the number of columns will likely differ, despite its designation as 'square') "has the virtue of forcing you to think relationally both about the social units under consideration and their properties" (1992 [1988]: 230). Some well-known examples in Bourdieu's work are a table cross-classifying major French corporate boards and their individual members by their educational pedigrees; a table cross-classifying subjects that would make a beautiful photograph by the occupation of people choosing each subject; and a table indicating as columns the epithets (ranging from 'lively' and 'cultivated' to 'flabby, nice, puerile', and worse) written in girls' progress reports at an elite secondary school and, as rows, the girls' fathers' occupations ('tax clerk, provinces', and so on; Bourdieu, 1996 [1989]: 362–363, 1984 [1979]: 526, 1988 [1984]: 195–198 respectively). From such tables one may construct "social spaces which, though they reveal themselves only in the form of highly abstract, objective relations, ... are what makes the whole reality of the social world" (1992 [1988]: 231).

In section 2 of this paper I consider correspondence analysis, the quantitative method with which Bourdieu is most identified. I do so, however, by cross-reading Bourdieu against the quite different approach of James Coleman. I show that there is a remarkable homology, at the level of their formal practices, between the mathematical techniques of Bourdieu's tool kit and those honed at Coleman's foundry. My purpose is not to assert that one analyst is more encompassing than the other or to 'misrecognize' (as Bourdieu might say) affinities among them, but to develop more sturdy relations among the tools in a practice theorist's kit.

A second main line of formal development in which practice theory has been moving is the analysis of dual (or Galois) lattices. The definitive sociological work (Mohr and Duquenne, 1997), which applies this model to a study of the logic of classification practices for poor relief in New York City around the turn of the century, has now been joined by a major study (Mische, 1998) of movements, social networks, and the formation of a civic culture in Brazil; Mische pushes Galois lattice analysis in the direction of research that takes time seriously, arguing for a dynamic conception of civic culture as the construction of identities, projects, and styles of interaction across diverse and contending networks. On the formal side, Mische and Pattison (this issue) extend lattice analysis to study three-way interpenetration among organizations, projects, and events. Wiley and Martin (1999; see also Martin, this issue) present a formal model that, in a manner of speaking, combines algebraic and statistical approaches to allow uncovering the skein of 'social logic' connecting cultural items. Within the growing literature on formal models (Freeman and White, 1993; Pattison, 1993: 135–171; White and Duquenne, 1996; Pattison and Reeve, 1996), an important technical issue, inseparable from substantive concerns, is how to simplify the algebraic structure of highly complex relations among symbols. In section 3 of this paper I contend that correspondence analysis methods, and related statistical models, can help here. Sections 4 and 5 focus on the

more general issues that I see as arising from the project of stocking a tool kit for practice theory.

2. Coleman and Bourdieu: Dual equilibria in a social field

"If I make extensive use of correspondence analysis", Bourdieu affirms, "it is because correspondence analysis is a relational technique of data analysis whose philosophy corresponds exactly to what, in my view, the reality of the social world is." Specifically, "it is a technique which 'thinks' in terms of relation, as I try to do precisely with the notion of field" (Bourdieu and Wacquant, 1992: 96).[1] Correspondence analysis takes as its material the 'square-table of pertinent properties of a set of agents or institutions' introduced in this paper's introductory section. Produced by the technique is a set of dimensions that (in a certain mathematical sense) may be said to underlie the structure.

2.1. National distinctions in an academic field

Criticisms of correspondence analysis and related procedures as practiced by French, Dutch, and occasionally Japanese researchers have been legion, especially in America and England. Disputes among statisticians on this subject are so heated as to often result in a rhetoric of national character differences. "These national distinctions are more real than one might think", the eminent British statistician J.C. Gower writes in the pages of *Applied Statistics* (Gower, 1989: 273), treating correspondence analysis as an instance of "Franco-Dutch statistics" which in confrontation with "Anglo-Saxon statistics" leads to "opportunity for confusion" as to what is and is not a model, as to the importance of graphical methods in defining a model, as to data description versus statistical testing, and other issues. In a markedly uncharacteristic departure from his usual attention to the most relevant issues of statistical analysis, Leo Goodman (1987) writes in a leading American sociology journal that "although it is not very relevant, I cannot forbear to include here the following ... statement from [a French] ... report: 'French sociology will not 'follow' Anglo-Saxon sociology ... in its mathematisation but will develop its own indigenous methodological research ....'" (Goodmann, 1987: 535). J.-P. Benzécri (1991), an early shaper of the development of correspondence analysis in France, commenting on a paper of Goodman's in a leading statistics journal, and considering "the three small tables that served as a grounding point in his article", writes that

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[1] Van Meter et al. (1994: 133) describe how "in some cases" Bourdieu's use of correspondence analysis "was quite clear and well presented", whereas in other cases it was "rather rhetorical", involving synthetic graphics "prepared by the author himself without direct reference to a specific correspondence analysis". Van Meter and colleagues note that, due to Bourdieu's prominent use of the technique, which produced visualizations that were "quite convincing in spite of the lack of a detailed presentation of the analysis" (1994: 133), correspondence analysis was more and more accepted, and applied to an increasing extent by methodologically sophisticated social science researchers in France and elsewhere.

"On both sides of the Atlantic, the same numerical algorithms are applied to data analysis. Bibliographical references cross over the ocean, but the very spirit of correspondence analysis, as we understand it, did not cross over yet." (Benzécri, 1991: 1115)

Indeed, my essay can be read in part as an effort at 'recovering' the spirit of correspondence analysis from its English and American critics in much the same way that Holt (1997) endeavors to recover Bourdieu's theory of tastes from its American critics.

Because of the criticisms of correspondence analysis for being merely descriptive, data-dredging, and so forth (see the historical and analytical perspective presented in van Meter et al., 1994), and also for other reasons soon to become apparent, I turn now to an approach that seems in certain respects the antithesis of Bourdieu's. I refer to the precisely formulated 'mathematics of social action' in James Coleman's *Foundations of social theory* (1990), which underlies the author's rational choice program of research and theory building. I will show that there is a remarkable homology – at the level of formal practices, if not indeed in their 'very spirit' – between the mathematical techniques in Bourdieu's tool kit and those developed more explicitly by Coleman. My purpose is not to assert that one analyst is more encompassing than the other, but to raise a series of questions, some of which I find troubling and some promising, about the tools resting in a practice theorist's kit.

To be specific, I will consider an example that a student of Coleman's work might find congenial. The members of the U.S. Supreme Court can be said to be differentially interested in cases exemplifying various issues: civil rights versus due process issues versus economic issues, perhaps. And they might be said to exercise differential amounts of control in each of these areas. I take as my example two terms (Fall 1991 through Spring 1993) of the 'Rehnquist Court', using data from the U.S. Supreme Court Judicial Database (Spaeth, 1994). I define 'interest' as the tendency of a justice to author opinions not required by the Court and focused on cases of a particular type (civil rights, due process, and so on).[2] I define 'control' as the tendency of a justice to be in the majority of opinions formally voted upon by the Court in each respective issue area. Tables 1 and 2 report the data reflecting the 'Interest' and 'Control' of the nine justices in several areas; I will sometimes refer to these tables as matrix X and matrix C respectively.[3] The issue areas I have chosen are too

[2] The assignment of the writing of opinions by the chief justice to his associates is clearly an exercise of formal authority. For this and related reasons, I restrict my attention to 'special opinions', defined as those which no justice can be forced to join or prevented from joining. (One example is a dissenting opinion; another is the writing of an opinion notwithstanding membership in the majority or plurality opinion coalition; a more elaborate, technical definition is given in Segal and Spaeth, 1993: 276–279.) Segal and Spaeth (1993: 279) argue that writing and joining of special opinions "bespeak an ability to persuade or convince another of the correctness of one's position ... without the use of coercion, authority, or political control". Work on the Supreme Court related to that presented here appears in Breiger and Roberts (1998) and in Han and Breiger (1997).

[3] To illustrate how Table 1 was constructed, consider the 48 cases in the area of crime that were decided by the Supreme Court in the period of interest. In 36 of these cases Rehnquist voted with the majority, and in 15 cases Thomas voted with the majority. Thus, the proportion of cases in which Rehnquist and Thomas voted in the majority was .75 (= 36/48) and .31 (= 15/48), respectively. Table 1 norms

few and too broadly defined to be adequate for a serious analysis, but are handy nonetheless for making my points. Research that moves closer to 'getting the text' (Mohr, 1998) of discursive practices should go further than the didactic example chosen here toward understanding within a relational context how courts function as "moving classification systems" such that "the kind of reasoning involved in the legal process is one in which the classification changes as the classification is made" (Levi, 1949: 3)

Table 1
Matrix C of Control, and derived vector r_i of actor power

Justice	Matix C of Control					Derived power (r_i)
	Crime (48 cases)	Economy (46 cases)	Civil rights (32 cases)	First amend. (14 cases)	Due process (7 cases)	
Rehnquist	.14	.11	.15	.17	.13	.138
Kennedy	.14	.13	.13	.16	.13	.137
O'Connor	.13	.13	.13	.12	.13	.125
Scalia	.13	.11	.11	.14	.13	.122
Stevens	.09	.12	.11	.14	.11	.108
Blackmun	.11	.12	.10	.10	.05	.107
White	.10	.10	.11	.07	.16	.103
Souter	.11	.10	.10	.07	.08	.099
Thomas	.06	.08	.06	.03	.08	.062
Total (Votes)	1.00 (256)	1.00 (287)	1.00 (192)	1.000 (58)	1.00 (38)	1.00

2.2. *Power and value as dimensions of a space*

In considering Coleman's *Foundations*, I urge recognition of "the two-level character of the theory" (Coleman, 1990: 667). In fact, Coleman doubles the dual-

these numbers by using a different constant, however, just to insure that the sum of each column is unity (so as to be consistent with the most elementary form of Coleman's algorithm to be applied to these data). The total number of votes in the majority (from cases with 5–4 splits or higher if nine justices decided, or splits of 5–3 or above in the three cases decided by only eight justices) is 256 for cases dealing with criminal law. Table 1 norms the number of times each justice voted in the majority by the number of majority votes on each issue respectively. Hence, the entries for Rehnquist and Thomas in the first column of Table 1 are .14 (= 36/256) and .06 (= 15/256), respectively. Thus, Control over an issue is defined as the tendency of a justice to prevail (vote in the majority) on that issue. Turning to Table 2 (Interest), the unit of analysis is the 'special opinion' (defined in the previous note). As an illustration: of the 36 special opinions authored by Rehnquist in the period of interest, 12 (or 33%) were in the area of crime, and 2 (or 6%) were in the area of due process. Hence, the entries for Crime and Due Process in Rehnquist's column of Table 2 are .33 and .06, respectively. In this way, Interest is defined as the tendency of a justice to author opinions in a given area of the law (confining the measure to those authored opinions that were not required by the Court, as described in the previous note).

Table 2
Matrix X of Interests, and derived vector v_j of resource value

	Matrix X of Interests									Derived
Issue	Rehnquist	Kennedy	O'Connor	Scalia	Stevens	Blackmun	White	Souter	Thomas	value v_j
Crime	.33	.37	.37	.33	.43	.35	.50	.29	.45	.375
Economy	.39	.23	.23	.27	.21	.22	.21	.18	.23	.247
Civil rights	.11	.20	.19	.23	.20	.22	.07	.18	.19	.175
First amend.	.11	.14	.16	.13	.11	.13	.21	.18	.10	.141
Due process	.06	.06	.05	.04	.05	.09	.00	.18	.03	.061
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.000
(Opinions)	(36)	(35)	(43)	(48)	(56)	(55)	(14)	(17)	(31)	1.000

ity, by considering the interlacing of actors and issues with respect to two relations (interest and control) simultaneously (and to more than two in his chapter 27; on this extension, see also Marsden and Laumann, 1977). Moreover, Coleman provides a self-consciously thin meta-narrative (in a sense intended as the exact opposite of the kind of 'thick' description often applied by Clifford Geertz and other practice theorists) about action and exchange.[4] Assuming "there is no structure to impede any actor's use of resources at any point in the system" (Coleman, 1990: 719) – that is, positing the absence of transaction costs – actors exchange some of their control over resources they have in order to gain more of the resources they desire. Emergent from such a market-like social system are analogues to 'price', in that Coleman's mathematics allows him to compute the 'value' of each resource (denoted v_j). And dually, the 'power' of each actor (denoted r_i) is also a scalar quantity that emerges from the 'market' of exchanges. To the extent that one actor controls the resources in which another is interested – such control being represented in the matrix product CX – to that extent 'power' is exercised, within Coleman's framework.

An extensive presentation of Coleman's (1990) mathematical model appears as part IV of his work. What is important for present purposes is the relation of Coleman's model to correspondence analysis. The basic relation is as follows. The Correspondence Analysis (CA) of a matrix of relations yields a decomposition of that matrix into the marginal effects (i.e., functions of the one-variable distributions of actors into row categories and into column categories) *plus* a set of dimensions that account for the statistical association between the row categories and the column categories. Two points need to be made about the relation of CA to Coleman's model. First, Coleman's mathematical solutions for the 'power' of actors and for the 'value' of events are eigenvectors of products of his C and X matrices, even though he never

[4] "In the parsimonious conception of a system of action that I want to establish, the types of action available to the actor are severely limited. All are carried out with a single purpose – to increase the actor's realization of interests" (Coleman, 1990: 32).

quite says so.[5] Thus, at a purely formal level, Coleman's mathematics of rational action and the type of CA that Bourdieu employs are mutually implicative. Second, Coleman's model yields a single set of eigenvectors ('power' and 'value' respectively) that pertain essentially to the marginals alone. In other words, Coleman's analyses of interest and control (or dually, the power of actors and the equilibrium values of events) exploits the one-dimensional distributions of interest and control while ignoring subsequent dimensions pertaining to statistical interactions. See Appendix A to this paper for related discussion.

2.3. *Constructing power and value in a juridical field: The supreme court*

Tables 1 and 2 report Coleman's derived constructs of 'power' and 'value' (r_i and v_j) along with the Control and Interest matrices (C and X, respectively). The derived vectors of power and value were computed using the 'iterative method' given in Coleman (1990: 698–700), identical to the eigenvector approach of this paper's appendix (section A.4). From Table 1 it is seen that each number in the 'power' vector is close to the average entry in its row, and a similar observation pertains to the 'value' vector given in Table 2. This closeness is 'built in' to Coleman's model (and see also section A.5 of the appendix).

The one-dimensional marginal effects embodied in Coleman's principal constructs, while not the full picture, go a long way in guiding interpretation, even with respect to this rather home-cooked example. It is seen that Justices Rehnquist and Kennedy have the highest 'power' scores (scores in Table 1 of .138 and .137), defined operationally (implementing an idea of Coleman's within the Supreme Court context) as voting with the majority in issue areas of greatest concern among the justices. In fact, Rehnquist, in contrast to his predecessor as chief justice, has emerged as a highly central leader of the Court (Simon, 1995). And in the 1992–1993 term Justice Kennedy was the 'least frequent dissenter' (dissenting in five out of 107 votes overall; Greenhouse, 1993). At the other extreme, Justice David Souter, who according to my implementation of Coleman's measure (voting with the majority in issue areas of high concern) has low power, in fact was a frequent dissenter, dissenting in 12 of the 17 cases decided by a 5–4 vote in the 1992–1993 term. Also at the 'low power' end of Coleman's scale is Justice Clarence Thomas, these two years being his first on the Court following an explosive confirmation process and marked by opinions, such as his dissent from the finding that it was cruel and unusual punishment to confine a non-smoking prisoner in a cell with a chain-smoker, that "took issue with 17 years of Supreme Court precedents on unconstitutional prison conditions" (Greenhouse, 1993: E1). Thus, Coleman's 'power' dimension for Table 1 seems to make a great deal of practical sense.

Anecdotal validation of the 'value' measure in Table 2 is less straightforward. By construction, the matrix XC is of dimension issues by issues, and reports the extent

[5] Pullum (1975) and Marsden and Laumann (1977: 244) have noted that Coleman's mathematical solution for 'power' and 'value' reduces to an eigenvector problem, and Tam (1989) has taken this insight in substantive directions.

to which each given issue area is controlled by justices who desire each area. 'Value' is an eigenvector of this matrix (see Appendix A). Crime and the economy were by this criterion the most valued issue areas among the justices, with due process valued least.

It will be instructive to compare an analysis of these data deriving from Coleman's approach to one based on the Correspondence Analysis that figures prominently in some of Bourdieu's work. For this purpose I use the 'raw' counts of votes on which Table 1 is based, and, similarly, the actual numbers of opinions written (Table 2).[6]

Consider first Table 1. The simple row sums of Table 1 correlate .998 with Coleman's 'power' measure. (The 'n' for this correlation consists of the nine justices.) The row sums correlate .995 with the first dimension of the SVD of Table 1 (see Appendix A). The correlation of this first dimension with the row sums is .989. Consider next Table 2, where we have only five issue areas. Across these five, the row sums correlate .998 with Coleman's 'value' measure. The first dimension of the SVD of Table 2 correlates .997 with these row sums, and correlates .9995 with Coleman's 'value' measure.[7] Coleman's principal explanatory constructs are essentially tapping into the marginals of these tables.

I turn next to the Correspondence Analysis of these data from the Supreme Court, as the CA model includes the marginal effects (discussed above) *plus* dimensions pertaining to the association of rows and columns. Because my interests are largely didactic, I will focus only on (the 'raw' counts of votes in) Table 1, the matrix of Control, and on the first two dimensions above and beyond the marginals.[8] These dimensions are shown graphically in Fig. 1.

A great deal of the popularity of CA with structural analysts and practice theorists alike derives from its ability to portray two types of entity (here, Supreme Court justices and issue areas) in the 'same' space.[9] Goodman (1996, 1997) provides a well-founded interpretive framework for CA diagrams of this sort, one with which practice theorists should become familiar. In offering the following interpretation of Fig. 1 I cut some corners (so to speak) of Goodman's interpretive framework in the interest of a concise treatment, which I believe will nonetheless suffice for present purposes. I will focus on the distance of each entity from the origin (the

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[6] The reader may recover these counts by multiplying the proportion given in any cell of Table 1 (or of Table 2) by the number in parentheses at the bottom of that column, and then rounding to the nearest whole integer. See note 3 above.

[7] The correlation of Coleman's power measure with row sums of the matrix product CX (Control × Interest) is perfectly +1. Dually, the correlation of Coleman's value measure with row sums of XC (Interest × Control) is also perfectly +1. See also Appendix section A.5.

[8] Although it is standard practice among CA analysts to use the first two dimensions, this is a higly contentious issue with respect to tables of counted data, and very much related to the criticism that CA is not a well-founded statistical procedure. See on these issues the development of Goodman's (1987, 1996) powerful framework, and also the comments of van Meter et al. (1994).

[9] Indeed, the CA model posits that entities of one type (justices, for example) have scores that are the weighted averages of scores of the other type (issue areas, say), where the weights are the proportions in the data table. In this sense the justices 'are' the issue areas, and vice versa.

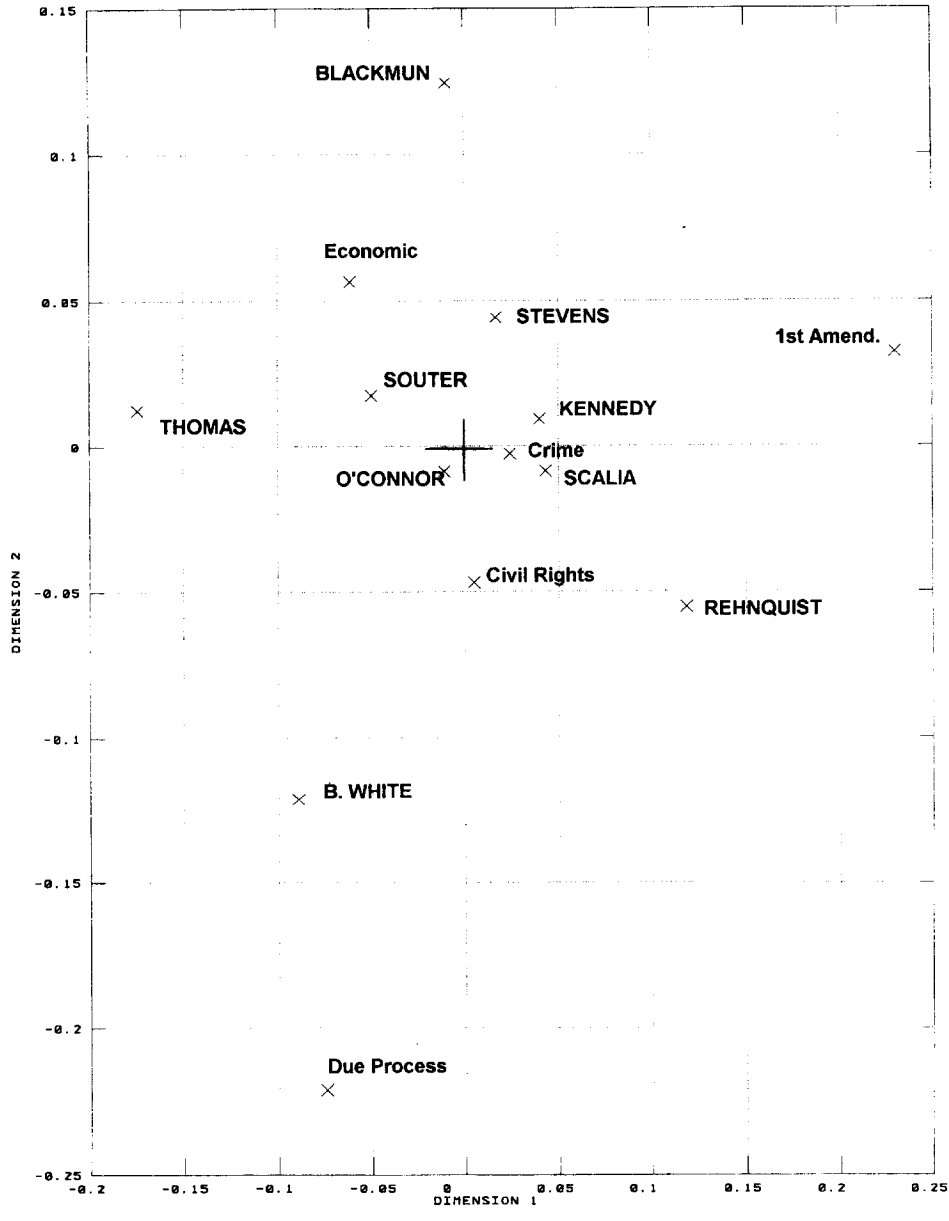

Fig. 1. Correspondence analysis (first two dimensions) of the Control matrix (the vote counts of Table 1).

point [0,0] on the graph) and on the closeness of the angle between any two entities and the origin. The short length of the projection of 'crime' onto the vector formed by Justice Scalia and the origin depicts a strong statistical association: with respect to these data, Scalia tended to vote with the majority when the case concerned criminal law.

The angle between Blackmun and Stevens is small (has a large cosine), reflecting a high degree of correlation between these two justices with respect to their control over issue areas. External evidence suggests that Blackmun and Stevens are 'the Court's two most liberal members' (Greenhouse, 1992). Similarly, Scalia and Rehnquist are seen from Fig. 1 to be highly correlated, and they (along with Justice Thomas) are the most conservative members of the Court. Moreover, the angle between the Blackmun-Stevens dyad and the Rehnquist-Scalia dyad is quite large, suggesting that these two dyads are 'far apart' in the space of judicial control portrayed in Fig. 1. And furthermore, Blackmun and Rehnquist are further away from the origin than are Stevens and Scalia, suggesting (with respect to both the diagram and the social space) the defining of axes. The three newest members of the Court – O'Connor, Kennedy, and Souter – have 'low' profiles (they are close to the graph's origin); the other aspect they have in common is that their locations are all rather orthogonal from both the liberal and conservative cores. This orthogonality found social expression in the behavior, for example, of Justice Souter in the term ending in June 1993: in 40 cases in which Scalia and Blackmun were on opposite sides, the moderate Souter voted with Scalia in 56 percent and with Justice Blackmun in 44 percent (Greenhouse, 1993).[10] Justice Thomas (discussed above) and Justice White, who by 1993 was by far the longest-serving member of the Court and about to retire, are located apart from each other and from the other justices.

In brief: the CA dimensions reflect similarities of style and profile that are no doubt related to Coleman's concept of actor 'power', but related more indirectly than are the marginals of Table 1, on which Coleman focuses in essence exclusively.[11] Both Coleman's approach and the CA approach exploit a duality that is relevant for practice analysts, but they do so in distinctively different ways. Coleman focuses on defining power and value with respect to the *magnitudes* of two relations (interest and control) that cross-cut actors and resources. CA focuses on the *similarities* among entities of different types (such as actors and resources) mapped into a common space of profile and distinction. Coleman's analysis is more sophisticated than that of Bourdieu in that Coleman 'doubles' the duality by studying mappings of actors and resources with respect to *two* relations (interest *and* control). At the same time, Bourdieu's analysis is more sophisticated than that of Coleman's in that Bourdieu moves beyond the 'marginal' magnitudes to study the *association* of actors with

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[10] Simon (1995: 12) writes of O'Connor, Suiter, and Kennedy: "their secret collaboration, unknown to any of their colleagues, produced a joint opinion in the 1992 case of *Planned parenthood of Southeastern Pennsylvania v. Casey*, which preserved Roe – and stunned Rehnquist and Scalia".

[11] The first dimension of the CA (with respect to the rows space of the Control matrix) correlates .61 with Coleman's 'power' dimension reported in Table 1, and (with respect to the column space of Control) .31 with the 'value' scores of Table 1.

resources (so to speak 'above and beyond' the marginal distributions), and moreover he does so within a space that is multidimensional.

3. The dual lattice structure of social fields

Some seemingly unlikely correspondences between Pierre Bourdieu's use of an empirical, data-analytic method and James Coleman's formulation of a model of rational choice have provided the focus of the previous section. Implications for social theory are drawn in section 4. There are also implications for related methods deployed by practice theorists. I will now draw out those implications with reference to a technique – termed Galois lattice or concept lattice analysis – that in the work of Mohr and Duquenne (1997) and Mische and Pattison (this issue; Mische, 1998) has produced fundamental insights about the co-constitution of symbols and social action. Like correspondence analysis, Gallois lattice representations are very handy for studying the association of phenomena at different levels (such as Supreme Court justices and issue areas). Moreover, unlike statistical approaches, the lattice is an algebraic object that is 'purely' structural. There are some practical problems with lattice analysis, however, such as the fact that lattice models quickly become highly complicated when applied to real data of interest, and require data in binary form. I will show how correspondence analysis can help with these problems (see also Breiger and Pattison, 1999).

3.1. How to construct and interpret a Galois lattice

A Galois lattice (Davey and Priestley, 1990) is a means for representing two orders of information in the same diagram, such that every point in the diagram contains information on both orders simultaneously. This lattice representation is relevant for the data contexts introduced in section 1.1 above in the case that the dual connections are all of a binary nature (consider for example the table relating epithets written in each girl's progress report to her father's occupation).

To understand why practice theorists like dual lattices, consider Table 3, which (in the form of its first six rows) is a binary version of the Supreme Court 'Control' matrix of Table 1. I will soon detail how Table 3 is derived from Table 1, but at this point in my exposition I will simply take Table 3 as 'given'. The Galois lattice constructed from Table 3 may be represented as in the diagram of Fig. 2, and I will explain the relation between the table and the diagram. It is assumed that both Rehnquist and Scalia tend to vote in the majority in the areas of Crime, Civil Rights, First Amendment, and Due Process; that is why their names are combined in row (1), and entries of '1' appear in the respective cells of row (1).

To construct a Galois lattice from Table 3 (first six rows), we begin with the first two rows and examine their intersection (the set of issues on which the justices indexed by the first two rows jointly tend to vote with the majority). Thus comparing (Rehnquist and Scalia) with Justice Kennedy, we observe that Kennedy's issues (criminal and First Amendment cases) are exactly a subset of those in row (1). In this

Table 3
A model of Control, as described in section 3.2

		Issue area				
Label	Justice(s)	Crime	Economy	Civil rights	First amend.	Due process
(1)	Rehnquist, Scalia	1	0	1	1	1
(2)	Kennedy	1	0	0	1	0
(3)	O'Connor, White	0	0	1	0	1
(4)	Stevens	1	1	0	1	0
(5)	Blackmun	0	1	0	1	0
(6)	Souter, Thomas	0	1	0	0	1
(1) ∧ (5)		0	0	0	1	0
(1) ∧ (6)		0	0	0	0	1
(2) ∧ (3)		0	0	0	0	0
(4) ∧ (6)		0	1	0	0	0
Universal		1	1	1	1	1

sense, the intersection of rows (1) and (2) is row (2). Because Kennedy tends to prevail on issues which are a subset of those in which Rehnquist and Scalia prevail, we represent Kennedy 'below' Rehnquist and Scalia in the Gallois lattice diagram of Fig. 2.

In this way we systematically compare *all* pairs of rows in Table 3. When we endeavor to compare row (1) and row (5), however, we find an intersection (containing only the First Amendment cases) that does not correspond to any of the rows in the given table (the first six rows of Table 3). We deal with this by adding the new intersection to our original table (see the seventh row in Table 3, which is the first 'new' row), and we represent this 'new' row as a point (one not labeled by justices' names) 'below' rows (1) and (5) in the diagram of Fig. 2. (See the point in Fig. 2 labeled 'First Amendment'.). In constructing a Galois lattice in this way we consider intersections of all pairs of rows, those in the original dataset and those we adjoin to it because they represent intersections of rows already considered. By means of this construction we obtain an object that is closed under the operation of taking intersections. We also always add in the Universal element (having 1's in all cells; see the last row listed in Table 3). In constructing the lattice diagram (Fig. 2), we portray each row as a point, placing each point beneath those in which it is included (or identifying it with those that are identical, as is the case in this example with Rehnquist and Scalia), and connecting two points with a downward-sloping line if the higher point contains the lower one and is most similar to it.

Here is the 'punchline' of the mathematics of the Galois lattice. Suppose we had started with issues instead of justices (i.e., by considering intersections of *columns* of Table 3, instead of intersections of rows). Then it is nonetheless guaranteed that the *same* lattice diagram (Fig. 2, in our example) represents the issues! (See the 'Fundamental theorem on concept lattices'; Davey and Priestley, 1990: 224; or Freeman

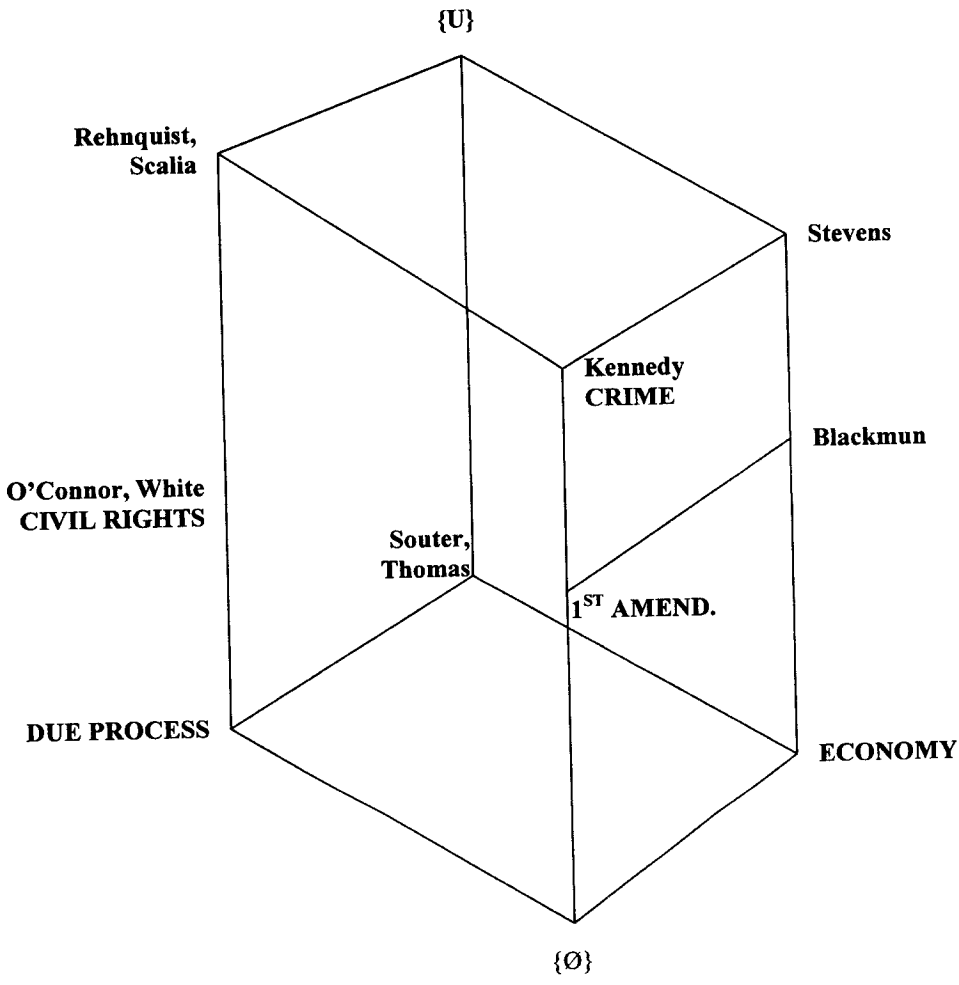

Fig. 2. Galois lattice representation of Table 3.

and White, 1993.) We need only to read the diagram in the opposite orientation. As to justices, Rehnquist and Scalia are toward the *top* because they predominate on the same issues (and more) as do those justices listed below them (O'Connor, White, and Kennedy). As to issues, dually, Due Process is *below* Civil Rights in Fig. 2 because all the justices associated with Civil Rights are *included* among those associated with Due Process. (In Table 3, the column for Civil Rights is a subset of the column for Due Process.) The 'punchline', therefore, is that Galois lattice diagrams such as Fig. 2 provide an understandable means for locating objects at different levels of analysis (such as justices and issues) within a single hierarchy of co-constitution.

3.2. Tasks and tools: Lattices and dimensional structure

Mohr and Duquenne (1997) had data of a different sort than Table 3: not zeros and ones, but counts of the references made by organizations to their poverty practices (e.g., giving food, finding a job) and to their client types (destitute, stranger, and so on). Because lattice analysis seems to require binary data, the authors (1997: 317) treated all numbers greater than zero as 'present'. Using different cutoff values (greater than 2? Or perhaps 'filling in' some of the zero cells from marginal values on the assumption that small counts 'might' have been 'missed' by the sampling procedure?) 'ought' not to matter too much, in the sense that the cutoff criterion might be conceived as governing the 'graininess' of the representation rather than its major contours.

The issue of how to binarize relates to another of much greater concern. Although the duality of the Galois representation is appealing, diagrams such as the one described above (Fig. 2 and Table 3) can become prohibitively large.[12] Much of the recent algebraic work on lattice analysis (e.g., articles by Freeman, Duquenne and White in White and Duquenne, 1993; Pattison, 1993; Pattison and Reeve, 1996) seeks formal methods of simplification.

This brings us back to data on counts, and to our concern with correspondence analysis and related methods. There are deep relations between eigenvectors and dimensional representations, on the one hand, and lattices, on the other (Breiger and Pattison, 1999). As an alternative to more complex algebraic models, Pattison and I suggest that we might search instead to make the data simpler. As a technique to focus on row-column association (by so to speak factoring out the marginal effects), existing models such as CA or somewhat related techniques of log-linear modeling (Goodman, 1996) might well be employed in a new way.

Specifically, in order to think of the Supreme Court data in Table 1 (actually, the raw counts on which this table was based; see note 6) as a candidate for Galois lattice analysis, I fitted Goodman's two-dimensional association model to these counts, and then examined expected frequencies divided by marginal parameters, in order to focus on the 'part' of each fitted count that results solely from its situation with respect to the two postulated dimensions. Although other choices are possible, I binarized these parameters at zero (taking any association between rows and columns to index the presence of a relationship). This is how Table 3, discussed extensively above, was generated from (the raw counts underlying) Table 1. The relatively small size of Table 3, including the 'new' rows added by the construction process described above, suggests at least for this example that the process of restricting attention to row-column interactions 'net' of the marginal effects leads to a reduction of complexity with respect to the lattice resulting from the analysis (Fig. 2).

Perhaps the greatest contribution of Fig. 2 is to illustrate that Galois lattices and correspondence analysis (along with related techniques of loglinear model-

[12] Even for the illustrative example studied by Freeman and White (1993: 137), consisting of just 18 women and 14 groups, the size of the Galois lattice representation was 65 elements.

ing) are not as different as might have been thought. Both representations comprehend the cross-cutting nature of entities of different types; both techniques are suitable for practice theory. From Fig. 2 we learn (if we focus only on the positive interactions as defined above), for example, that Rehnquist and Scalia tended to vote in the majority in the *same* issue areas. Reading down the diagram, these areas were: crime, civil rights, first amendment cases, and those raising due process questions. Blackmun voted in the majority on the subset of issue areas in which Stevens tended to prevail (specifically, the diagram reveals that Blackmun, unlike Stevens, tended not to vote with the majority in criminal law cases). Moreover, Rehnquist-Scalia and Stevens-Blackmun tended not to 'intersect' by appearing in the majority in any issue area (the intersection of Rehnquist and Blackmun is the 'null' node at the bottom of the diagram). In something of the spirit of Mische's (1998) use of correspondence analysis to study a different problem (the evolution of student movements in Brazil), it ought to be possible to use Fig. 2 and related data on successive time periods to study the evolution of coalitions among the justices (see also Mische and Pattison, this issue). Fig. 2 shows, for example, that at one historical moment Justice Souter tended to join with Stevens, Blackmun, and Thomas in voting in the majority on economic issues, while he tended to join with O'Connor, White, Rehnquist, Scalia, and Thomas in voting in the majority on due process issues. Conjunctures of issues and individuals such as these suggest hypotheses about the unfolding dynamics of a social field, and in particular about the role of the so-called moderates (see also Greenhouse, 1992; Simon, 1995).

4. Implications for practice theory of the methods of Bourdieu and Coleman

The following more general – and to me in some instances more troubling – comments about the implications for practice theory of these formal models also seem warranted.

First, it is possible to use the discussion of section 2 to support arguments to the effect that, "despite his disclaimers, Bourdieu does indeed share a good deal with Gary Becker and other rational choice theorists" (Calhoun, 1993: 71), or related concerns that, as a practice theorist, Bourdieu studies practices that "themselves are largely utilitarian and economistic, with actors seeking to maximize various forms of capital to enhance their own positions" within structures (Ortner, 1996: 4). The present paper could be used to support such arguments in the following way. In developing his model of power and value, Coleman (1990: 681–687) directly applies competitive equilibrium theory from economics. In a competitive equilibrium, each good (read: resource) has a single price (read: value), the rate at which it is exchanged in all transactions. Each actor maximizes utility subject to a resource constraint (read: power) which is equal to the sum of goods possessed weighted by their price (read: the sum of resources controlled weighted by their value). Furthermore, the 'solutions' for power and value in Coleman's system are (as seen in section 2.2 and illustrated in section 2.3) dual eigenvectors intimately related to the Correspon-

dence Analysis often employed by Bourdieu.[13] Lash (1993: 195) offers a suitable meta-narrative along these lines as to "just how Bourdieu's fields (and markets) work". Fields are sites of collective symbolic struggles and individual strategies, and "the value of a symbolic good depends upon the value assigned to it by the relevant consumer community". Victory in a symbolic struggle, in Lash's interpretation of Bourdieu, means that one's symbolic goods have been judged to possess more value than those of one's competitors. It is also possible to use the discussion of this paper to refute the charge that Bourdieu's reliance on correspondence analysis is economistic (see my fourth observation below).

Second, and entirely apart from any imputations concerning the role of individuals' rationality in Bourdieu's sociology, it is possible to see the eigenstructure of CA and its relation to equilibrium ideas as helping to clarify Bourdieu's concepts of 'field' and of 'habitus'. Bourdieu (1990a [1980]) seems to understand the habitus as a concept of *equilibrium*, as when he speaks of it as "a matrix generating responses adapted in advance to all objective conditions identical to or homologous with the (past) conditions of its production; it adjusts itself to a probable future which it anticipates and helps to bring about because it reads it directly in the present of the presumed world, the only world it can ever know" (Bourdieu, 1990a [1980]: 64. In the analysis of a habitus, it is necessary to uncover *principles of action* that organize fields of activity both spatially and temporally. For example, on the basis of Bourdieu's (1988 [1984]: 48) study, 'the university field' in France may be said to be organized according to two principles of hierarchization: the social hierarchy (reflecting trajectories through the elite secondary school system in France, father's occupation and appearance in *Who's who*, and so on), and 'the specific, properly cultural hierarchy' reflecting scientific authority and individual renown. Correspondence analysis brings these two concepts together: the principles of action identified with the dimensions of CA are seen (as in this paper's appendix) to provide 'best' representations, at equilibrium, of an entire relational field (or 'bundle of relations', Bourdieu and Wacquant, 1992: 16).

Third, now turning the spotlight on Coleman's magnum opus, the new and important insight that emerges from this paper is that Coleman may be seen as an analyst of social fields. Specifically, his master concepts are seen to be consistent with correspondence analysis, and in fact (in the sense specified) identical to a singular value decomposition – but with some questions coming into play when this work is read from a perspective congenial to Bourdieu's. Coleman's emphasis on duality (for example, his 'power' and 'value' as solutions to a singular value decomposition of matrix *products* based on relations of actors and resources conceived as co-constituting one another) is a highly innovative contribution. But on the other hand, the most obvious question arising from the framework of this paper is: why does Cole-

[13] I am not arguing that Bourdieu was *aware* of the mathematical relations between correspondence analysis and rational choice models such as Coleman's (indeed, see note 1 above), but rather that analysts who *are* aware of these relations can see important elements of utilitarianism (such as equilibrium, and a micro-model in which actors trade forms of capital in order to enhance their position) as 'built in' to the most important quantitative methods that he deploys in his empirical work.

man stop with *just one* dimension for his analysis of social action? In Coleman's (1990: 713–715) brief analysis of data from the General Social Survey on the values of worker resources (education, experience) and job resources (wages, occupational prestige), for example, he derives values for these resources on both 'sides' of the exchange or matching process, in a generalization of the approach reviewed here. If one were to consider dimensions beyond the first, it might be possible to view the labor market as a differentiated 'space' of workers and jobs the most interesting characteristic of which might be its inhomogeneity with respect to what is valued, along which dimensions, by whom, and in relation to which other constructors of value. The focus on power and value as *magnitudes* that, I have argued, is built in to Coleman's formal approach seems similar to Bourdieu's (1990b: 128) specification of the 'first dimension' of what he terms the 'overall social space' as comprised of "the overall volume of the capital that ... [agents] possess". Crucially in addition, however, Bourdieu focuses on a separate dimension pertaining to "the structure of their capital, that is, ... the relative weight of the different kinds of capital, economic and cultural, in the total volume of their capital" (Bourdieu, 1990b: 128).

Fourth, in symmetry with my first observation: is it possible to see Bourdieu as the theorist who supplies the causal foundations of Coleman's model? This question follows from recognition (previous observation) that Coleman is a theorist of social fields but one who does not conceptualize their multidimensional nature. In economic theory a valued good has 'a single price' at equilibrium (Coleman, 1990: 682). In contrast, the values in the space of correspondences that Bourdieu constructs are always polysemous, multidimensional, carrying differing meanings with respect to associated principles of action and contradictions among those principles, and likely to be interpreted differently with respect to actors' distinctive locations in a social or cultural field.[14] This point alone markedly distinguishes Bourdieu's technique from the modeling framework of economics, and provides one sort of grounding for Bourdieu's suggestion that "far from being the founding model, economic theory (and rational action theory which is its sociological derivative) is probably best seen as a particular instance, historically dated and situated, of field theory" such as his own (quoted in Calhoun, 1993: 85–86). A further argument for portraying Bourdieu as providing (in effect) the causal foundations for Coleman's framework is that, in his major work *Distinction* Bourdieu (1984 [1979]) has elaborated a comprehensive theory of how it is that people and social groups tend to value certain kinds of objects and outcomes over others – just the kind of theory of valuation that is necessary but exogenous to Coleman's (1990) specification of the 'Interest' matrix, and a theory that in Bourdieu's formulation is intimately related to domination or 'control' as well as to 'interest'.

Fifth, it seems clear that cultural analysis would benefit from a theory of social measurement and meaning relevant to the issues in this paper. I do not have in mind the unification of Bourdieu's and Coleman's social theories in some single frame-

[14] An interpretation of Bourdieu's work that emphasizes the importance of the dual roles of time and space (location, concentration, synchronization, pace) in Bourdieu's thinking about both the material and the logical integration of action is that of Friedland and Boden (1994: 21–23). See also Abbott (1997).

work, as I am convinced that such a project would do symbolic violence to both schemes. Within the framework of this paper, what seems most necessary is a modeling context that brings a concern with dimensions underlying the *marginals* of relational fields (similar to Coleman's 'power') within the same scope as a concern for *dimensions* for social proximities and profiles (as in Bourdieu's use of CA). I would put forward as an example of this kind of work the analysis in Han and Breiger (1999; building on Breiger and Ennis, 1997; Breiger and Roberts, 1998) of relations among investment banks formed in 'doing deals', where both kinds of dimensions are delineated within a single model of exchange and hierarchy.

A point related to the fifth observation is that neither Bourdieu nor Coleman, in the work reviewed here, provides a statistical framework within which the relevance of their formal methods to data might be assessed. However, a great deal of work in the area of loglinear models and related methods (see in particular Goodman, 1996) has gone into formulating related statistical models. Techniques used by Han and Breiger, unlike those employed by either Bourdieu or Coleman, implement loglinear models that allow answers to the question of how well a model fits the data.

5. Practical methods and methodological practice

Social and cultural analysts well know that issues of theoretical orientation are matters of contention and worth fighting over. When it comes to quantitative methods, however, we often assume (even while occasionally being content to condemn such methods out of hand) that styles of quantification are entirely irrelevant to theoretical and ideological struggles. Such an assumption is not productive. Interpretation of quantitative methods is inseparable from more usual forms of textual interpretation, and on occasion interpretation of an author's methods of quantification can deeply enrich our reading and writing of social and cultural theory.

Both Coleman and Bourdieu are important structuralist thinkers of the twentieth century. The difference between them for present purposes is that Coleman, who had earlier been an inventor of contextual analysis (Coleman, 1958–1959: 30–31) and a father of network analysis, sought in his later work, for bold and principled reasons having to do with his beliefs about what is most necessary for the development of social theory (Coleman, 1990: 650–664), to push structural analysis further and further toward generalizations removed from the context of time and place; Bourdieu, on the other hand, and despite notable counter-tendencies, seeks to push structuralist analysis as far as possible in the direction of analyzing practical actors, performance, meaningfulness as a social product, and interpenetration of cultural and symbolic action.

In this paper (section 2 above) Bourdieu and Coleman have been so-to-speak caught assigning the same numbers, to however many decimal places one cares to take account of, to methodological procedures which they and everyone else claim to be entirely different. What is the meaning of this? The meaning is up for negotiation, and I endeavor to negotiate these shoals in section 4. Is Bourdieu a rational choice theorist? Can Coleman be claimed as a field theorist by institutionalists interested in

the pragmatics of performance? Asking these questions, and more generally using quantitative analysis as providing frameworks for probing social and cultural theory and as a means for the comparison and interrogation of texts, are some of the gains from recognizing that quantitative applications themselves are carried out within domains of social practices and cultural symbols. Reading 'across' methodological traditions can yield new insights and new tools, such as the proposed synthesis (in section 3 of this paper) of Galois lattice analysis with correspondence analysis and related procedures.

Several stories might be, and are, told about eigenvectors. They are the low-dimensional scaffolds that support higher-dimensional structures (see Appendix A). They index the dimensions of Bourdieu's social fields. They are, in Bourdieu's (1984 [1979]) application of correspondence analysis, a "visualization of proximities between specific response levels of a questionnaire and characteristics of the respondents", demonstrating the association between certain types of cultural profiles and certain social situations (van Meter et al., 1994: 133). They are the weights that define actors' centrality recursively (Rosenthal et al., 1987). They are the equilibrium outcome of exchanges in a market of rational traders (point one in section 4 above). They are fundamental to von Neumann's model of an expanding economy and to Leontief's model of equilibrium exchanges among economic sectors (Strang, 1980: 203–204). In Coleman's (1990) model they provide the macro-structure of actors' power and events' value that emerges from actors' micro-level exchanges of control on the basis of rational pursuit of individuals' interests. Like other kinds of stories, stories about applicable methods are underdetermined (they are not self-contained narratives). Stories are constituents of social spaces (White, 1992: 68), but they don't fully sustain themselves internally. They exist within social fields. Which one applies to some research problem at hand? These stories need to be contextualized, with plot lines joined or separated as appropriate, by researchers working under particular social and cultural practices – that is, by practical researchers. The ability to comprehend a variety of genres and plot lines and to contribute to them will continue to distinguish important work (Cicourel, 1993).

Swidler's (1986: 279, 281) identification of two contrasting modes of culture – culture as system; culture as tool kit – finds a reflection in cultures of methodological analysis. Once it is recognized, however, that different 'logics' of methods exist, choosing between them requires, so to speak, stepping outside their scope (DiMaggio, 1992) and recognizing that one has become a practical actor, an actor capable of choosing appropriately as well as correctly.

I want to conclude this article in the special issue of *Poetics* by pointing out that Culler (1997: 75, 78) identifies as a major problem for the theory of poetry the relation between the poem as a structure made of words (a text) and the poem as an event (an act of the poet, an experience of the reader, an event in literary history; see also Jakobson, 1990 [1960]). Likewise, it is important to recognize that quantitative methods consist of a formal structure (a mathematics) and an event (an application to a dataset, a linkage to another mathematical structure, an incorporation within a social or cultural story). The relation between structure and event is problematic in ways that are highly productive of sociological analysis. This is precisely the sort of

problem that needs to be addressed in a practical theory of research methods, and it is not too far off from the problematics of practice theory more generally.

Appendix A: A gloss on the mathematics of correspondence analysis and related models

The following non-mathematical gloss on mathematics might be useful for readers unfamiliar with these concepts. To pursue matters further, one might consult an introductory treatment such as Digby and Kempton (1987: 193–203), Rosenthal et al. (1987), or Weller and Romney (1990). For pursuit of these issues beyond the introductory level, I recommend the substantive papers of Marsden and Laumann (1977) and Tam (1989).

A.1. Singular value decomposition

Loosely speaking, an *eigenvector* of a square, symmetric matrix M is a string of numbers – that is, a *vector* – termed $s = (s_1, s_2, ..., s_n)$ such that, when multiplied by itself – so that in cell (i,j) we have the product $s_i \times s_j$ – the result is a 'best' representation of the original matrix M ('best' by the criterion of least squares: the sum of squared differences between cells of M and cells of the representation is smaller with our choice of s than with any other choice). This is in fact the 'first' eigenvector. The 'second' may be found by computing an eigenvector from the residuals produced in subtracting from M the representation defined above (or by computing an eigenvector on residuals from the comparison of M to the representation composed of the first k eigenvectors, when constructing the k+1st.). In this sense, the 'first' eigenvector provides a 'best' representation of a matrix by means of a single string of numbers. Associated with each eigenvector is a weight (a single number), termed a *singular value*, reflecting the extent to which that vector contributes to accounting for the association between rows and columns of M. Define the *singular value decomposition* (SVD) of a rectangular matrix A having n rows and m columns to be

$$A = U S V^T$$

In this representation, the columns of matrix U are the eigenvectors of the square symmetric matrix AA^T, where the superscript T refers to taking the transpose of matrix A. Dually, the columns of matrix V are the eigenvectors of the square symmetric matrix A^TA. (If these concepts appear foreign, perhaps this example will help. If rows of A denote occupations and columns denote possible subjects of beautiful photographs, then the cells of AA^T connect each pair of occupations by the extent to which their incumbents choose similar subjects as beautiful. And the cells of A^TA connect each pair of photograph subjects by the extent to which they are jointly chosen by members of the same occupation.) Matrix S has zeros everywhere except on its diagonal, which consists of the singular values associated with the eigenvectors in U (which turn out by a mathematical duality to be identical to the singular values associated with the eigenvectors in V).

A.2. The first dimension of SVD pertains to the marginals

In estimating a simple regression equation, the 'best' representation of a string of numbers (the dependent variable) by a single number is their mean. (Hence, the least-squares solution for the 'intercept' in simple linear regression is a linear function of the mean of the dependent variable.) Similarly, the 'best' one-dimensional representation of a square, symmetric matrix

of numbers is a linear function of the row sums (or identically, the column sums) of that matrix. This yields the following fact: with reference to the SVD of a matrix A, the row sums of AA^T are perfectly correlated with the first eigenvector (i.e., the first column of matrix U in the equation above).

A.3. Correspondence analysis

Correspondence analysis (CA) can be defined, loosely but informatively, as follows:

CA on {matrix A} is SVD on {matrix A with the influence of the row and column marginals removed}

Specifically, for any matrix A, if P_{ij} ('cell proportions') refers to the number in cell [i,j] of A divided by the matrix sum, and if P_i ('row proportions') and P_j ('column proportions') refer to the row and column sums, respectively, of the matrix of P_{ij}, then the CA of matrix A is the SVD of $\{P_{ij} - P_i P_j\} / \{P_i P_j\}^{1/2}$.

A.4. Coleman's "power" and "value" as an SVD

The vector (r_i) that Coleman terms 'power' may be computed as follows from the SVD of the equation in A.1 above. (On this point see Coleman, 1990: 687; or Tam, 1989). Define A as the matrix product CX, where C and X are Coleman's matrices of Control and Interest respectively. Then r_i is the first column of U in the equation in A.1, with the stipulation that its entries are normed so that they sum to 1.00. Dually, Coleman's vector of 'value', v_j, may be computed by means of SVD. Define A as the matrix product XC. Then v_j is the first column of U in the equation, normed so that its entries sum to 1.00.

A.5. "Power" and "value" pertain to the marginals of CX and XC

For reasons analogous to those of section A.2 above, Coleman's r_i is perfectly correlated with the sums of the rows of matrix CX. And Coleman's v_j is correlated perfectly with the sums of the rows of matrix XC.

References

Abbott, Andrew D., 1997. Of time and space: The contemporary relevance of the Chicago school. Social Forces 75, 1149–1182.

Benzécri, J.-P., 1991. Comment [on a paper by Leo A. Goodman]. Journal of the American Statistical Association 86, 1112–1115.

Bourdieu, Pierre, 1984 [1979], Distinction: A social critique of the judgement of taste. (Translated by Richard Nice.) Cambridge, MA: Harvard University Press.

Bourdieu, Pierre, 1988 [1984], Homo academicus. (Translated by Peter Collier.) Stanford, CA: Stanford University Press.

Bourdieu, Pierre, 1990a [1980], The logic of practice. (Translated by Richard Nice.) Stanford, CA: Stanford University Press.

Bourdieu, Pierre, 1990b, In other words: Essays towards a reflexive sociology. (Translated by Matthew Adamson.) Stanford, CA: Stanford University Press.

Bourdieu, Pierre, 1992 [1988]. The practice of reflexive sociology (The Paris workshop). In: P. Bourdieu and L.J.D. Wacquant, An invitation to reflexive sociology, 216–260. Chicago, IL: University of Chicago Press.

Bourdieu, Pierre, 1996 [1989], The state nobility : Elite schools in the field of power. (Translated by Lauretta C. Clough.) Stanford, CA: Stanford University Press.
Bourdieu, Pierre and Loïc J.D. Wacquant, 1992. An invitation to reflexive sociology. Chicago, IL: University of Chicago Press.
Breiger, Ronald L., 1974. The duality of persons and groups. Social Forces 53, 181–190.
Breiger, Ronald L. and James Ennis, 1997. Generalized exchange in social networks: Statistics and structure. L'Année Sociologique 47, 73–88.
Breiger, Ronald L. and Philippa E. Pattison, 1999. Lattices and dimensional representations: Unifying some new approaches to duality in social network analysis. Paper presented at the Sunbelt International Social Networks Conference, Charleston, SC.
Breiger, Ronald L. and John M. Roberts, Jr., 1998. Solidarity and social networks. In: Patrick Doreian and Thomas J. Fararo, eds., The problem of solidarity: Theories and models, 239–262. New York: Gordon.
Calhoun, Craig, 1993. Habitus, field, and capital: The question of historical specificity. In: C. Calhoun, E. LiPuma and M. Postone, eds., Bourdieu: Critical perspectives, 61–88. Chicago, IL: University of Chicago Press.
Calhoun, Craig, Edward LiPuma and Moishe Postone, eds., 1993. Bourdieu: Critical perspectives. Chicago, IL: University of Chicago Press.
Cicourel, Aaron V., 1993. Aspects of structural and processual theories of knowledge. In: C. Calhoun, E. LiPuma and M. Postone, eds., Bourdieu: Critical perspectives, 89–115. Chicago, IL: University of Chicago Press.
Coleman, James S., 1958–1959. Relational analysis: The study of social organizations with survey methods. Human Organization 17, 28–36.
Coleman, James S., 1990. Foundations of social theory. Cambridge, MA: Harvard University Press.
Culler, Jonathan, 1997. Literary theory: A very short introduction. New York: Oxford University Press.
Davey, B.A. and H.A. Priestley, 1990. Introduction to lattices and order. Cambridge: Cambridge University Press.
Digby, P.G.N. and R.A. Kempton, 1987. Multivariate analysis of ecological communities. London: Chapman.
DiMaggio, Paul, 1992. Nadel's paradox revisited: Relational and cultural aspects of organizational structure. In: Nitin Nohria and Robert G. Eccles, eds., Networks and organizations: Structure, form, and action, 118–142. Boston, MA: Harvard Business School Press.
Duranti, Alessandro and Charles Goodwin, eds., 1992. Rethinking context: Language as an interactive phenomenon. Cambridge: Cambridge University Press.
Emirbayer, Mustafa, 1997. Manifesto for a relational sociology. American Journal of Sociology 103, 281–317.
Freeman, Linton C. and Douglas R. White, 1993. Using Galois lattices to represent network data. Sociological Methodology 23, 127–146.
Friedland, Roger and Deirdre Boden, 1994. NowHere. In: R. Friedland and D. Boden, eds., NowHere: Space, time, and modernity, 1–60. Berkeley, CA: University of California Press.
Goodman, Leo A., 1987. New methods for analyzing the intrinsic character of qualitative variables using cross-classified data. American Journal of Sociology 93, 529–583.
Goodman, Leo A., 1996. A single general method for the analysis of cross-classified data: Reconciliation and synthesis of some methods of Pearson, Yule, and Fisher and also some methods of correspondence analysis and association analysis. Journal of the American Statistical Association 91, 408–428.
Goodman, Leo A. 1997. Statistical methods, graphical displays, and Tukey's ladder of re-expression in the analysis of nonindependence in contingency tables: Correspondence analysis, association analysis, and the midway view of nonindependence. In: D.R. Brillinger, L.T. Fernholz and S. Morgenthaler eds., The practice of data analysis: Essays in honor of John W. Tukey, 101–132. Princeton, NJ: Princeton University Press.
Gower, J.C., 1989. Discussion of the paper by van der Heijden, de Falguerolles and de Leeuw. Applied Statistics 38, 273–276.
Greenhouse, Linda, 1992. Moderates on Court defy predictions. New York Times, July 5: E1.

Greenhouse, Linda, 1993. The Court's counterrevolution comes in fits and starts. New York Times, July 4: E1.

Han, Shin-Kap and Ronald L. Breiger, 1997. Negotiating positions: The U.S. Supreme Court, 1971–1991. Paper presented at the International Social Networks Conference, San Diego, CA (February).

Han, Shin-Kap and Ronald L. Breiger, 1999. Dimensions of corporate social capital: Toward models and measures. In: R.T.A.J. Leenders and Shaul Gabbay, eds., Corporate social capital and liability, 118–133. Boston: Kluwer.

Holt, Douglas B., 1997. Distinction in America? Recovering Bourdieu's theory of tastes from its critics. Poetics 25, 93–120.

Jakobson, Roman, 1990 [1960]. The speech event and the functions of language. In: Linda R. Waugh and Monique Monville-Burston, eds., On Language, 69–79. Cambridge, MA: Harvard University Press.

Lash, Scott, 1993. Pierre Bourdieu: Cultural economy and social change. In: C. Calhoun, E. LiPuma and M. Postone, eds., Bourdieu: Critical perspectives, 193–211. Chicago, IL: University of Chicago Press.

Levi, Edward H., 1949. An introduction to legal reasoning. Chicago, IL: University of Chicago Press.

Marsden, Peter V. and Edward O. Laumann, 1977. Collective action in a community elite: Exchange, influence resources and issue resolution. In: Rowland J. Liebert and Allen W. Imershein eds., Power, paradigms, and community research, 199–250. Beverly Hills, CA: Sage.

Martin, John Levi, this issue. What do animals do all day? The division of labor, class bodies, and totemic thinking in the popular imagination.

Mische, Ann, 1998. Projecting democracy: Brazilian youth networks and the making of civic culture. Ph.D. dissertation, New School for Social Research.

Mische, Ann and Philippa E. Pattison, this issue. Composing a civic arena: Publics, projects, and social settings.

Mohr, John W., 1998. Measuring meaning structures. Annual Review of Sociology 24, 345–70.

Mohr, John W. and Vincent Duquenne, 1997. The duality of culture and practice: Poverty relief in New York City, 1888–1917. Theory and Society 26, 305–356.

Ortner, Sherry B., 1996. Making gender: The politics and erotics of culture. Boston, MA: Beacon.

Pattison, Philippa, 1993. Algebraic models for social networks. Cambridge: Cambridge University Press.

Pattison, Philippa and Robert Reeve, 1996. Boolean models for item response patterns. Paper presented at the International Congress of Psychology, Montreal (August).

Pullum, Thomas W., 1975. Review of James Coleman's The mathematics of collective action (1973). American Journal of Sociology 81, 665–67.

Rosenthal, Naomi, Roberta Karant, Michele Ethier and Meryl Fingrutd, 1987. Centrality analysis for historians. Historical Methods 20, 53–62.

Segal, Jeffrey A., and Harold J. Spaeth, 1993. The Supreme Court and the attitudinal model. Cambridge: Cambridge University Press.

Simon, James F., 1995. The center holds. New York: Simon.

Spaeth, Harold J., 1994. United States Supreme Court judicial database, 1953–1992 terms computer file, fifth release. Ann Arbor, MI: Inter-university Consortium for Political and Social Research.

Strang, Gilbert, 1980. Linear algebra and its applications, second edition. New York: Academic Press.

Swidler, Ann, 1986. Culture in action: Symbols and strategies. American Sociological Review 51, 273–286.

Tam, Tony, 1989. Demarcating the boundaries between self and the social: The anatomy of centrality in social networks. Social Networks 11, 387–401.

van Meter, Karl M., Marie-Ange Schiltz, Philippe Cibois and Lise Mounier, 1994. Correspondence analysis: A history and French sociological perspective. In: Michael Greenacre and Jörg Blasius, eds., Correspondence analysis in the social sciences: Recent developments and applications, 128–137. London: Academic Press.

Weller, Susan C., and A. Kimball Romney, 1990. Metric scaling: Correspondence analysis. Newbury Park, CA: Sage.

White, Douglas R. and Vincent Duquenne, eds., 1996. Special issue: Social networks and discrete structure analysis. Social Networks 18, 169–318.

White, Harrison C., 1992. Identity and control: A structural theory of action. Princeton, NJ: Princeton University Press.

Wiley, James A. and John Levi Martin, 1999. Algebraic representations of beliefs and attitudes: Partial order models for item responses. In: Michael E. Sobel and Mark P. Becker, eds., Sociological Methodology 29, 113–146. Washington, DC: American Sociological Association.

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