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THE DIFFUSION OF POLITICAL VIOLENCE IN
ARGENTINA: A DOMESTIC VS. AN INTERNATIONAL
CONTEXT; BELIEF IN THE RIGHT TO QUESTION
CHURCH TEACHINGS, 1958-1971; A COMPARISON OF
TWO METHODS FOR THE CAUSAL ANALYSIS OF SURVEY
DATA.

THE UNIVERSITY OF ARIZONA, PH.D., 1979

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THE CAUSAL ANALYSIS OF SURVEY DATA

by

Douglas Burton Koller

A Dissertation Submitted to the Faculty of the

DEPARTMENT OF SOCIOLOGY

In Partial Fulfillment of the Requirements
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DOCTOR OF PHILOSOPHY

In the Graduate College

THE UNIVERSITY OF ARIZONA

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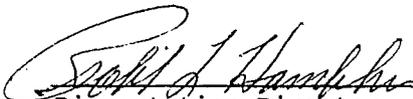
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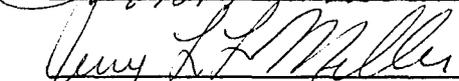

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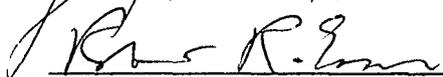
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ABSTRACT

A differential equation model of the temporal diffusion of domestic political violence, based on behavioral generalizations, is tested and compared with a logistic model. Longitudinal data on four kinds of domestic violence and one kind of nonviolent conflict in six Latin American countries are used. The social learning model, which generates a Gompertz equation, is preferred over the logistic. This paper also explores the linkage between the diffusion pattern of political violence within Argentina and domestic violence in surrounding countries. The social learning model fits the corresponding epidemics of domestic violence from the more inclusive, six-country region better than the Argentine data alone, suggesting the applicability of the social learning premises in an international context.

. . .

Between 1958 and 1971 there was a pronounced increase of belief in the right to question church teachings among Detroit Catholics, but there was no significant change among Protestants in general. Certain events calling into question the infallibility of papal pronouncements in the 1960's are suggested as possible forces behind the increase among Catholics. The magnitude of the change is inversely related to age and directly related to education and church attendance.

. . .

Two methods for the causal analysis of systems of qualitative variables--Goodman's log-linear analysis and Coleman's continuous-time discrete-state modeling--are compared. Goodman previously assessed interpretations of a specific data set by the two approaches, presenting them as competing analyses. Distinctions between the methods' underlying assumptions have largely been ignored, however. It is shown here that the methods differ substantially in their orientations toward causal interpretation, their basic parameters for describing causation, sets of relationships studied, assessments of exogenous variables and judgments of statistical significance of effects. The basic distinction is seen as the difference between math modeling (Coleman) and statistical modeling (Goodman). The differences are further illustrated through an analysis of two-wave panel data.

I

THE DIFFUSION OF POLITICAL VIOLENCE IN ARGENTINA: A DOMESTIC VS. AN INTERNATIONAL CONTEXT

The investigation of the varieties, correlates, and causes of political violence has become a major topic of research over the past few years. The study of political unrest has drawn upon theoretical perspectives and analytical styles from all the social sciences. Researchers who have tried to explain the occurrence of manifest political violence or related phenomena have generally tried to enumerate possible precipitating factors. Some propose various psychological determinants (e.g., Feierabend and Feierabend, 1966; Deutsch, 1961; Gurr, 1968a, 1968b, 1970; Caplan and Paige, 1968; Davies, 1969; Leiden, 1969; Feierabend, Feierabend and Nesvold, 1969), while some others focus on organizational or structural characteristics (e.g., Downes, 1968; Lieberman and Silverman, 1965; Tilly, Tilly and Tilly, 1975; Snyder, 1975; Shorter and Tilly, 1974; Duff and McCamant, 1976; Alcock, 1976). Macro-economic factors are among structural variables which have received considerable attention as determinants of domestic political violence (e.g., Flanigan and Fogelman, 1970; Parvin, 1973; Sigleman and Simpson, 1977; Nagel, 1974; Eckhardt and Young, 1974). All in all, the popular tendency has been to search for discrete social variables to explain the occurrence of some type of political violence.

It has been argued (Pitcher, Hamblin and Miller, 1978; Shreiner, 1977; Midlarsky, 1978; Snyder, 1978), however, that such research into the causes of violence has failed to take into account explicit time-related processes that mediate the impact of the various factors. These studies have generally treated acts of violence as being essentially discrete and independent, not assuming or testing for processes involving diffusion or contagion. In this paper, however, over-time distributions of events involving political violence or nonviolent conflict will be examined for their characteristic form and the possible conditions which generate this form.

A number of models of diffusion have already been developed through previous research. Included is a model, based on social learning premises, which has been used to describe the diffusion of collective violence (see Pitcher et al., 1978). The purposes of this study are to (1) explain how this macro-learning model of diffusion applies to the spread of domestic political violence, (2) evaluate the fit of the model to actual events' data and compare it with the fit of another established model, and (3) investigate the international context of domestic violence by comparing the model's fit to conflict data from Argentina with its fit to more inclusive international epidemics of domestic conflict.

Domestic Political Violence as Diffusion

Diffusion has generally been used to refer to the spread of adoption or usage of a particular invention. It involves the communication of the innovation throughout a society or cultural area during

a given period of time. The mechanism by which the diffusion takes place has been given various labels, such as imitation, mimicry, contagion and suggestibility.

The epidemic nature of political violence suggests a diffusion process wherein the adoption of a conflict tactic spreads via some process such as contagion. Inspection of the political histories of violent nations generally indicates that a continuity does not exist in the over-time spread of political violence. Rather, epochs or phases of conflict occur. Incidents of political violence often accumulate rapidly over short periods of time and then tail off slowly. Hamblin, Jacobsen and Miller (1973) suggest that such patterns of violence occur during time periods which are theoretically defined and bracketed by the occurrence of system-changing events.

The study of violence as a diffusion process has received increased attention during the past several years. Some investigations have suggested the possibility of time-related, usually cyclical, patterns of violence (cf. Moyal, 1949; Denton and Phillips, 1968; Shorter and Tilly, 1974; Snyder and Kelly, 1976). Some have incorporated discussions of contagion into their empirical investigations (Li and Thompson, 1975; Midlarsky, 1970, 1978; Spilerman, 1970). A few studies have proposed that the timing and extent of the diffusion of selected epidemics of violence exhibit a characteristic pattern. For example, Huff and Lutz (1974) used a logistic equation to describe the growth of political unrest in parts of Africa. Shreiner (1977) concluded that this basic equation and, under certain conditions, the decaying exponential adequately reflect epidemics of racial conflict in the Southern United

States over a ten-year period. Likewise, Hamblin et al. (1973) used a logistic analysis to describe various epidemics of political violence in Latin America. Updating such research, Pitcher et al. (1978) investigated the importance of social learning premises for analyzing the over-time diffusion of collective violence. They generated a Gompertz model which evidently is more isomorphic with the underlying processes.

Social Learning Assumptions

Based on earlier work by Bandura and Walters (1963), Midlarsky (1970) summarizes the important elements of a theory of diffusion, the most important being the existence of a behavioral model or what he labels a prototype. He suggests three effects which may occur after a certain act or behavior is exhibited: (1) A modeling effect in which the act is imitated, (2) an inhibitory effect, and (3) a disinhibitory effect. In other words, observational learning takes place and imitation may occur contingent on the dialectic process of inhibition and its opposite.

In outbreaks of political violence, modeling generally involves vicarious learning via the mass media and reports. Thus, people become aware of the reinforcing consequences of certain tactics and innovations used by others in the political arena. As Pitcher et al. (1978:25) note, however, a threatening situation must also exist for the modeling to occur. Experimental evidence suggests that a threat without the model or vice versa produces minimal aggression. In the case of political violence, one without the other would generate only a limited number of violent events.

In summary, this approach to the diffusion of political violence assumes a collective, vicarious learning process. It involves both positive and negative imitation effects. Monetary and political gains are popular benefits that encourage imitation. Counterviolence and repression are major costs which result in the negative imitation process. (See Pitcher et al., 1978, for a more detailed discussion of macro-social learning theory and its relation to violence.)

Social Learning Model

The model assumes an equality of three terms by specifying that violent events (V) are behavioral models (M) which are imitations (I) of previous events. The development of the model begins with an exponential differential equation for imitation which specifies that the increment in imitations (dI) per increment in time (dt) is some proportion (p) of the number of previous imitations (I), or:

$$\frac{dI}{dt} = pI, \quad \text{or} \quad \frac{dM}{dt} = pM, \quad \text{or} \quad \frac{dV}{dt} = pV. \quad (1)$$

The quantity p thus becomes the rate at which imitation is instigated. Since V is assumed to be equal to both I and M and corresponds with the data to be analyzed, the latter part of equation (1) will be used.

As noted, there is also a negative, or inhibition process which opposes the instigation process. Therefore, it is assumed that any relative increase in domestic political violence (dV/V) per increment in time (dt) not only varies directly with p but is inversely proportional to the accumulated number who are inhibited (i), or:

$$\frac{dV}{V} = \frac{p}{i} dt. \quad (2)$$

It is also assumed that inhibition is the result of observational and symbolic learning. Therefore, the imitation equation (1) applies, so that the number of those inhibited (i) increases over time as some proportion (h) of those already inhibited (i), or:

$$\frac{di}{dt} = hi, \quad \text{or} \quad \frac{di}{i} = hdt, \quad (3)$$

where h , like p , is always greater than zero. Solving equation (3) by integration, we obtain:

$$i = i_0 e^{ht}, \quad (4)$$

where i_0 is the initial value of i and e is the base of the natural logarithm. Substituting equation (4) for i into equation (2) yields:

$$\frac{dV}{V} = \frac{p dt}{i_0 e^{ht}} = rb^t dt, \quad \text{or}$$

$$\frac{dV}{dt} = rb^t V, \quad (5)$$

where $r = p/i_0$ and $b = e^{-h}$. Equation (5) thus represents the model for describing the diffusion of political violence where r is the gross rate of instigation and h the rate of inhibition.

Equation (5) refers to the rate of events of violence during very small increments in time (dV/dt). Since the accumulated data correspond to V much better than the available rate data correspond to dV/dt , the equation was solved by integration for V , yielding:

$$V = Ae^{kb^t}, \quad 0 < b < 1, \quad (6)$$

where A, the asymptote, equals $V_0 e^{r/\ln b}$, and $k = r/\ln b = -r/h$. Equation (6) is a double exponential, generally referred to as a Gompertz equation.

Logistic Model

As previously noted, the logistic model of diffusion (Dodd, 1955; Pemberton, 1936; Coleman, Katz and Menzel, 1966) has been used to describe various outbreaks of violence. It is used here to provide an empirical basis of comparison with the social learning model.

Like the Gompertz equation, the logistic generates an S-shaped curve. Unlike the Gompertz, however, it constrains the curve to be symmetric because a constant rate of adoption (q) is assumed. This model also assumes that the events are limited to a number (N). Thus, in the context of political violence, the number of events at a point in time (t) which can yet occur in an epidemic is specified by the term $(N-V)$. The subsequent differential equation for the logistic model is similar to equation (1) but modified by the addition of this $(N-V)$ term:

$$\frac{dV}{dt} = qV(N-V). \quad (7)$$

Solving this equation for V , by integration, the following is obtained:

$$V = \frac{N}{1 + ae^{-ct}}, \quad (8)$$

where $a = e^{qt_i}$ (t_i being the point of inflection) and $c = qN$.

Political Violence in Argentina

The thirty-year period of Argentine history from 1946 to 1975 provides an interesting study of political conflict. There has been a

remarkable balance of both violent and nonviolent political opposition relative to other Latin American nations (Duff and McCamant, 1976:46). There have been coups, revolutions, outbreaks of guerrilla warfare, as well as peaceful political changes. Despite the high incidence of unarmed opposition, Argentina is generally recognized as one of the most violent nations in Latin America. Incidents involving various tactics of violence often hit epidemic proportions in short periods of time.

This period also reflects the continual influence of a controversial and ambiguous political ideology. Its founder, Juan Domingo Peron, ascended to the presidency in 1946, was overthrown in 1955, and died in 1974 after succeeding in his eighteen-year struggle to regain the nation's top post. The extensive political violence associated with this period is dominated by the deep divisions between the followers of "Peronism" and their opponents, as well as the tensions among Peronist factions themselves.

Political terrorism became especially widespread in the 1970's. Opposition to the Argentine military government reached a peak in 1969 and erupted into violence, instances of which continue to persist. In May 1969, a general strike and near insurrection, known as the Cordobazo, occurred in the city of Cordoba. Students and workers united in a bloody battle against government troops. This renewed resistance on a mass scale and seemed to give impetus to subsequent opposition, including violence of other forms. Demonstrations, strikes, riots, and assorted terrorist acts such as bombings and kidnappings became prevalent.

The spread of terrorist acts in the 1970's was marked by large-scale tactics carried out by several urban guerrilla groups. The

increase in terrorism, especially among organized groups, prompted Johnson (1975:1) to describe the state of affairs as "the most remarkable example of guerrilla warfare" in the Western World. Terrorism on the left was countered by terrorism on the right. Three successive military governments failed to crush the upsurge of violence or the organized guerrilla bands.

International Context of Domestic Political Violence

This research was originally undertaken to describe the diffusion of internal political violence within Argentina. Despite the domestic nature of the events under study, it became apparent that their diffusion could have international implications. The process of imitation or contagion, assumed by the social learning model, need not be limited by the boundaries of a country. In fact, the study of outside domestic violence may be necessary for a complete description of the diffusion of a country's internal political violence.

Studies of what Rosenau (1967; 1969) termed "linkage politics" have suggested this possibility but have not yet analyzed it. The label "linkage politics" describes the field of inquiry into the relationship between two or more political systems. Rosenau (1969:44) defines linkage as "any recurrent sequence of behavior that originates in one system and is reacted to in another." The study of political conflict and violence in terms of linkages has received considerable attention since the early 1960's. A main assumption has been that violence in the domestic system is affected by, and influences, events outside its boundaries or in the international system (Stohl, 1976:35). Most quantitative

studies of conflict "linkages" have investigated the relationship between the domestic and foreign conflict behavior of nations (e.g., Rummel, 1963; Tanter, 1966; Wilkenfeld, 1968; Hazelwood, 1973; Kegley, Richardson and Richter, 1978).

It is clear, however, that Rosenau was also conceptually interested in other aspects of conflict linkages. One facet suggested in his writings concerns the relationship between internal violence in one country and internal violence in others. In describing internal war as an international event, Rosenau notes the natural interest and curiosity in violence across international boundaries. He suggests that violence may be contagious in nature, wherein the publicity of violent conflicts in one system very often stimulates similar activity in other societies (Rosenau, 1964:52). The imitation of tactics becomes especially likely among foreign groups with similar goals and grievances. This suggests the additional inquiry into conflict linkages concerning possible diffusion relationships among events of domestic violence in different countries.

The likelihood of a common diffusion pattern of domestic violence exists among Argentina and its neighboring countries--Chile, Bolivia, Paraguay, Brazil, and Uruguay. Their proximity naturally facilitates the communication of domestic violence across boundaries via the media. The communication channels and the similarities in the economic conditions that could encourage violence increase the likelihood of the imitation of conflict tactics between the countries.

For example, the growth of organized guerrilla groups in the late 1960's within Argentina, Chile, Bolivia, Brazil, and Uruguay and their

relationships facilitated the use and spread of similar terrorist tactics throughout the 1970's. The common ideological basis of a number of the terrorist groups (Halperin, 1976; Laqueur, 1977) contributed to a similarity in governmental opposition. The main guerrilla groups in the five countries sometimes drew inspiration as well as logistical assistance from each other (Johnson, 1975; Hodges, 1976). In fact, guerrilla leaders from these countries met formally in Argentina at least twice, in 1970 and in 1974. Their informal exchange agreements evolved into a more formal communication structure in 1974 (Russell, Schenkel and Miller, 1974). Although they never directly engaged in the others' warfare, guerrilla groups from the different nations were usually well aware of each others' strategies, successes, and failures. The social learning model should describe the diffusion of terrorist acts in this southern region of South America quite well.

Hodges (1976:Chapter 5) suggests that the Argentine resistance movement acquired an international dimension by serving as a model for the domestic resistance against the governments of Brazil, Uruguay, and Chile. Even though certain kinds of violence were initiated in other countries, such occurrences were generally isolated until becoming widespread within Argentina. The use of the conflict tactics (e.g., kidnappings) then tended to diffuse more rapidly through the wider region.

A comparison of the fit of the Gompertz equation to epidemics of conflict events in Argentina with its fit to epidemics (of similar time periods) in the larger region may be instructive. Argentina provides the basis of comparison because of its suggested role as a model of governmental resistance and the fact that more conflict events of the

types to be analyzed have occurred there than in any of its neighboring countries. Although the model does not explicitly test spatial or geographical diffusion, an improved fit to the regional data is at least consistent with the suggestion concerning the significance of the international conflict linkage of events of domestic violence. In any case, the adequacy of the model for describing domestic violence in the larger region tests its generality as a descriptive equation applied in an international context.

The Data and Methods

In order to evaluate the descriptive adequacy of the models, data were obtained on four categories of domestic violence and one type of nonviolent conflict in Argentina, Chile, Bolivia, Paraguay, Brazil, and Uruguay. These data include riots and strikes between 1946 and 1975 and terrorist acts in general, bombings and kidnappings between 1968 and 1975. Data on Paraguay were not included under the last three categories because there were only two published events during the specified time period, and organized terrorist groups did not develop in the country. The term "terrorist act" is a general category of isolated violent events which includes bombings, kidnappings, and minor political assassinations, as well as other small-scale acts. Definitions of the measures of conflict are given in the appendix.

Most of the data used for this analysis were taken from an unpublished events file still being finalized in an NSF sponsored project-- "A Mathematical Analysis of Political Violence and Change"--directed by Robert L. Hamblin and Jerry L. L. Miller (n.d.). This data bank includes

daily event chronicles of domestic conflict in twenty-two Latin American countries from 1946 to 1975. These event chronicles provide brief descriptions of various types of political conflict, the parties involved, any published reasons, and the outcomes (i.e., extent of damage, casualties, etc.).

The primary source of the data bank is the New York Times which not only draws upon its own international news service for Latin America but also upon AP, UPI, and Reuters. The event chronicles were developed from detailed abstracts of articles taken from daily editions of the paper. This provides more detailed information than is included in a number of chronologies used in other studies which rely only on the paper's index. High intercoder reliability checks (averaging greater than 90%) calculated for each month of the thirty-year period indicate the accuracy and completeness with which the data bank reflects the published accounts.

Two additional sources were used to complete the data bank-- Facts on File and Keesing's Contemporary Archives. By systematically combining reports from the three overlapping news sources for the thirty-year period, the coverage of political violence was greatly improved over the use of just one source. The events file provides a more comprehensive listing of violence events than other existing data banks (e.g., Banks, 1971; Taylor and Hudson, 1972; Russett et al., 1964).

As noted, the period from 1968 to 1975 was marked by a high intensity of political terrorism. Because of this proliferation of violence, comprehensive coverage by an international newspaper such as the New York Times is even less possible. Therefore, additional events

published in three separate chronologies by Jenkins and Johnson (1975, 1976), Russell et al. (1974), and the Annual of Power and Conflict (1971-1976) were used as supplements to the list of terrorist acts after 1968.

The Gompertz and logistic equations were fit to data on epidemics of conflict using the SPSS nonlinear regression program on a CDC 6400 computer. The beginning and ending of epidemics are marked by the low points in the cyclical frequency distributions of conflict events over the thirty-year period. Both models were fit to five epidemics of riots and four epidemics of strikes in the six-country region. The social learning model (Gompertz equation) was also fit to data on riots and strikes in Argentina for the same time periods. The Argentine data by itself did not always approach epidemic proportions (i.e., there were some time categories with very low or zero frequencies). The data for riots and strikes were accumulated in six-month time periods. The social learning model was also fit to two epidemics each of terrorist acts, bombings, and kidnappings in both geographical contexts. High frequencies and greater access to these data allowed for their accumulation in shorter, three-month time periods.

Results

Table 1 summarizes the results of the nonlinear regression analysis for riots and strikes in the six-country region. R^2 is used as a measure of fit between the data and the corresponding frequencies generated by the two integrated equations. Both models fit the different epidemics extremely well. Overall, however, the Gompertz model provides a better fit, with a median r^2 of .9950 compared to .9907 for the logistic

Table 1. Summary Analysis of Epidemics of Riots and Strikes--Six Latin American Countries, 1946-1975.

Event	Period	Parameters**			R ²	d.f.
		P ₁	P ₂	P ₃		
Gompertz Model						
Riots	Jan., 1946-Dec., 1948	41.79	-1.22	.378	.9966	3
	Jan., 1949-June, 1958	256.96	-3.23	.917	.9969	16
	July, 1958-Dec., 1967	524.37	-2.45	.939	.9908	16
	Jan., 1968-Dec., 1969	74.28	-1.49	.330	.9993	1
	Jan., 1970-Dec., 1975	181.02	-2.91	.674	.9949	9
Strikes	Jan., 1946-June, 1949	88.39	-1.58	.768	.9898	4
	July, 1949-June, 1957	286.33	-2.07	.855	.9913	13
	July, 1957-June, 1971	434.32	-2.41	.891	.9950	25
	July, 1971-Dec., 1974	151.27	-2.80	.556	.9940	4
Logistic Model						
Riots	Jan., 1946-Dec., 1948	41.08	2.23	1.33	.9916	3
	Jan., 1949-June, 1958	166.45	12.26	.208	.9958	16
	July, 1958-Dec., 1967	336.64	6.06	.149	.9903	16
	Jan., 1968-Dec., 1969	71.27	3.17	1.68	.9999	1
	Jan., 1970-Dec., 1975	172.42	9.82	.631	.9980	9
Strikes	Jan., 1946-June, 1949	74.35	3.02	.477	.9907	4
	July, 1949-June, 1957	255.38	5.07	.262	.9857	13
	July, 1957-June, 1971	400.08	6.65	.187	.9892	25
	July, 1971-Dec., 1974	141.26	8.85	.950	.9874	4

*Data accumulated from the beginning of the first month and year listed, through the last month and year listed, in six-month intervals.

**P₁, P₂, and P₃ correspond to the estimated parameters of the Gompertz equation (6) and the logistic equation (8).

model. The comparison of the two models for epidemics of other events yielded similar results, with the Gompertz empirically describing the data slightly better in both geographical contexts. Therefore, the fit of the logistic model to the other categories of conflict is not detailed here.

The results of the Gompertz analysis for riots and strikes in Argentina are given in Table 2. The fit of the equation to two of the periods of riots was not obtained. The first period (1946-1948) did not contain enough cases, while the other (1958-1967) did not even approximate a diffusion curve and the nonlinear program never reached a solution. The empirical fit of the Gompertz model to six of the seven remaining distributions of riots and strikes is lower than its fit to similar epidemics in the larger region (six-country area). The median r^2 is .9756.

Finally, the fit of the Gompertz to two epidemics each of terrorist acts, kidnappings, and bombings in both geographical regions is summarized in Table 3. The fit is quite acceptable (i.e., $r^2 > .98$) for all but the first period of kidnappings in Argentina. The median r^2 for the six distributions of Argentine data is .9926 compared with .9963 for the regional distributions. Although the temporal length of corresponding epidemics of a given event may vary slightly with the geographical context, the time periods for the larger region generally encompass those for Argentina. Thus, direct comparisons of epidemics in the two regions can still be made. The shorter time periods for some of the Argentine distributions generally reflect an epidemic's later start there. For each epoch of a particular event, the Gompertz model fits the regional

Table 2. Summary of Gompertz Analysis of Epidemics of Riots and Strikes--Argentina, 1946-1975.

Event	Period*	Parameters**			R ²	d.f.
		A	k	b		
Riots	Jan., 1946-Dec., 1948***					
	Jan., 1949-June, 1958	78.93	- 5.24	.872	.9833	16
	July, 1958-Dec., 1947****					
	Jan., 1968-Dec., 1969	22.40	-13.65	.110	.9387	1
	Jan., 1970-Dec., 1975	63.26	- 3.38	.665	.9756	9
Strikes	Jan., 1946-June, 1949	36.82	- 2.29	.730	.9959	4
	July, 1949-June, 1957	162.33	- 2.43	.930	.9711	13
	July, 1957-June, 1971	165.74	- 1.71	.833	.9806	25
	Jan., 1972-Dec., 1974	73.76	- 1.67	.679	.9467	3

*Data accumulated from the beginning of the first month and year listed, through the last month and year listed, in six-month intervals.

**A, k, and b are the estimated parameters for equation (6).

***There were riots in only three of the time intervals.

****The nonlinear fit did not converge on the least squares solution. The data did not approximate a Gompertz distribution.

Table 3. Summary of Gompertz Analysis of Epidemics of Terrorist Acts--
Argentina vs. Five-Country Region, 1968-1975.

Event	Period [#]	Parameters**					d.f.
		A	k	b	R ²		
ARGENTINA							
Terrorist Acts	Apr., 1969-Dec., 1971	198.08	-3.04	.861	.9934	8	
	Jan., 1972-Dec., 1975	987.91	-4.21	.850	.9977	13	
Kidnappings	Jan., 1970-Dec., 1971	54.09	-3.18	.905	.9710	5	
	Jan., 1972-Dec., 1975	161.84	-8.71	.656	.9970	13	
Bombings	Apr., 1968-Sep., 1970	38.45	-3.78	.790	.9902	7	
	July, 1971-Dec., 1975	199.59	-3.49	.854	.9919	15	
FIVE-COUNTRY REGION							
Terrorist Acts	Jan., 1968-Dec., 1971	597.85	-4.72	.879	.9954	13	
	Jan., 1972-Dec., 1975	1078.45	-3.82	.838	.9984	13	
Kidnappings	Oct., 1968-Dec., 1971	69.64	-6.75	.787	.9902	10	
	Jan., 1972-Dec., 1975	175.29	-6.34	.683	.9954	13	
Bombings	Jan., 1968-June, 1970	63.82	-2.81	.809	.9974	7	
	July, 1971-Dec., 1975	240.72	-3.81	.823	.9973	15	

*Data accumulated from the beginning of the first month and year listed, through the last month and year listed, in three-month intervals.

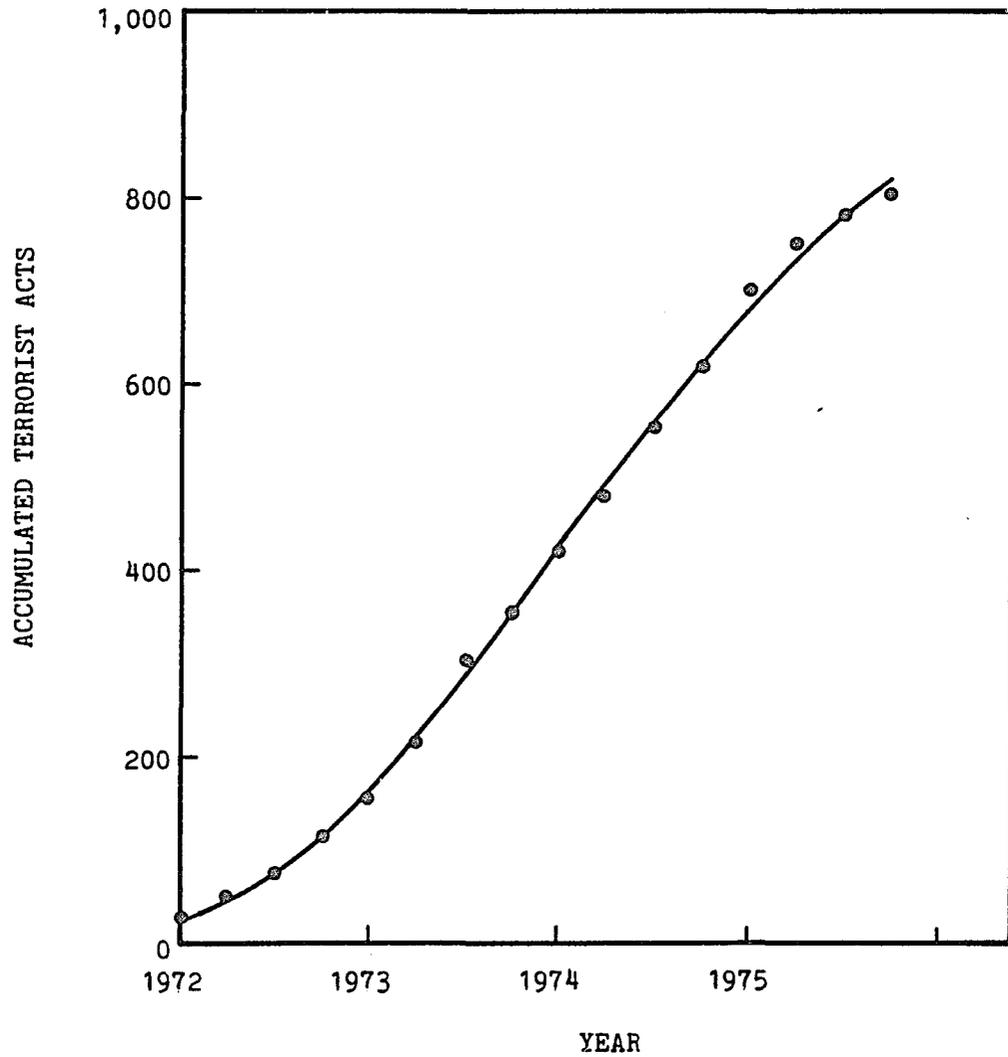
**A, k, and b are the estimated parameters for equation (6).

data better than the Argentine data, with one exception. It provides a better fit to the Argentine data for the second epidemic of kidnappings.

Discussion

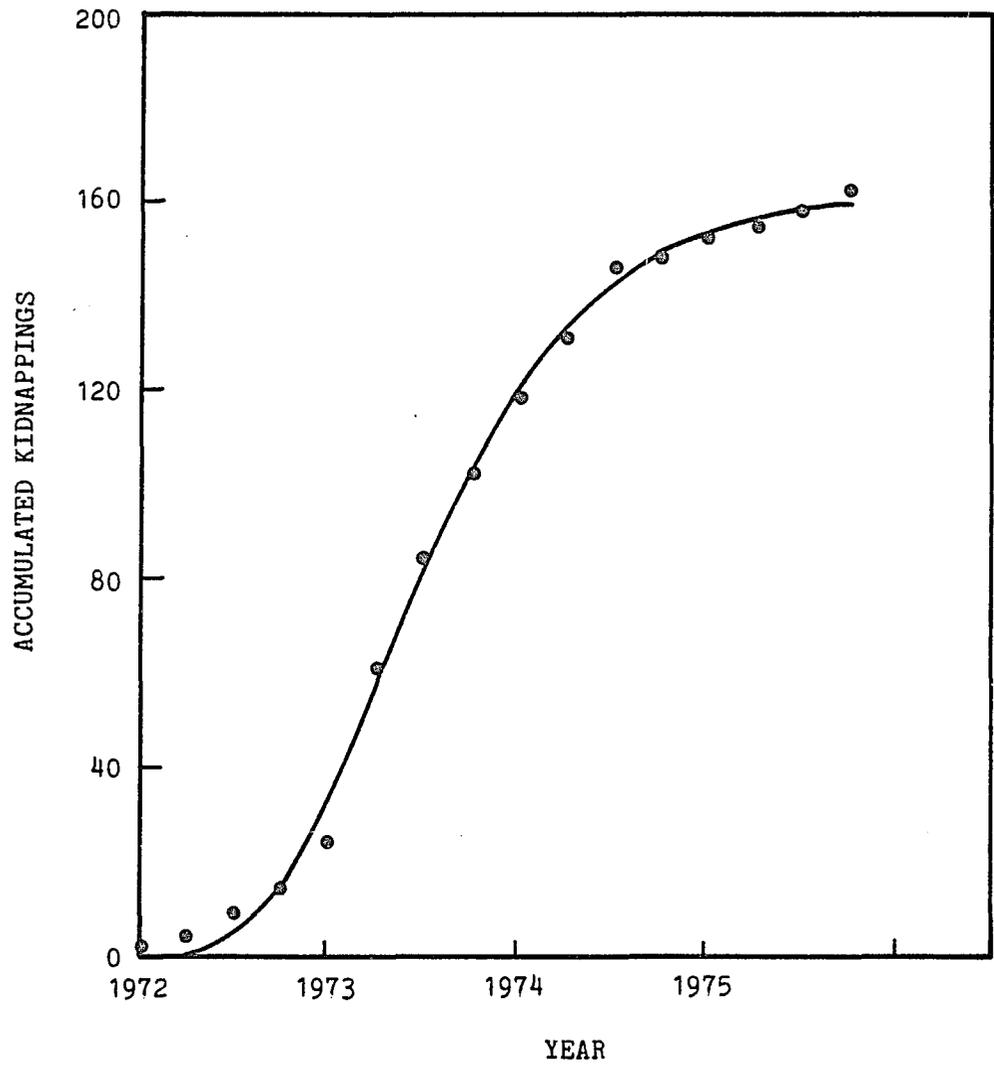
Although the Gompertz and logistic equations generate similar curves, the former is preferred for describing outbreaks of domestic political violence and conflict. It provides a significantly better fit to most of the epidemics analyzed here. Unlike the logistic, it does not constrain the form of the epidemic to be symmetric. Many of the distributions of conflict events are markedly right-skewed. This, for example, largely accounts for the much better fit of the Gompertz to the last three epidemics of strikes in the six-country region. Examples of the fit of the Gompertz equation to epidemics of terrorist acts and kidnappings in Argentina are pictured in Figures 1 and 2.

The social learning model used to generate the Gompertz is also preferred on theoretical grounds. The criticisms presented by Pitcher et al. (1978:24) of the logistic as a model of the diffusion of collective violence also apply here. Briefly summarized, the logistic theory of diffusion (cf. Coleman et al., 1966) generally assumes direct communication among adopting units. Vicarious learning (with some direct communication), assumed by the social learning model, is a more realistic mechanism for the diffusion of domestic political violence in a large region. Also, logistic theory has generally assumed a binary process in which a unit in the population is characterized as either having adopted a particular strategy or not. The diffusion becomes complete when all first adoptions have been counted. In outbreaks of domestic violence, many of



The solid line represents the least squares Gompertz equation.

Figure 1. Accumulated Terrorist Attacks Plotted by Three-Month Periods, 1972-1975



The solid line represents the least squares Gompertz equation.

Figure 2. Accumulated Kidnappings Plotted by Three-Month Periods, 1972-1975

the social actors participate more than once. The inclusion of the (N-V) term in the logistic model (see equation 7) becomes theoretically confusing, especially when referring to events rather than adopting units.

Pitcher et al. (1978:27) did specify the integrated form of an alternative derivation of the logistic equation. Although not detailed in their paper, the model was developed from social learning assumptions rather than the more generally used logistic theory compared above. The results here agree with their conclusion that this alternative form, which assumes a different inhibition process, is apparently not as isomorphic with the underlying processes as the Gompertz model.

Although the social learning model cannot confirm the existence of geographical diffusion, its overall better fit to the multi-national data is consistent with this possibility. The assumed imitation process appears relatively incomplete when the data are restricted to Argentina. In any case, the model does provide an excellent empirical description of the over-time diffusion of events of domestic political violence accumulated on a regional basis. Past literature supports the contention of vicarious learning and some direct interaction among social actors using terrorist tactics in the 1970's in the different countries of this southern region of South America.

Hernes (1972:181) aptly warns, however, that the good fit of a mathematical model does not insure the propriety of the theoretical model or the causal explanation which generated that equation. Different reasonable premises can generate the same basic mathematical form. Additional research needs to be done testing the implications of the social learning model in the context of domestic political violence.

For example, the model assumes counterviolence or repression as a major cost resulting in a negative imitation process, which eventually causes an epidemic to decelerate. The relationships between epidemics of violence and counterviolence should be tested. Also, additional substantive evidence, based on historical descriptions, needs to be explored for the macro-social learning assumption. Finally, the instigation and inhibition parameters should be related to exogenous variables which further test their meaning.

A diffusion theory does not really provide an alternative to other theories of political violence. For example, two main fields of inquiry into political and collective violence, "relative deprivation" and "resource mobilization" (see Snyder, 1978, for a comparison), focus on different theoretical inquiries than that presented by a diffusion approach. While relative deprivation proponents emphasize the individual motivational factors that lead to manifest conflict, the resource mobilization field underscores the importance of organizational processes by which resources become mobilized for use in conflict behavior. These theoretical fields attempt to explain why or how conflict and violence occur in the first place. A diffusion theory, in many ways, describes a complimentary process--the proliferation of subsequent conflict events once violence or threats have been initiated.

However, the proper specification of the mathematical form for describing epidemics of political violence may have important implications for testing theories about the necessary conditions for that violence. Most quantitative analyses of political violence ignore the more natural temporal break between periods of violence suggested by this form, thus

compounding problems associated with their neglect of its dynamics. A fruitful approach may involve the analysis of epochs of violence. Hamblin et al. (1973), for example, use a power function to evaluate the relationship between logistic epidemics of various kinds of events. In a similar manner, a lagged relationship between epidemics of different types of political violence, described by the social learning model, can be tested. Thus, patterns of conflict escalation can be explored. This also suggests that the relationship between violence and other variables, including structural indicators, can be tested while preserving their dynamic features.

Therefore, by understanding the over-time diffusion process of violence and using its proper functional form, we can begin to test certain implications of other theories. This suggests further research which is now being undertaken.

APPENDIX

MEASURES OF CONFLICT BEHAVIOR*

1. Riot: Any violent demonstration or clash involving a large group (at least 100) of citizens. Riots are generally evidenced by the destruction of property, people being wounded or killed, or by the use of the police of riot control equipment such as clubs, guns, or water cannons.
2. Strike: Any strike of rural, industrial or service workers against a public or private employer. General strikes are not included in this category.
3. Terrorist Act: A somewhat isolated act such as arson, sabotage, bombings, assassination of minor officials, political kidnapping, and sniping. Multiple occurrences of an act (e.g., a bombing) in the same location by the same social actor during the same day are coded as one event. Although many of these acts are attributed to ongoing guerrilla bands, the category is distinguished from guerrilla warfare, which includes organized attacks on police posts, small villages, government patrols, military barracks or transportation routes.
4. Bombing: Any politically motivated use of explosives to damage or destroy property or to wound or kill individuals. Multiple bombings in the same locality by the same social actor during the same day are coded as one event.
5. Kidnapping: Any politically motivated abduction of a person or persons.

*These definitions are based largely on those used by Rummel (1963), and Gurr and Ruttenberg (1969).

II

BELIEF IN THE RIGHT TO QUESTION CHURCH TEACHINGS, 1958-1971

While the Protestant laity's right to question church teachings has long been recognized (Davidson, Schlangen and D'Antonio, 1969), Catholics traditionally have been seen as having little of this right. In one sense, the Protestant movement was initiated on the very basis of one man's belief in, and subsequent action on, the right to question what the dominant church was teaching. Other "protesting" religions came into existence as this basic belief diffused. Catholicism, on the other hand, is unique in that the power for decision about orthodoxy culminates in the doctrine of papal infallibility. Coupled with the strict hierarchical nature of the church's authority structure, the questioning of church teachings has been seen as an anomaly.

Although the analysis of religious attitudes is receiving greater attention, studies of change in such attitudes are few, owing to the lack of good trend data. Laity perceptions of the authority structure, and in particular the right to question what the church teaches, have received even less attention. The events of the 1960's suggest a shift in this attitude. This paper describes change in the belief in the right to question church teachings among Detroit Protestants and Catholics between 1958 and 1971. Effects of education, age, and church attendance on this change are also explored.

Davidson, Schlangen and D'Antonio (1967, 1969), analyzing data from a 1965 survey given in two Oklahoma communities, found that the Catholics were much less likely than respondents in seven Protestant groups to advocate the laity's right to question their own church "in all matters" (22% vs. 65%). Seventy-seven percent of the Catholics did believe in the laity's right to question the church "in some matters" or "in all matters." This was more similar to the Protestants (88%). The survey was conducted near the end of the Second Vatican Council but did not measure change over time. No other studies involving belief in the right to question were encountered in a review of literature dealing with religious indicators.

Theoretical Considerations and Historical Background

Perhaps the most popular explanation for religious trends has invoked some kind of a secularization approach. There is a great diversity of secularization explanations, however (e.g., Gerharz, 1970; Shiner, 1967). Some writers focus on the change in religious expression or experience, while others stress the loss of certain social functions of religion. The various approaches to secularization usually have in common the alteration or loss of some particular aspect of religion.

Change in the belief in the right to question what one's church teaches seems to indicate an alteration in a very basic aspect of religion. It questions both teacher and tradition as well as what is being taught. Change toward belief in this right may simply reflect the widely published notion that one should reserve the right to question any traditional authority, religious or otherwise.

Secularization, with its assumed effect on traditional authorities, is usually linked with continuous modernizing processes such as urbanization and industrialization. Such an approach suggests that persons of all religious groups, and of all ages and educational levels, should be moving to a more liberalized position in relation to church authority and teachings.

Wuthnow (1976) noted, however, that trends involving certain religious indicators cannot be fully described by gradual evolutionary processes such as modernization. Fluctuation in many religious indicators has been the rule rather than the exception in the last few decades. An alternative explanation for some religious changes is the occurrence of specific events which undermine the credibility of certain religious doctrines.

Between 1958 and 1971, two major events occurred which point toward a dramatic change among Catholics concerning the right to question: the Second Vatican Council, and the publication of the Encyclical Letter "Humanae Vitae" (which reaffirmed the traditional birth control position of the church).

Vatican II, 1962-1965, was the most widely publicized event in the 1960's involving the Catholic church. The calling of the Council, in itself, signified a redefinition of the role of the papacy in the church. There seemed to be an acknowledgment of the Pope's inadequacy to the task of resolving certain issues (Caporale, 1967).

The questioning of the church within its own ranks was legitimated by the Vatican Council. One important theme of the Council centered around a small portion of the adopted "Constitution of the

church" (see Roche, 1968:148): "An individual layman by reason of the knowledge, competence, or outstanding ability which he may enjoy is permitted and sometimes obliged to express his opinion on things which concern the good of the church." Roche (1968:148) argued that the laity have taken the leadership at their word and, as a result, are "challenging traditions in a way that would have been considered outrageously presumptuous before the Council began." The Council thus deviated from the notion that all decisions have to come from the top.

Greeley (1977) suggested that the birth control encyclical, 1968, was the major impetus behind the decline during the last decade in various religious indicators among Catholics. He showed that apostasy as well as a significant drop in weekly church attendance became problems for American Catholics only in the 1970's after the publication of the birth control encyclical. Likewise, almost four-fifths of both the clergy and laity agreed that birth control was not sinful. In effect, they were not only questioning what the church was teaching, but ignoring it.

The Pope's decision on birth control overruled the recommendation for liberalization made by his own commissioned study as well as by other groups (Roche, 1968). However, given the nature of the Pope's statement, to challenge the birth control norm is to deny the authority of the church. As Osborne (1968:80) stated: "The reality of the public debate undermined this faith in the teaching authority of the church."

Although Vatican II and the birth control encyclical were probably the most publicized Catholic events of the 1960's, other significant issues were being debated. Some of these include the open housing issue

(Roche, 1968), compulsory mass attendance, value of the priesthood itself (Osborne, 1968) and optional celibacy. The 1960's marked a decade of unprecedented questioning of church teachings by the Catholic clergy and laity alike.

Hadden (1969) suggested that the growing crisis over purpose and meaning of the Catholic church and the emergence of doubt and theological reorientation have led to a struggle over authority. Although this struggle appears more dramatic in the Catholic church, it should not completely overshadow the power struggles occurring within Protestantism. Issues during the 1960's such as civil rights involvement and policy have divided the opinions of many Protestants in relation to the credibility of church teachings (Earle, 1969; Hadden, 1969; Quinley, 1974; Wood, 1970).

Greeley (1972) noted a convergence taking place between Catholics and Protestants, not so much concerning doctrine but in organizational style and attitudes toward authority. He predicted a growing similarity between the two groups concerning freedom for discussion and criticism, and more openness in viewing church authority. The right to question church teachings is one belief where this convergence may be taking place.

In summary, a substantial increase of belief in the right to question church teachings among American Catholics in the 1960's would be expected in view of a number of events which might well have stimulated such a change. Unfortunately, however, the data analyzed in this paper do not permit a measure of the extent that specific events affect change in the dependent variable. The historical tradition of Protestantism suggests an already high level of belief in the right

to question church teachings. Among Protestants during this time period, the number and impact of events negatively affecting perceptions of church authority appear to be much less than among Catholics. A greater similarity between the two groups regarding this belief in the right to question is, therefore, expected in 1971.

Data and Methods

The data analyzed in this paper were collected in the Detroit Area Studies of 1958 and 1971. The 1971 study was expressly designed to replicate items from investigations in a number of earlier years, including 1958. (See Duncan, Schuman and Duncan, 1973, for a discussion of the sampling and data collection procedures.)

In both years, respondents were asked a series of questions on their religious beliefs, including "Do you feel you have the right to question what your church teaches or not?" (Yes, Unsure, or No). Responses of "unsure" are not included in the present analysis as this category involved only four percent and two percent of the total responses in 1958 and 1971, respectively. Respondents who answered "no" to a previous question on whether they believed there is a God were exempted from answering this question. Only 1.1% in 1958 and 2.5 % in 1971 of the total samples were further excluded. Table 1 summarizes the "belief in the right to question church teachings" responses for Protestants and Catholics in both years.

Since the dependent variable in this study is a dichotomy, it is necessary to modify the usual methods of multiple regression analysis in

Table 1. Belief in the Right to Question What One's Church Teaches
by Religion, 1958 and 1971.

Religion	Year	Response		Odds	Ratio
		Yes	No	Yes:No	1971:1958
Protestant	1958	275	70	3.93	1.09*
	1971	774	181	4.28	
Catholic	1958	117	99	1.18	4.84
	1971	561	98	5.72	

*This odds ratio is not significantly different from 1.0.

testing its relationship to independent variables. Where all the independent variables also are qualitative (e.g., religion, year), multiway contingency table methods, involving maximum likelihood estimation, are employed (Goodman, 1972; Fienberg, 1977). With scaled independent variables (i.e., education, birth year) it is more convenient to use Berkson's (1953) weighted least squares technique. In either case, alternative models are considered in order to determine the relationship of the logarithm of the odds on a "yes" response (i.e., the ratio of the probability of saying "yes" to the probability of saying "no") to the independent variable(s). Among the possible multiple regression models, one is selected to represent the data on the basis of its goodness of fit (as measured by the appropriate chi-square statistic) and parsimony (as established by tests of significance for each included coefficient). Table 1 illustrates the calculation of odds, the logarithms of which are plotted in Figure 1. Since this table shows significant three-way interaction, the slopes of the regression of response on year are different for Catholics and Protestants. Similar evidence of significant differential change underlies the remaining figures. Table 2 summarizes the preferred regression models depicted in Figures 2 through 4.

Findings

As noted, there is a significant three-way interaction between year, religion (Protestant or Catholic) and belief in the right to question what one's church teaches (see Figure 1). Although Protestants were much more likely to insist on the right to question than were

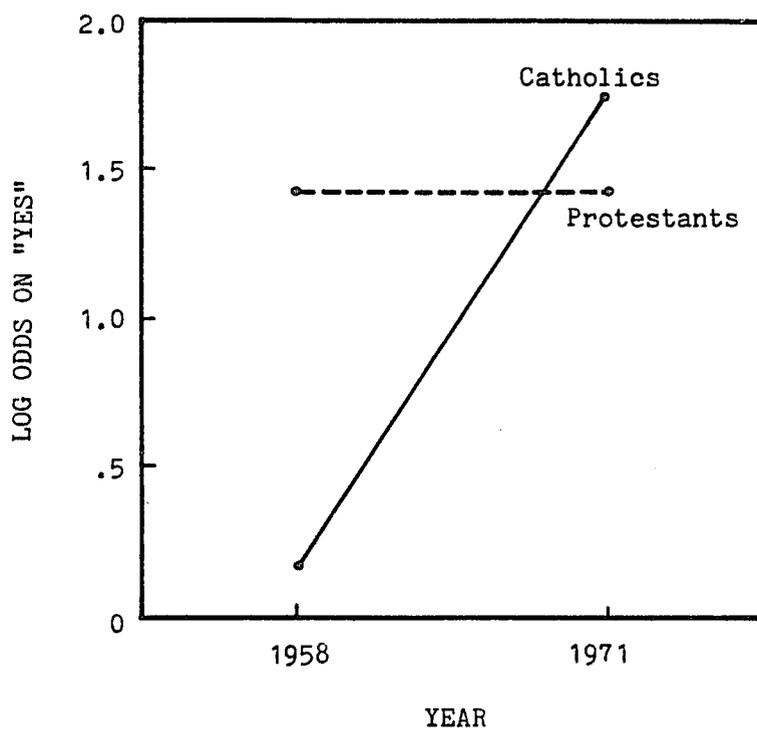


Figure 1. Log Odds on Responding "Yes" among Detroit Catholics and Protestants, 1958 and 1971

Table 2. Constants and Coefficients for the Regressions of Log Odds on "Yes" on the Independent Variables in Figures 2-4.

Figure (X_3^*)	<u>Coefficients</u>										<u>Fit of Model</u>	
	Constant	<u>Main Effects</u>				<u>Interaction Effects</u>				X^2	d.f.	p
		Year	Religion									
	X_1	X_2	X_3^*	X_4	X_1X_2	X_1X_3	X_2X_3	$X_1X_2X_3$				
1 (Education)	.593	-1.026	-1.171	.216		1.337	.322			17.01	18	>.50
2 (Birth Cohort)	.676	-.665	-1.148	.102		1.386	.080			32.69	40	>.75
3 (Church Attendance)	1.866		-2.077	-.172	.411	1.980		.382	-.254	10.39	13	>.50

* X_3 for each row is the variable in parentheses in column 1.

Values-- X_1 : 0 = 1958, 1 = 1971; X_2 : 0 = Protestants, 1 = Catholics.

Education: 1 = 1-6 years, 2 = 7-8 years, 3 = 9-11 years, 4 = 12 years, 5 = 13-15 years, 6 = 16 or more years.

Birth Cohort: 1 = Before 1894, 2 = 1894-1898, . . . 13 = 1947-1950; (the intermediate categories shown in Figure 3 are given values of 3 to 12 respectively).

Church Attendance: 1 = Once a week or more, 2 = 2-3 times a month, . . . 5 = Never.

X_4 : 1 = 2-3 times a month (Church Attendance), 0 = Other attendance categories.

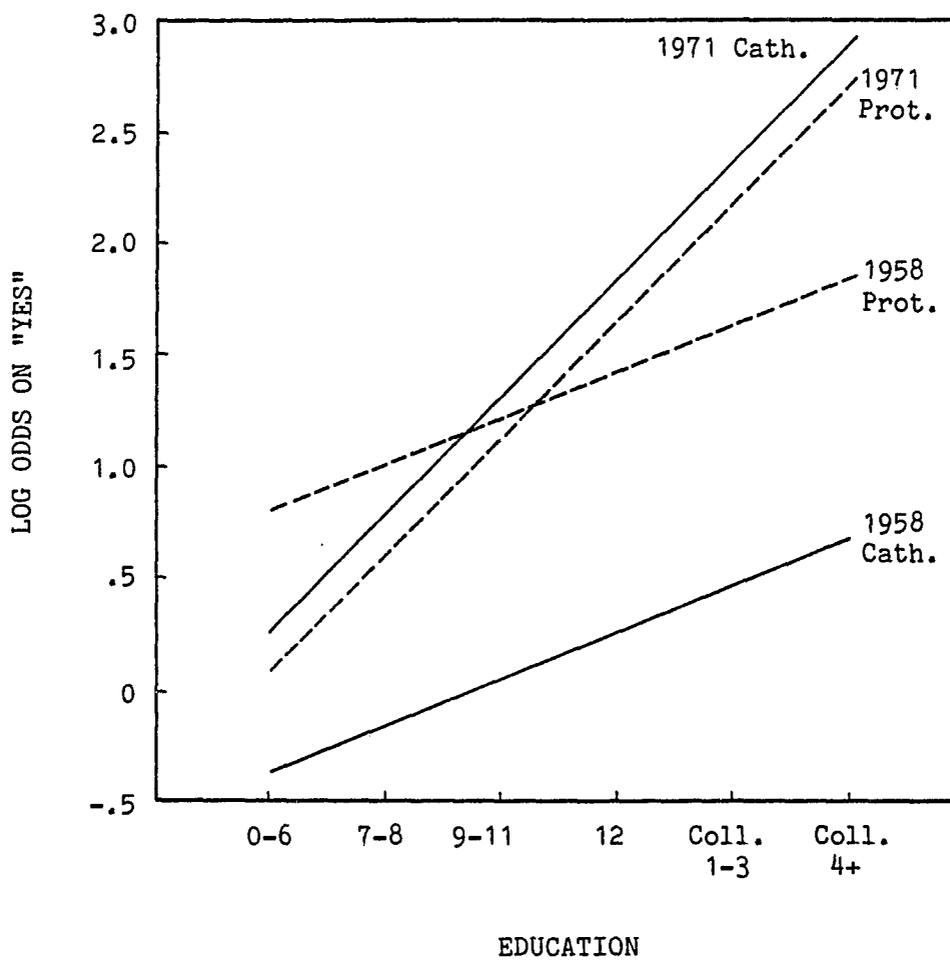


Figure 2. Belief in the Right to Question by Education by Religion by Year

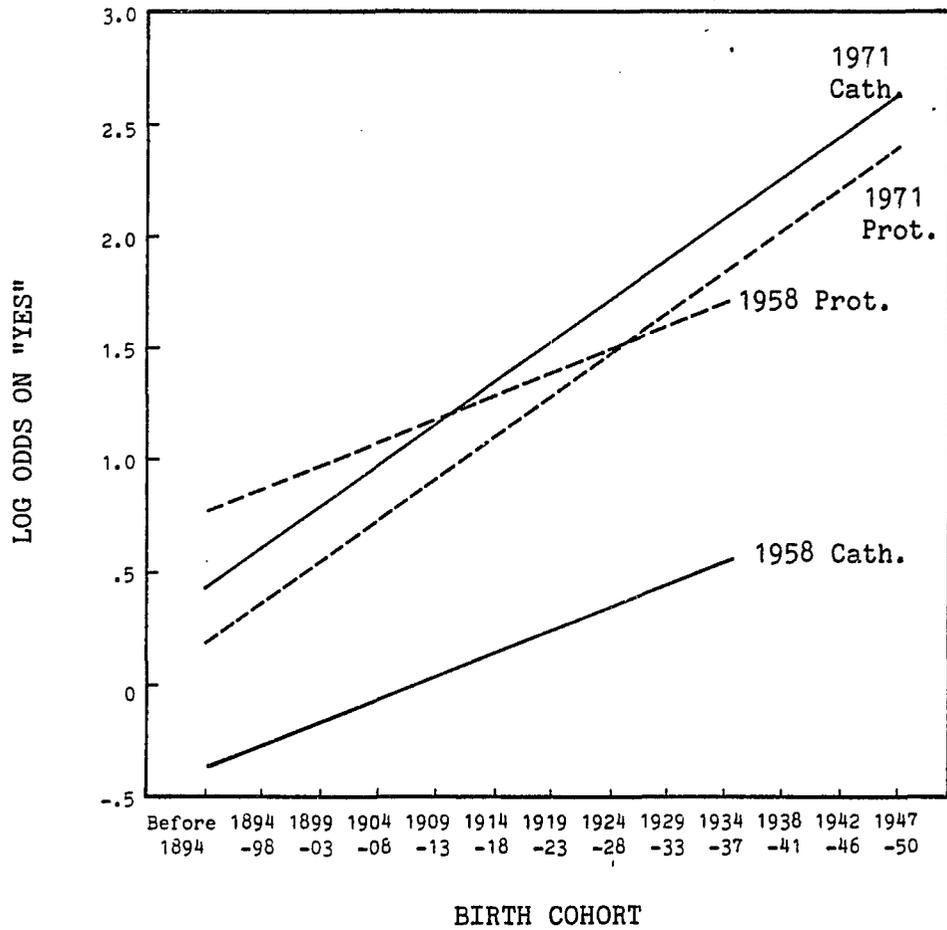


Figure 3. Belief in the Right to Question by Birth Cohort by Religion by Year

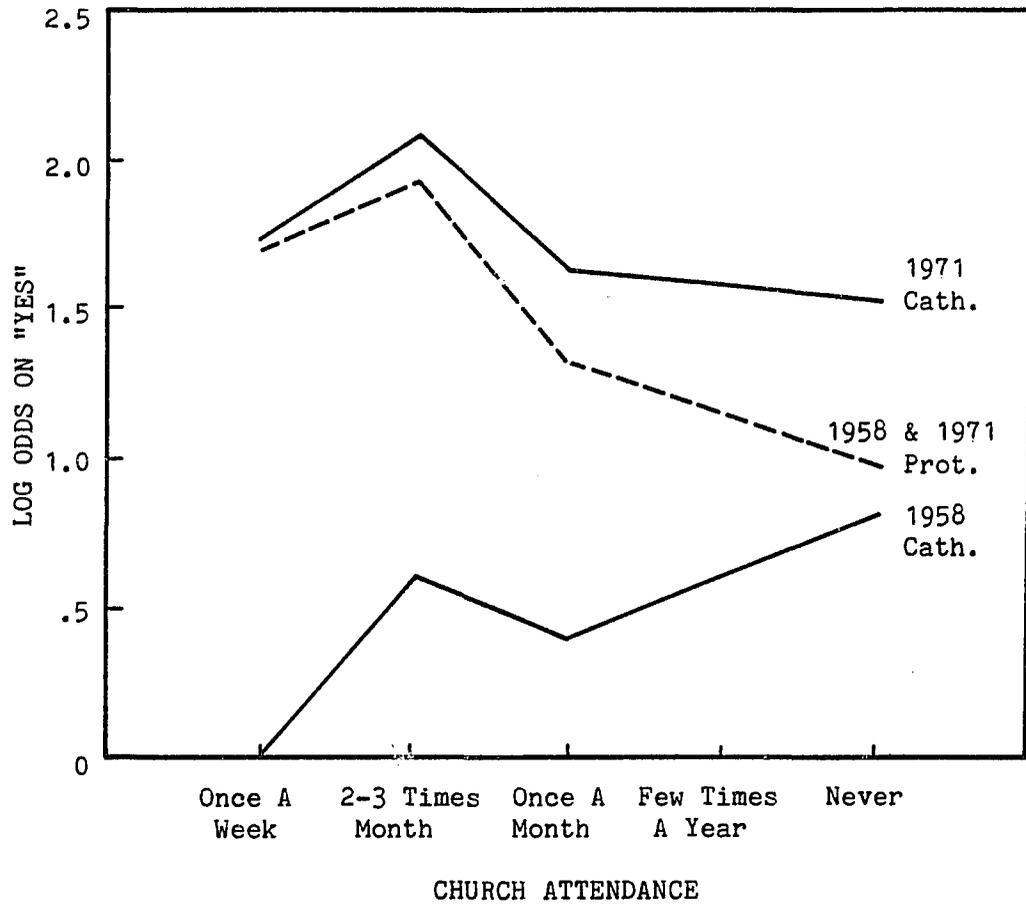


Figure 4. Belief in the Right to Question by Church Attendance by Religion by Year

Catholics in 1958, the rapid change among the latter erased the difference by 1971. While the Catholic sample had a higher proportion of "yes" responses in that year than the Protestant sample, the difference is only marginally significant, $.05 < p < .1$. The main finding, then, is that Catholics "caught up" with Protestants regarding this belief some time during the thirteen-year period.

The diversity of authority structures and teachings among Protestant denominations and sects raises the question of the validity of grouping them all into one category. An analysis of responses among Presbyterians, Lutherans, Episcopalians, Methodists, Baptists, neo-fundamental groups, neo-traditional groups, and "other" Protestant religions revealed no significant change in the response patterns between 1958 and 1971 among respondents in any of these seven categories. The aggregated Protestant category concealed no significant decline or increase in the odds on "yes" among the various groups. Examination of the ungrouped data indicates that the main difference in 1958 in relation to the dependent variable is between Catholics and Protestants as a whole and not between the several Protestant denominations. Because of this response pattern and the limitations of sample size, there was no further investigation of trends among each of the various Protestant groups.

Education

Education is one factor in our culture which is generally believed to have a liberalizing influence on people's religious attitudes. Additional education enhances the probability of contact with other

"world views" or, in other words, increases the pluralism of one's intellectual environment. Those with higher educational attainment would be more likely to question church teachings than people with lower levels of education.

A significant linear relationship between the dependent variable and education, within religion and year, was detected (see Figure 2). The odds on "yes" under the preferred model are raised across education categories by a factor of 1.2 in 1958 and 1.7 in 1971. This holds for both Catholics and Protestants. Differences between the two groups in 1958 and 1971 are the same for each education category.

The change over time is generally greater among the more highly educated. Roche (1968) suggested that those Catholics not intellectually prepared probably did not understand the dynamics of Vatican II and were hardly touched by it. Although this causal link cannot be tested, the less educated or less intellectually prepared probably did not fully grasp the liberalizing influences of the events of the 1960's.

One variable often discussed when analyzing the attitudes of Catholics is whether or not they attended parochial school. In relation to the right to question what one's church teaches, however, parochial school attendance (yes or no) showed no significant effect in either year.

Birth Cohort

Research on religion and the life cycle generally suggests that orthodox beliefs and practices tend to decline from the middle teens to about age 30, whereafter they slowly increase again (Argyle, 1958;

Hastings and Hoge, 1970). The potential for change may be greater among younger cohorts who tend not to be as set in their ways as older people. Most of them are still being socialized, if only to a small extent in their religious attitudes.

Under the preferred regression model (see Figure 3), the expected odds on responding "yes" are raised by a factor of 1.1 across successive age categories from old to young among both Protestants and Catholics in 1958. In 1971 these odds are successively raised by a factor of 1.2. The steady increase in the odds does not coincide with the non-linear pattern across age categories generally implied for other belief trends.

There is a greater increase over time in the odds on "yes" among the younger Catholic birth cohorts than among older ones. Assuming that events mentioned only had liberalizing effects on the questioning of church teachings, the younger birth cohorts were more influenced by them. Among Protestants, on the other hand, the odds on "yes" increase only for the two youngest cohorts for which change can be studied. For successively older cohorts, these odds decrease over time by a growing factor. This follows the more traditional pattern of age effects on religious beliefs and possibly reflects the absence of "liberalizing" Protestant events in contrast to the events in the Catholic church.

Church Attendance

Attendance at church has been seen as one major indicator of religiosity, especially in Catholicism (Osborne, 1968). To the extent that belief in the right to question church teachings and non-attendance

at church indicate a departure from religious devotion, a negative relationship between the two variables (attendance and log odds on "yes") would be expected. This relation to devotionism is not very clear or well-documented, but it is one logical possibility.

Under the preferred model (see Figure 4), the odds on "yes" are raised among those who attended "2-3 times a month" relative to those who attended "once a week or more" in both years for both religious categories. The odds then decrease, although not linearly, across attendance categories for Protestants in 1958 and 1971 and Catholics in 1971. While the odds decrease among Catholics who attended about "once a month" in 1958 relative to the previous category, these odds then increase across the last two categories.

In 1958, the relative prevalence of Catholic believers in the right to question church teachings is greatest among those who never attended. This is consistent with the idea that lack of devotion is reflected in both non-attendance and questioning the church. The strong belief in papal infallibility and the norm of unquestioning obedience before the Second Vatican Council plus the use of attendance as a major indicator of the Catholic's religiosity are consistent with this result.

A different pattern occurs among Catholics in 1971, however. As noted, there was a debate over compulsory mass attendance in the 1960's. The relation of attending to being a "good" Catholic may have weakened over this time interval. Also, church-goers were being taught that they had a new responsibility to think for themselves on some religious matters. Those who attended services sometimes encountered clergy who, themselves, were reacting against the official birth control policy and

the norm of unquestioning obedience. In 1971, the Catholics who attended the most believed in the right to question as much, or even slightly more, according to the preferred model, than those who attended church meetings once a month or less. Only among those who attended "2-3 times a month" are the odds on "yes" significantly higher.

The pattern of belief in the right to question among Protestant categories of church attenders does not significantly change between 1958 and 1971. This lack of change, differential and net, may reflect, again, a relative absence of "liberalizing" events. The odds on "yes" are lowest among the non-attending Protestants. This may indicate just a higher level of apathy or even a lack of knowledge of what the churches were teaching. Those who attended at least two to three times a month probably had a greater knowledge of what their church actually was teaching. Reaction to this greater knowledge is a more liberal stance among the "2-3 times a month" attenders relative to those who attended more often. As Herberg (1955:270) described the Americans who were attending church, ". . . their conceptions and values, their institutions and loyalties, bear a strangely ambiguous relation to the teachings that the churches presumably stand for."

Other Attitudes

The question arises as to how the dependent variable fits in with other attitudes concerning religion. One trend in particular indicates a possible change between 1958 and 1971 in the implication of believing in the right to question.

The Catholic respondents were asked whether or not they believe theirs is the only true religion established by God. Responses of "unsure" and "no" were combined, as partitioning (a method outlined by Duncan, 1975) revealed no significant difference between them in either year. This measure of religious particularism not only differentiates among responses on the "right to question," it also shows a differential change over time (see Figure 5). Although the odds on "yes" increase among those in both response categories, this increase is greater among those believing that the Catholic church is the only true one. In 1971, those who answered "yes" to this question were nearly as likely to believe in questioning church teachings as those who answered "unsure" or "no." The change toward accepting the validity of other faiths interacts with the increased belief in the right to question Catholic doctrine.

"Belief in the right to question church teachings" appears to measure a religious dimension distinct from indicators of orthodoxy. For the most part, studies of change see various aspects of religiosity declining among both Protestants and Catholics since the so-called religious revival of the 1950's (Demerath, 1968; Stark and Glock, 1968).

Comparison of responses from the 1971 Detroit Area Study with those from the 1958 and 1959 studies provides two further examples of such trends. While the vast majority of the respondents in both 1959 and 1971 believed there is a God (97% and 94% respectively), the percentage of those having "no doubts" about God's existence declined significantly from 64% to 44% among Protestants and from 72% to 48% among Catholics. Between 1958 and 1971 there was a significant decline in the percentage of those believing in life after death among Protestants

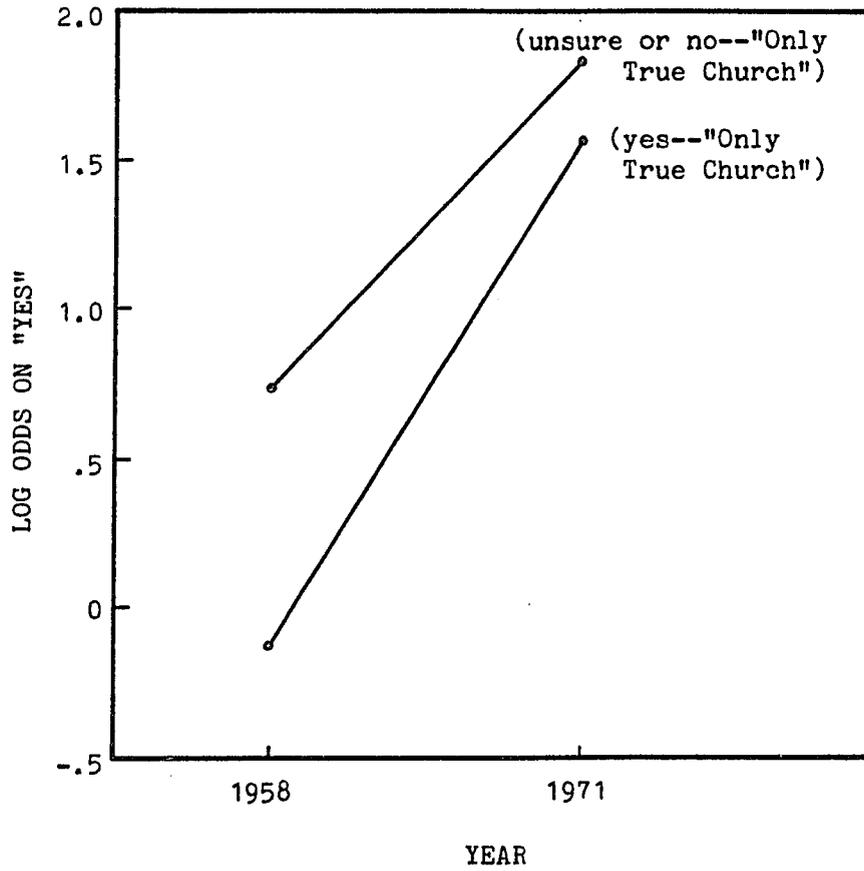


Figure 5. Belief in the Right to Question (Catholics) by Only True Church by Year

(from 72% to 64%) and among Catholics (from 81% to 69%). Pronounced change in the belief in the right to question teachings among Catholics vs. the absence of significant change among Protestants reflects a difference from the trends generally found among other religious indicators.

Conclusion

The prevalence of belief in the right to question church teachings grew substantially between 1958 and 1971 among Detroit Area Catholics. The magnitude of this change varies positively with education and church attendance but inversely with age. Belief in this right increased only to a small and insignificant extent among Protestants in general, however.

By the 1970's, the Catholic church in one sense had become "Protestantized," perhaps even more so than the Protestant religions themselves. This is not to say that Catholics have become like Protestants in their doctrinal beliefs. Catholics became more like Protestants in claiming the right to question church instructions.

A secularization approach was considered as a possible way of describing change in the questioning of church teachings. Although this explanation provides some useful insights, the causal trends underlying secularization hardly explain the results obtained here. There is no reason to suspect that Detroit Catholics should be more influenced by modernizing processes than Protestants. Likewise, the general erosion of traditional authority does not describe the differential trend found. Only the occurrence of specific events affecting one religious group and not another can easily explain such a change.

The credibility of religious teachings is affected by the exposure to a number of contradictory and competing definitions of reality. Certainly the theme behind Vatican II was contradictory to Catholic tradition. The Council legitimated questioning by the laity and indicated that there were a number of ways of being a Catholic. Thus, in 1971, a Catholic questioning church teachings is not, ipso facto, quite so likely to be a not very good or not very religious Catholic, as may have been the case in 1958. Likewise, the birth control encyclical conflicted with the definition of reality and way of life of many Catholics.

It should be emphasized that there may be a substantial difference between a decline in "religiosity" and an increase in belief in the right to question church teachings. The extent of belief in the right to question is generally as high or even higher among those who attended church at least two to three times a month relative to those who attended less. Also, the differential change in the dependent variable in question does not follow the pattern of change in orthodox beliefs.

Belief in the right to question what one's church teaches provides one distinct measure of religiosity, quite different from beliefs in orthodoxy or religious participation which dominate the literature dealing with religious indicators. It brings us back to the historical distinction between Catholicism and Protestantism which has become somewhat obscure in recent research on religious attitudes.

III

A COMPARISON OF TWO METHODS FOR THE CAUSAL ANALYSIS OF SURVEY DATA

A number of distinct methods for the causal analysis of survey data have been developed. The application of the techniques, such as Goodman's log-linear approach, has generated some debate in the last few years (e.g., Reynolds, 1977; Gillespie, 1978; Goodman, 1979). It becomes important, therefore, to compare the assumptions and characteristics of the various methods. The choice of one method rather than another may alert the investigator to different relationships among variables and affect the final interpretation of the data.

The purpose of this paper is to compare two approaches to the causal analysis of panel data: The continuous-time discrete-state modeling outlined by Coleman (1964, in specific Chapter 5) and the method of log-linear analysis developed by Goodman (1973, 1972a, 1972b). Both have been used to analyze causality in over-time systems of dichotomous or polytomous variables and they have been treated as competing methods (see Goodman, 1973). A brief outline of certain basic aspects of each approach will be given here in order to facilitate the comparison. Distinctions between the two methods will then be illustrated by comparing Coleman's and Goodman's interpretations of a contingency table representing a panel study.

Coleman's Method

The impetus for his continuous-time discrete-state model comes from Coleman's acknowledgment that "there is no model for dichotomous attributes analogous to that of differential equations and algebraic equations for quantitative variables" (Coleman, 1964:105). Many of the theories in the social sciences assume or describe continuous processes and variables while much of the available data for testing them are categorical, such as those generally obtained in attitude surveys. Coleman developed his method to describe continuous processes using discrete-state data.

Coleman's analysis begins with the notion of the causal relationship necessarily acting through time. It underlies his whole modeling approach and differentiates it from other methods. Relationships analyzed using cross-sectional data lend themselves to causal interpretation and measurement only when the data are assumed to be in aggregate equilibrium (i.e., there is no change over time in the proportion of frequencies in each state). Causes are thus conceptualized in terms of the over-time changes they bring about.

The fundamental parameter in the continuous-time processes described by Coleman's model is the transition rate, q_{ij} , or the probability of moving from state i to another state j . Causal effect between variables is assumed to occur "through these fundamental governing quantities in the process" (Coleman, 1964:116). The transition probability operates constantly over time; and, therefore, the expected frequency in a given state is written in the form of differential equations relative to time. Beginning with a simple two-state system, the probability of

moving from state 1 to state 2 in any small interval of time dt is $q_{12}dt$. Likewise, the probability of moving from state 2 to state 1 is $q_{21}dt$. From this, we obtain Coleman's basic equation which describes the rate of change in the probability of being in the first state (p_1):

$$\frac{dp_1}{dt} = q_{12}p_1 + q_{21}p_2. \quad (1)$$

An important feature of the model is that the parameters describing the subsequent change over time in the dependent attribute can be partitioned. Depending on substantive theory, the transition rates may be produced by the systematic effects of some variable on the dependent attribute and/or by "random shocks" due to extraneous factors. These random shocks indicate a general migration from one state to another. Therefore, in a two-state system under aggregate equilibrium, total variation in p_e (the expected probability of being in a given state) can be attributed to three causes: an independent attribute and unexplained or random shocks in two directions. The partitioning of the q_{ij} , therefore, involves an "assumption about the way in which the effects of attributes combine to produce an overall transition rate" (Coleman, 1964:117).

Coleman presents two methods for estimating transition rates from survey data. First, an "exact method" accounts for all possible jumps between the discrete points in time for which there are data. An approximate method, which is generally used with cross-sectional data and assumes aggregate equilibrium, neglects all jumps beyond those described at the discrete states. These cross-sectional estimates can only indicate the relative sizes of the transition rates, however. An

advantage of having both estimates for panel data is that the cross-sectional data for the first point in time may be used to estimate the ratios of the transition rates in effect up to that point in time while the over-time data may be used to estimate the absolute values of transition rates in effect between the two points in time (for details see Coleman, 1964:136-139, 166-172).

Goodman's Method

Goodman's intent is also to present a method for the analysis of data obtained from panel studies as well as other kinds of surveys. Assessment of "causation" is only one possible use. The approach is limited to the analysis of dichotomous or polytomous variables.

Goodman presents a method for determining whether we can ignore information that may be lost in simplifying an original n-way contingency table by replacing it with subtables of smaller dimensions. Various models are specified which fit different marginals of the multiway table. Under each of these models, different hypotheses express the expected frequencies, F , in terms of a product. For example, the expected frequencies under a "saturated" model, which contains all possible main and interaction effects, for some four-way table (dichotomous variables A, B, C, D) would be:

$$F_{ijkl} = n \tau_i^A \tau_j^B \tau_k^C \tau_l^D \tau_{ij}^{AB} \tau_{jk}^{BC} \tau_{kl}^{CD} \tau_{il}^{AC} \tau_{jl}^{BD} \tau_{ikl}^{BCD} \tau_{ijl}^{ACD} \tau_{ijk}^{ABC} \tau_{ijkl}^{ABCD}, \quad (2)$$

where $\tau_i^A = 1/\tau_2^A$; $\tau_{11}^{AB} = \tau_{22}^{AB} = 1/\tau_{12}^{AB} = 1/\tau_{21}^{AB}$;

$$\tau_{111}^{ABC} = \tau_{221}^{ABC} = \tau_{212}^{ABC} = \tau_{122}^{ABC} = 1/\tau_{121}^{ABC} = 1/\tau_{211}^{ABC} = 1/\tau_{222}^{ABC} \text{ etc.}$$

The superscripts denote the variables involved with their respective levels indicated by the subscripts. The F_{ijkl} for this saturated model simply equal the observed frequencies, f_{ijkl} . In a sense, each T corresponds to fitting the marginals of some subtable of the original table. By setting different T 's equal to one, we ignore certain information in the original table and thus generate different models.

To test whether a model fits the data, the F_{ijkl} generated under the corresponding hypotheses are estimated and then compared with the observed frequencies by calculating either the usual chi-square goodness-of-fit statistic, χ^2 , or the corresponding χ^2_{LR} based on the likelihood-ratio statistic. The fit is judged against the tabulated χ^2 distribution for the given degrees of freedom. Hierarchical models can be compared to test whether certain parameters contribute to the fit of a model in a statistically significant way.

The basic parameter used in describing a relationship between variables is the expected odds, Ω . Defining a new parameter γ , which is equal to the corresponding square of a T parameter, each model can then be expressed as a system of equations involving the Ω 's and the γ 's. For example, Goodman found the following model to fit quite well the data later analyzed in this paper:

$$F_{ijkl} = n_{i^T j^T k^T l^T} \gamma_{ij}^A \gamma_{ik}^B \gamma_{jk}^C \gamma_{jl}^D \gamma_{kl}^E \quad (3)$$

From this model we can then obtain a system of equations which measure the basic parameters describing the hypothesized causal process.

$$\Omega_{ijk}^D = \gamma_{ij}^D \gamma_{jk}^B \gamma_{kl}^C \quad (4)$$

$$\bar{\Omega}_{ij.1}^C = \gamma_{i.}^C \gamma_{.j}^C \gamma_{.1}^C \bar{\Omega}_{ij.1}^C \quad (5)$$

$$\bar{\Omega}_{i.K1}^B = \gamma_{i.}^B \gamma_{.K}^B \gamma_{.1}^B \bar{\Omega}_{i.K1}^B \quad (6)$$

$$\bar{\Omega}_{.jkl}^A = \gamma_{.j}^A \gamma_{.k}^A \gamma_{.l}^A \bar{\Omega}_{.jkl}^A \quad (7)$$

Equation (4) states, for example, that the expected odds pertaining to variable D, $\bar{\Omega}^D$, are dependent upon the level of variables B and C, but not upon variable A. The γ 's, therefore, describe the effect of a variable on the estimate of the expected odds pertaining to the categories of a particular variable. Equations (3) through (7) can be expressed in additive form by letting $G_{ijkl} = \ln F_{ijkl}$, $\theta = \ln \eta$, $\lambda = \ln T$, $\phi = \ln \Omega$ and $\beta = \ln \gamma$.

The estimated β 's in the additive form of the equations can then be used in path diagrams which are somewhat analogous to those used in the causal interpretation of relationships involving quantitative variables. By comparing the χ^2 values for different hypothesized models, the statistical significance of each effect (β) in the path diagram can be assessed.

A Comparison of Methods

Although both methods are purportedly amenable to the analysis of causation in panel and other survey data, their differences have important implications for the interpretation of data. Characteristics on which they differ include their orientation toward causation, incorporation of time, basic parameters, assessment of symmetry in relationships,

analysis of exogenous variables, and testing the fit of models. These differences in turn guide their modeling processes in distinct directions.

Orientations Toward Causation

As noted, Coleman begins with a notion of causation that necessarily implies change over time. Temporal ordering (i.e., for A to cause B it must occur prior to B), therefore, assumes high priority in his modeling process.

Goodman, on the other hand, does not begin with the intent of mimicing a particular causal process. Unlike Coleman's notion of causation, his methods are often used to detect "causal" relationships between synchronous variables as well as the same attribute at different points in time. Temporal ordering is not a necessary condition for including an effect parameter between the variables in a path diagram.

While Coleman builds assumptions of causation directly into his model from the beginning, such assumptions, however different, enter into Goodman's approach at the state of selecting alternate systems from among those described by a given acceptable model. For example, if the model of equation (3) holds true, then any pair of equations among the four equations (4) through (7), except for the pair (5) and (6), is actually equivalent to (3). Thus, this model can reflect a wide range of relationships among four variables. Figure 1 summarizes various systems that could be accepted under model (3). In order to make a selection from among the various "causal" systems in Figure 1, additional assumptions concerning causation within the system of variables (e.g., temporal ordering) are needed. Thus, in Figure 1, if A and B are

Fig. 1A Equations (4)-(7)

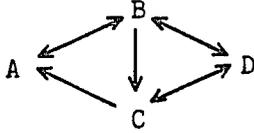


Fig. 1B Equations (4) and (5)

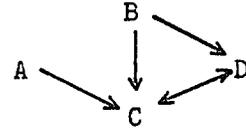


Fig. 1C Equations (4) and (6)

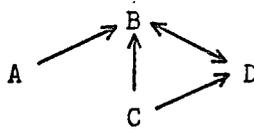


Fig. 1D Equations (5) and (7)

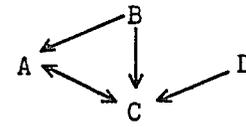


Fig. 1E Equations (6) and (7)

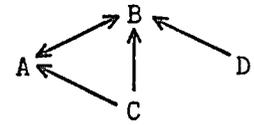


Fig. 1F Equations (4) and (7)

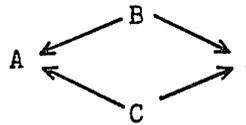


Fig. 1G Equations (4),(5),(7)

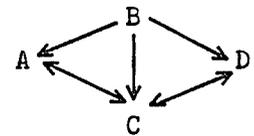


Fig. 1H Equations (4),(6),(7)

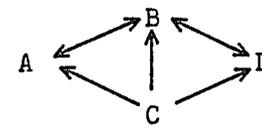


Fig. 1I Equations (5),(6),(7)

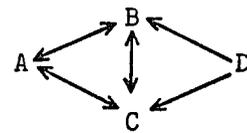


Figure 1. Diagrams of Some Causal Systems Described by Model (3)

measured at the same time and C and D at a later time (as in the last section), none of the figures would illustrate a plausible model (assuming temporal ordering) unless the concepts of latent variables (see Goodman 1973:1158-1160) are introduced. The system described by Figure 1B most nearly conforms to these hypothetical assumptions but still includes one causal effect between synchronous variables (relation between C and D).

Incorporation of Time

Coleman measures continuous-time processes, whereas Goodman compares discrete-time models. Coleman's emphasis on the measurement of dynamic processes obviously proceeds from his orientation toward causation. He suggests that one difficulty with over-time data is that responses of a person at discrete points in time do not necessarily reflect the changes in attitude or behavior between the observations nor the number of such changes (Coleman, 1964). Goodman neglects such multiple shifts and investigates only the aggregate or "one-jump" change between discrete observations.

Because Coleman's method focuses on continuous-time processes rather than on describing the aggregate distribution, the timing, permanency, and duration of events become important. For example, when one of the variables is exposure to a stimulus (experimental vs. control group situation), the variable timing of that stimulus between observations can have differential effects on the transition rate. The rate may be altered at the time the stimulus is presented. Only then does the additive main effect of the independent variable combine with the random shocks to produce a new transition rate. Goodman's discrete-time

analysis would ignore the timing of such stimuli between observations, taking into account only the beginning and end states.

Basic Parameters

The fundamental difference concerning the incorporation of time is reflected in the basic parameters of the two methods. The transition rate measures or approximates the change going on between observations. On the other hand, Goodman's basic parameter, the odds or odds ratio, does not necessarily imply change over time.

In one way, however, the use of odds corresponds to Coleman's approximate method of estimation since both neglect all jumps beyond the one measured by comparing the discrete observations. For example, using the approximate method to estimate the ratio of transition rates, q_{ij} , in a one-attribute two-state system we simply obtain the odds on being in one state rather than the other at time one, or:

$$\frac{q_{21}}{q_{12}} = \frac{n_1}{n_2}, \quad (8)$$

where n_1 is the number in state 1 at time one and n_2 the number in state 2 at that same time. If the data were in aggregate equilibrium, these odds would give the same estimate of the relative sizes of the transition rates as Coleman's exact method of estimation. Unlike the exact method, however, the odds cannot measure the absolute sizes of transition rates.

Schmeikal (1977), likewise, indicated a distinct mathematical similarity between the two methods when the assumption of aggregate equilibrium is met. He transformed Coleman's process into the language of odds and obtained a decomposition of the equilibrium-odds into gamma

factors similar to Goodman's derivation. The similarities disappear, however, when aggregate equilibrium cannot be assumed.

Assessment of Symmetry in Relationships

The relationship between two attributes measured by cross-sectional data is analyzed differently in yet another way by the two approaches. Where both attributes affect each other, the two corresponding effect parameters are constrained to be equal (the relationship is symmetrical) in Goodman's models. A cause-effect relationship is either symmetrical or the effect is absent for one of the variables acting on the other. A unidirectional effect is not built into the model, however, but depends only on substantive decisions after the acceptance of the model. On the other hand, Coleman's model allows the effect of variable A on variable B to differ from the effect of B on A, although they may be equal.

With panel data, Goodman's approach, in one sense, does not constrain symmetry in the analysis of causal relationships. This is because an attribute at two points in time is analyzed as two separate variables. Thus, the magnitude of the effect parameter describing the relationship between $A_{t=1}$ and $B_{t=2}$ can be different than between $B_{t=1}$ and $A_{t=2}$. Otherwise, symmetry is a constraint in the relationship between attributes.

Analysis of Exogenous Variables

The two methods also differ in their analysis of exogenous variables. External or random shocks are an intrinsic part of Coleman's model. The combined effects of variables not specified in a given system

are estimated by the model. On the other hand, Goodman's models describe a closed system in the sense that if variables outside the system (e.g., variables other than A, B, C, D in Table 1) have any effect on the variables within the system, it is to produce the usual random variation of the f_{ijkl} from their corresponding F_{ijkl} . Coleman's model provides a partitioning of its basic effect parameter (into main and random effects), which Goodman's method does not.

Testing the Fit of Models

The judging of the fit of a model to observed data reflects another basic difference between the methods of Coleman and Goodman. Goodman is working from the notion of testing significance. All of his estimates are maximum likelihood estimates, and their statistical significance can be assessed using χ^2 statistics. Likewise, the presence or absence of an effect is judged by the statistical significance of the difference between χ^2 's calculated from selected models.

Assessment of the unreliability of responses is seen as a problem by Coleman (1964:156). Both the exact and approximate methods for estimating transition rates from the data neglect sampling error. Thus, the methods do not provide maximum likelihood estimates nor asymptotically equivalent estimates. The presence or absence of an effect is determined by comparison of two transition rates, both of which include the same error term but only one of which contains the effect parameter. If the difference between the two is near zero (by subjective judgment), the causal relationship is assumed to be absent.

In summary, the two approaches for analyzing causal relationships among qualitative variables are quite distinct. While Coleman focuses on actual movement between states (which correspond to a joint response on a set of variables), Goodman looks at factors that affect the odds on being in one state (being in a particular category of one variable) rather than in another. Not only are their initial purposes for developing a modeling process different, but their integration of assumptions about causation into their analyses creates distinct parameters for describing causal relationships.

This brings us to the distinction between a math modeling and statistical analysis. The former is comprised of equations describing precise theoretical relationships among a set of variables. It involves a translation of theory into mathematical logic. Statistical analysis focuses on the choice between different statistical models rather than the simulation of the dynamics under consideration. It is not generally developed from substantive theory but is a tool to test and build theory. In this sense, Goodman's statistical modeling describes the data and lends itself to causal interpretation, while Coleman's math modeling attempts to simulate the causal process which generates a particular set of data. Still, both methods are used to analyze causal systems in data gathered from panel studies and other types of surveys.

Comparison of the Methods on the Analysis of a Data Set

A comparison of the two analytical approaches on the same data set further illustrates their congruities and differences. This is

facilitated by Goodman's (1973) reanalysis of a set of over-time data investigated by Coleman. The data (Coleman, 1961) were gathered from questionnaires given to adolescents in ten high schools. The two items of interest are 1) Are you a member of the leading crowd? (attribute X) and 2) If a fellow wants to be part of the leading crowd around here, he sometimes has to go against his principles (attribute Y). Table 1 summarizes the results of the survey for the male respondents.

Coleman uses the over-time responses to the two questions to describe the effect of each of the two attributes on the other. He analyzes the movement between four different states and posits certain main and random effects on the over-time movement. Figure 2 summarizes his causal explanation of Table 1. The q_{ij} 's are partitioned to include main effects, pushing responses toward a consistent state (1 or 4), and random effects for each direction between each pair of states. Each state represents a joint position on the two attributes for a given period of time. In essence, Coleman is conceptually uninterested in the relationship between the two attributes at the same point in time.

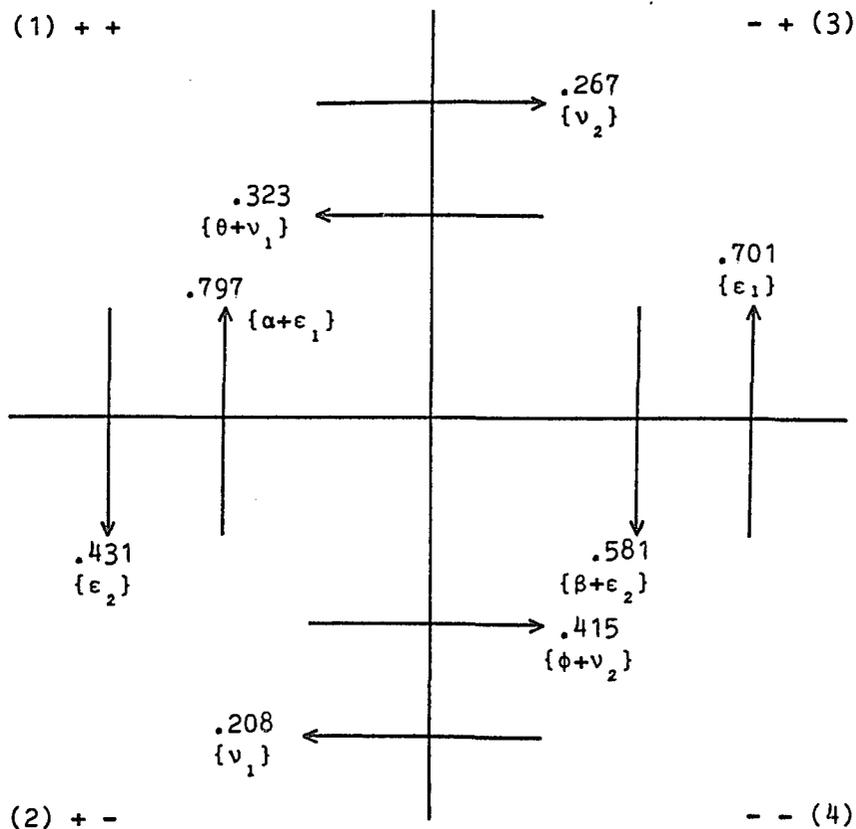
Using both the approximate and exact methods, Coleman arrives at estimates for each of the main and random effects. With respect to the interpretation of the results, Coleman (1964:172) states that "the strongest effects relative to the random shocks are the effect of a positive attitude toward the crowd's behavior on locating oneself within the crowd ($\theta = .115$) and the effect of a negative attitude on moving out of the crowd ($\phi = .148$)." Again, it should be emphasized that these main effects are relative to the random shocks. The two unpartitioned transition rates including α and β , q_{21} and q_{34} respectively, are considerably

Table 1. Attitude Toward and Membership in Leading Crowd for Two-Wave Panel Data (Boys Only)*

X		Second Interview			
		Membership (C) +	+	-	-
Y		Attitude (D) +	-	+	-
First Interview					
Membership (A)	Attitude (B)				
+	+	458	140	110	49
+	-	171	182	56	87
-	+	184	75	531	281
-	-	85	97	338	554

*"+" refers to perceived membership in leading crowd or to the attitude that one does not have to go against his principles to be in the leading crowd; "-" refers to their opposites.

Source: Coleman, 1961



+ and - refer to the two possible positions on attributes X and Y.
 θ --Effect of a positive attitude on locating oneself within the crowd.
 ϕ --Effect of a negative attitude on moving out of the crowd.
 α --Effect of locating oneself within the crowd on a positive attitude.
 β --Effect of not locating oneself within the crowd on a negative attitude.
 v --Random shocks
 ϵ --Random shocks

Figure 2. Coleman's Causal Explanation for the Data in Table 1

larger than those including θ and ϕ or q_{31} and q_{24} respectively. Partitioning reveals that the larger transition rates are mainly due to relatively larger random effects.

As noted, the expected frequencies under Coleman's model were not generated using maximum likelihood estimates. The exact fit of the model cannot be judged against the tabulated χ^2 distribution. However, Goodman (1973:1184) states that the numerical value of the χ^2 statistic obtained with asymptotically inefficient estimates (such as Coleman's) serves as an upper bound for the corresponding numerical value that could be obtained through the use of maximum likelihood techniques. A χ^2_{LR} statistic of 8.20 (d.f. = 4) is obtained when the expected frequencies generated by Coleman's model are compared with the observed frequencies in Table 1. Although this does not tell us exactly how good the model would fit using maximum likelihood estimates, the χ^2 value is small enough so that we can assume that it would provide a good fit to the data at the .05 level of significance.

In analyzing the same data, the Goodman method focuses on relationships among four separate variables. For Goodman, each attribute at the two points in time (i.e., first and second interview) constitutes two separate variables for analytic purposes. Thus, Goodman investigates the main and interaction effects in a four-variable system as opposed to the four-state system of joint responses to the two questions.

Goodman tests the fit of a number of models which posit different main and interaction effects. Through the use of hierarchical comparisons to examine the significance of different effects, he chooses two models from among those that adequately fit the data. The two models

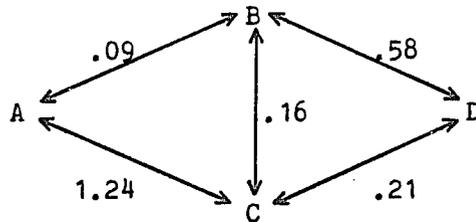
are of the same degrees of freedom and differ in only one parameter (i.e., one T is different). For purposes of illustration, only one of the accepted models is considered here.

The model chosen to describe causation among the variables in Table 1 indicates that the observed distribution can be fitted very well using only the information contained in five two-way cross-classification tables ($\chi^2_{LR} = 4.06$, d.f. = 6). The expected frequencies are given by

$$F_{ijkl} = \eta_{i j k l}^{T A T B T C T D T A B T A C T B C T B D T C D} \quad (3)$$

Each of the two-factor T 's in this model contributes in a statistically significant way. The β parameters generated under this model are shown in the path diagram which describes one acceptable "causal" description (see Figure 3). The diagrams in Figure 1 represent alternative systems acceptable under equation (3).

Goodman compares his analysis of Table 1 with that of Coleman. He states that, in contrast to Coleman's interpretation, he finds the weakest effect upon membership in the crowd at the second interview to be the effect of attitude toward the crowd's behavior at the first interview (also the weakest among all effects he considers). The next weakest effect is the synchronous effect of attitude toward crowd's behavior at the second interview, and the strongest effect (again upon membership at the second interview) is the effect of membership in the crowd at the first interview. Goodman emphasizes that the findings arrived at by the two analyses are contrasting.



A--membership at first interview
 B--attitude at first interview
 C--membership at second interview
 D--attitude at second interview

Figure 1B illustrates Goodman's preferred system under this model. The path between A and B can therefore be ignored.

Figure 3. Path Diagram for Goodman's Accepted Model for the Data in Table 1

In one sense, Goodman makes an unfair comparison of his findings with those of Coleman. Coleman is considering only four possible main effects: 1) a negative attitude on moving out of the crowd, 2) a positive attitude on moving into the crowd, 3) being in the crowd on a positive attitude toward the crowd, and 4) not being in the crowd on a negative attitude toward the crowd. Thus, what Goodman finds as the strongest effect does not enter into Coleman's analysis because Coleman did not consider it as part of the causal process. Likewise, what Goodman finds to have the weakest effect (attitude on membership in leading crowd in the following period) is found to be weakest relative to effects not seen as necessary for study by Coleman.

While Coleman considers various effects of attitudes on behavior and vice versa, he does not consider relationships in Goodman's analysis (see Figure 3) other than those between A and D and between B and C. Likewise, he would not consider these relationships as involving a single arrow or symmetrical double arrow effect between the variables. These two relationships analyzed by Goodman would be investigated by Coleman as involving eight distinct transition rates depending on the values of the joint variables.

Looking at those relationships where there is some comparability in the two conceptual analyses, we find less inconsistency in their conclusions. Goodman finds that the symmetrical effect between attitude at time one and membership at time two is greater than the effect between membership at time one and attitude at time two. Although each of these effects corresponds to two distinct main effects in Coleman's model, the findings are at least consistent with Coleman's. Among the four main

effects studied by Coleman, the two smallest are those of positive and negative attitude on perceived membership (+ and - respectively).

We can conclude that Goodman's comparison of his interpretation of Table 1 with Coleman's is in a sense like "comparing apples and oranges" since they are looking at "causal" effects relative to different sets of relationships. Although Goodman's accepted model appears to fit the data better than Coleman's and allows two more degrees of freedom (thus is more parsimonious in a sense), Coleman's interpretation should not be rejected outright in favor of Goodman's since they summarize different aspects of the data. Both methods of analysis give results that fit the data quite well, even though statistical fit is not a primary concern for Coleman. The essential difference between the methods of Goodman and Coleman is not reflected in the generation of different empirical results since their interpretations are not as contradictory (nor as comparable) as Goodman would lead us to believe. The main difference between the two approaches is in their conceptualization and integration of causal assumptions about relationships among systems of qualitative variables.

REFERENCES

I

- Alcock, Norman
1976 "Towards a causal theory of violence." *Peace Research* 8:91-101.
- Annual of Power and Conflict
1971- London: Institute for the Study of Conflict.
1976
- Bandura, Albert and Richard H. Walters
1963 *Social Learning and Personality Development*. New York: Holt.
- Banks, Arthur S.
1971 *Cross-Polity Time Series Data*. Cambridge, Ma.: MIT Press.
- Caplan, Nathan and Jeffery M. Paige
1968 "A study of ghetto rioters." *Scientific American* 29:15-21.
- Coleman, James S., Elihu Katz and Herbert Menzel
1966 *Medical Innovation: A Diffusion Study*. Indianapolis: Bobbs-Merrill.
- Davies, James C.
1969 "The J-curve of rising and declining satisfaction as a cause of some great revolutions and a contained rebellion." Pp. 671-709 in Hugh Davis Graham and Ted Robert Gurr (eds.), *Violence in America: A Report to the National Commission of the Causes and Prevention of Violence*. New York: Signet Books.
- Denton, Frank H. and Warren Phillips
1968 "Some patterns in the history of violence." *Journal of Conflict Resolution* 12:182-195.
- Deutsch, Karl W.
1961 "Social mobilization and political development." *American Political Science Review* 55:493-514.
- Dodd, Stuart C.
1955 "Diffusion is predictable: Testing probability models for laws of interaction." *American Sociological Review* 20:392-401.

- Downes, Bryan T.
1968 "Social and political characteristics of riot cities: A comparative study." *Social Science Quarterly* 49:504-520.
- Duff, Ernest and John McCamant
1976 *Violence and Repression in Latin America*. New York: The Free Press.
- Eckhardt, William and Christopher Young
1974 "A preliminary report on civil conflict and inequality." *Peace Research* 5:45-50.
- Feierabend, Ivo K. and Rosalind L. Feierabend
1966 "Aggressive behaviors within polities: 1948-1962: A cross-national study." *Journal of Conflict Resolution* 10:249-271.
- Feierabend, Ivo K., Rosalind L. Feierabend and Betty A. Nesvold
1969 "Social change and political violence: Cross-national patterns." Pp. 498-509 in Hugh D. Graham and Ted R. Gurr (eds.), *Violence in America: Historical and Comparative Perspectives*. Washington, D. C.: U.S. Government Printing Office.
- Flanigan, William and Edwin Fogelman
1970 "Patterns of political violence in comparative historical perspective." *Comparative Politics* 3:1-20.
- Gurr, Ted R.
1968a "Psychological factors in civil violence." *World Politics* 20:245-278.
1968b "A causal model of civil strife: A comparative analysis using new indicies." *American Political Science Review* 62:1104-1124.
1970 *Why Men Rebel*. Princeton: Princeton University Press.
- Gurr, Ted R. and Charles Ruttenger
1969 *Cross National Studies of Civil Violence*. Washington, D. C.: Center for Research on Social Systems.
- Halperin, Ernst
1976 "Terrorism in Latin America." *The Washington Papers* 4 (No. 33). Washington, D. C.: The Center for Strategic and International Studies.
- Hamblin, Robert L., R. Brooke Jacobsen and Jerry L. L. Miller
1973 *A Mathematical Theory of Social Change*. New York: Wiley.
- Hamblin, Robert L. and Jerry L. L. Miller
n.d. *Conflict Events File for Latin America, 1946-1975*. Unpublished Manuscript. Tucson: University of Arizona.

- Hazelwood, Leo
1973 "Externalizing systematic stresses, international conflict as adaptive behavior." In Jonathan Wilkenfeld (ed.), *Conflict Behavior and Linkage Politics*. New York: David McKay.
- Hernes, Gudmund
1972 "The process of entry into first marriage." *American Sociological Review* 37:173-182.
- Hodges, Donald C.
1976 *Argentina, 1943-1976: The National Revolution and Resistance*. Albuquerque: University of New Mexico Press.
- Huff, David L. and James M. Lutz
1974 "The contagion of political unrest in independent Black Africa." *Economic Geography* 50:352-367.
- Jenkins, Brian M. and Janera Johnson
1975 *International Terrorism: A Chronology, 1968-1974*. Santa Monica, California: Rand Corporation.
1976 *International Terrorism: A Chronology (1974 Supplement)*. Santa Monica, California: Rand Corporation.
- Johnson, Kenneth F.
1975 "Guerrilla politics in Argentina." *Conflict Studies* (No. 63): 1-21.
- Kegley, Charles W. Jr., N. R. Richardson and Gunter Richter
1978 "Conflict at home and abroad: An empirical extension." *The Journal of Politics*. 40:742-752.
- Laqueur, Walter
1977 *Terrorism*. Boston: Little, Brown and Co.
- Leiden, Carl
1969 "Assassination in the Middle East." *Transaction* 6:20-23.
- Li, Richard P. Y. and William R. Thompson
1975 "The coup contagion hypothesis." *Journal of Conflict Resolution* 19:63-88.
- Lieberson, Stanley and Arnold Silverman
1965 "The precipitants and underlying conditions of race riots." *American Sociological Review* 30:887-898.
- Midlarsky, Manus
1970 "Mathematical models of instability and a theory of diffusion." *International Studies Quarterly* 14:60-84.

- Midlarsky, Manus
1978 "Analyzing diffusion and contagion effects: The urban disorders of the 1960's." *American Political Science Review* 72:996-1008.
- Moyal, J. E.
1949 "The distribution of wars in time." *Journal of the Royal Statistical Society* 112:446-458.
- Nagel, Jack
1974 "Inequality and discontent: A nonlinear hypothesis." *World Politics* 26:453-472.
- Parvin, Manoucher
1973 "Economic determinants of political unrest: An econometric approach." *Journal of Conflict Resolution* 17:271-296.
- Pemberton, H. Earl
1936 "The curve of cultural diffusion." *American Sociological Review* 1:547-556.
- Pitcher, Brian L., Robert L. Hamblin and Jerry L. L. Miller
1978 "The diffusion of collective violence." *American Sociological Review* 43:23-35.
- Rosenau, James
1964 "Internal war as an international event." Pp. 45-91 in James Rosenau (ed.), *International Aspects of Civil Strife*. Princeton: Princeton University Press.

1967 *Of Boundaries and Bridges*. Princeton: Center for International Studies.

1969 *Linkage Politics*. New York: Free Press.
- Rummel, Rudolph J.
1963 "Dimensions of conflict behavior within and between nations." *General Systems Yearbook* 8:1-50.
- Russell, Charles A., James F. Schenkel and James A. Miller
1974 "Urban guerrillas in Argentina: A select bibliography." *Latin American Research Review* 9:53-89.
- Russett, Bruce M., Hayward R. Alker Jr., Karl W. Deutsch and Harold D. Lasswell
1964 *World Handbook of Political and Social Indicators*. New Haven, Conn.: Yale University Press.

- Shorter, Edward and Charles Tilly
1974 *Strikes in France: 1930-1968*. London: Cambridge University Press.
- Shreiner, Scott C.
1977 *Racial Conflict in the Southern United States 1954-1964; Systematic and Mathematical Models of Conflict Escalation and Diffusion Processes*. Unpublished Ph.D. Dissertation. University of Massachusetts.
- Sigleman, Lee and Miles Simpson
1977 "A cross-national test of the linkage between economic inequality and political violence." *Journal of Conflict Resolution* 21:105-128.
- Snyder, David
1975 "Institutional setting and industrial conflict: Comparative analysis of France, Italy and the United States." *American Sociological Review* 40:259-278.

1978 "Collective violence: A research agenda and some strategic considerations." *Journal of Conflict Resolution* 22:499-534.
- Snyder, David and William R. Kelly
1976 "Industrial violence in Italy: 1878-1903." *American Journal of Sociology* 82:131-162.
- Spilerman, Seymour
1970 "The causes of racial disturbances: A comparison of alternative explanations." *American Sociological Review* 35:627-649.
- Stohl, Michael
1976 *War and Domestic Political Violence: The American Capacity for Repression and Reaction*. Beverly Hills, Calif.: Sage Publications.
- Tanter, Raymond
1966 "Dimensions of conflict behavior within and between nations, 1958-1960." *Journal of Conflict Resolution* 10:41-64.
- Taylor, Charles L. and Michael C. Hudson
1972 *World Handbook of Political and Social Indicators*. New Haven, Conn.: Yale University Press.
- Tilly, Charles, Louise Tilly and Richard Tilly
1975 *The Rebellious Century*. Cambridge: Harvard University Press.

- Wilkenfeld, Jonathan
 1968 "Domestic and foreign conflict behavior of nations." *Journal of Peace Research* 1:56-69.

II

- Argyle, Michael
 1958 *Religious Behavior*. London: Routledge Kegan Paul.
- Berkson, Joseph
 1953 "A statistically precise and relatively simple method of estimating the bio-assay with quantal response, based on the logistic function." *Journal of the American Statistical Association* 48:565-599.
- Caporale, Rocco
 1967 "The dynamics of hierocracy: Processes of continuity-in-change of the Roman Catholic system during Vatican II." *Sociological Analysis* 28:59-68.
- Davidson, James D., Joseph A. Schlangen and William V. D'Antonio.
 1967 "Some implications of interfaith perceptions, patterns of belief, and perceptions of church structure." *Sociological Analysis* 28:123-141.
- 1969 "Protestant and Catholic perceptions of church structure." *Social Forces* 47:314-322.
- Demerath, Nicholas J., III
 1968 "Trends and anti-trends in religious change." Pp. 349-445 in Eleanor B. Sheldon and Wilbert E. Moore (eds.), *Indicators of Social Change: Concepts and Measurements*. New York: Russell Sage Foundation.
- Duncan, Otis Dudley
 1975 "Partitioning polytomous variables in multiway contingency analysis." *Social Science Research* 4:167-182.
- Duncan, Otis Dudley, Howard Schuman and Beverly Duncan
 1973 *Social Change in a Metropolitan Community*. New York: Russell Sage Foundation.
- Earle, Clifford
 1969 "How Presbyterians think about civil rights." *Social Progress* (Jan.-Feb.):5-35.
- Fienberg, Stephen E.
 1977 *The Analysis of Cross-classified Categorical Data*. Cambridge, Massachusetts and London: The MIT Press.

- Gerharz, George P.
1970 "Secularization as loss of social control: Toward a new theory." *Sociological Analysis* 31:1-11.
- Goodman, Leo A.
1972 "A general model for the analysis of surveys." *American Journal of Sociology* 77:1035-1086.
- Greeley, Andrew M.
1972 *The Denominational Society: A Sociological Approach to Religion in America.* Glenview, Ill.: Scott, Foresman.
1977 *The American Catholic.* New York: Basic Books.
- Hadden, Jeffrey K.
1969 *The Gathering Storm in the Churches.* Garden City, New York: Doubleday.
- Hastings, Phillip K. and Dean R. Hoge
1970 "Religious change among college students over two decades." *Social Forces* 49:16-28.
- Herberg, Will
1955 *Protestant, Catholic, Jew: An Essay in American Religious Sociology.* Garden City, New York: Doubleday.
- Osborne, William A.
1968 "Religious and ecclesiastical reform: The contemporary experience in the U.S." *Journal for the Scientific Study of Religion* 7:78-86.
- Quinley, Harold E.
1974 "The dilemma of an activist church: Protestant religion in the sixties and seventies." *Journal for the Scientific Study of Religion* 13:1-21.
- Roche, Douglas J.
1968 *The Catholic Revolution.* New York: D. McKay Company.
- Shiner, Larry
1967 "The concept of secularization in empirical research." *Journal for the Scientific Study of Religion* 6:207-220.
- Stark, Rodney and Charles Glock
1968 *American Piety: The Nature of Religious Commitment.* Berkeley and Los Angeles: University of California Press.
- Wood, James R.
1970 "Authority and controversial policy: The churches and civil rights." *American Sociological Review* 35:1057-1069.

Wuthnow, Robert

- 1976 "Recent patterns of secularization: A problem of generations?"
American Sociological Review 41:850-867.

III

Coleman, James S.

- 1961 The Adolescent Society. New York: Free Press.

1964 Introduction to Mathematical Sociology. New York: Free Press.

Gillespie, Michael W.

- 1978 "The application of log-linear techniques to recursive models:
Comment on Reynolds." American Journal of Sociology 84:718-722.

Goodman, Leo A.

- 1972a "A modified multiple regression approach to the analysis of
dichotomous variables." American Sociological Review 37:
28-48.

1972b "A general model for the analysis of surveys." American
Journal of Sociology 77:1035-1086.

1973 "Causal analysis of data from panel studies and other kinds
of surveys." American Journal of Sociology 78:1135-1191.

1979 "A brief guide to the causal analysis of data from surveys."
American Journal of Sociology 84:1078-1095.

Reynolds, H. T.

- 1977 "Some comments on the causal analysis of surveys with log-
linear models." American Journal of Sociology 83:127-143.

Schmeikal, Bernd

- 1977 "The derivation of Goodman's model from a continuous sta-
tionary Markov-process." Quality and Quantity 11:195-212.