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A Preliminary Markov Model of Interaction Between Police and Citizens Considered as General Systems

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ABSTRACT

Human groups may be reconceptualized in terms of general systems theory. In this article one ephemeral human group, the encounter between police and citizens, is reconceptualized as an input-output-feedback relationship between a citizen and a police system. These relations are then examined for their fit to a Markov model of intersystem interaction. Interaction process data collected by observers in an extensive study of uniformed police-citzen encounters is utilized. It is concluded that the interaction between the two systems approximately fits that expected in a second order Markov chain.

A PRELIMINARY MARKOV MODEL OF INTERACTION BETWEEN POLICE AND CITIZENS CONSIDERED AS GENERAL SYSTEMS

Most studies of police have been concerned primarily with substantive issues rather than with development of a more abstract theoretical orientation. Concerns have been with qualities of interaction which led to police violence, (Westley, 1953, 1956) good or bad police-public relations (Gourley, 1954), decisions by officers to take juveniles into custody, (Werthman and Piliavin, 1967; Pilaivin and Briar, 1964), the decision to arrest or make out an offense report (Black and Reiss, 1970; Black 1970; Reiss, 1971; Goldstein, 1960; LaFave 1962; Skolnick, 1966), the kind of interacts which led to violations of civil liberties (Sowle, 1966; Chevigny, 1969), as well as strategies for handling specific categories of the policed (Bittner, 1967a, 1967b; Parnas, 1967; Bard, 1969). Some attention has been given to interaction and collective violence (Feld, 1971). Few articles deal with interaction from the perspective of general theories of social psychology, (but see Hartjen, 1972; Tauber, 1967) as opposed to lower level special theories of police.[1]

My purpose here will be to suggest a much broader perspective with which to view the police-citizen encounter. My intention is not so much to question past discussions as to relate this specific subject to a much broader, less subject-specific framework. This will be done by

1. reconceptualizing the encounter as an instance in which two indeterminate systems -- police and citizens -- display input-output relations towards each other
2. analyzing these relations for their fit to a stochastic model of interaction (Hertel, 1968; Raush, 1965, 1972).

The theory will be tested on a subset of data gathered by field observers who quantitatively coded the nature of police-citizen encounters, their outcomes, and interaction between participants over several thousand hours. The intent of the research was to gather descriptive data on the nature of police activities as well as on the factors which influenced police-decision-making. To the author's knowledge this study is based on the most extensive field research utilizing quantitative interaction process data that has ever been attempted. The data make it possible to examine the process of interaction in several ways. In this analysis we will be concerned with the sequence of politeness or hostility states between officers and citizens.

The Encounter as a System

A system is "a set of components interacting with each other and a boundary which possesses the property of filtering both the kind and rate of flow of inputs and outputs to and from the system" (Berrien, 1968: 14-15). We shall not consider the specific personality systems of the officers or citizens, but analytically only their role. Each system, police and citizen, will be a "black box", and we will ignore what happens within it (Ashby, 1956; Watzlawick, et. al., 1967; Berrien, 1968).

The patrol system maintains two boundaries. The special car, insignia and uniform distinguish it visually from other components in the police suprasystem. Casual observation shows that the patrol component maintains its boundaries quite self-consciously in the sense of accepting certain inputs and filtering out others. Its boundaries as a subsystem within the police department are maintained by not performing or responding to certain inputs which it feels are appropriate to other components - policing of vice, for instance. It also responds negatively when other components trespass on its prerogatives - the negative evaluation it gives of the tactical squad, for instance.

At the same time the patrol maintains its boundaries within the police suprasystem, it also is itself a boundary between the police suprasystem and other suprasystems. As a patrol drives through a neighborhood it sees many things, but it will take official action only in regard to a few of these. Even after responding to a call it will still exercise a boundary function by refusing to take action where such action is not deemed the proper function of the police. The boundary maintenance function in this sense is interpreted by Berrien as similar to the effect of norms. "Norms are the gating or filtering function of the boundary for the social system" (Berrien, 1968: 111).

When a radio call directs the patrol to some event, or when the patrol takes action as a result of immediate observation of an event we may say that a transaction is taking place across the interface between the police suprasystem, on the one hand, and some other system, for instance an individual personality system, family system, voluntary association or commercial system.

The patrol is by no means concerned with community-wide norms exclusively. Many of its activities occur in private places into which it has been invited, and into which, without invitation, it could not otherwise venture (Stinchcombe, 1963-64). While in a particular case the basis for its action may be a general community norm, the immediate cause of its action is the specific system norm. Thus it ejects not all boyfriends from the private territory of girlfriends, but only from the territory of girlfriends who call them. The basic norm involved is not that of private property, but rather the boundary perceived in the case of the specific personality system, the girlfriend. It is she, not the police, who decides that the boyfriend is not wanted.

System Output and the Formal Theory of Codes

A coding system of interaction is a set of categories which are used to "measure" the reality being observed. Measure is perhaps an overstatement. "It is always important to distinguish between a physical property... and a ... magnitude of that property. When talking of measurement, any statements we make should be scientific statements, but we may discuss properties, attributes and qualities in a number of ways" (Cherry, 1957). When an observer codes a certain category he means that the referent of that category is present in the reality he is observing.

The code then represents a way of measuring the state of the outputs of the patrol and citizen systems at successive intervals. This (and to the author's knowledge every known interaction code) describes a closed system. "The system now means, not a thing, but a list of variables..." (Ashby, 1956: 31). The reason the system is closed is that the category list is exhaustive. There is no code which is "emergent," i.e., one which says, in effect, "there is something new here which none of these codes covers." Each time a code is used it may be interpreted as descriptive of the state of one of the systems.

A Stochastic Model of the Interaction

The interaction code used in the study contained many elements which measured, at least in the nominal sense, the state of outputs of each system. In this paper we whall be concerned only with a collapsed subset of the code, the citizen-officer politeness scale (COPS) (for a full description of the revised code see Sykes, 1972). Carefully trained observers rated each interact of officers and citizens during field observation of more than 2000 encounters. The original COPS code was a five point rating of the politeness of an officer addressing a citizen or a citizen addressing an officer. Reliability tests using Cohen's k (Cohen, 1960) indicated that the five point scale was not sufficiently reliable, but that when the three ratings of politeness and the two ratings of impoliteness were collapsed into two categories, polite or impolite, a coefficient of about .80 was obtained, adequate for analysis of quantitative field data. Thus each system's output could be said to be in one of two states: polite or impolite. The output in every case was directed towards the other system.

It is possible to place the antecedent outputs of one system in a matrix together with the consequent outputs of the other system. Since each statement of each system addressed to the other system was coded, the state of each was known throughout the duration of the interaction. The total number of transitions from the state of the antecedent system to the state of the consequent system was then calculated. Since what is consequent at one step becomes antecedent at the next step two matrices are necessary: one for those instances in which citizen is antecedent and patrol consequent; and another for those instances in which the patrol is antecedent and the citizen consequent. Each matrix may be considered a stochastic matrix since each is square, and each row may be treated as a probability vector. Following Hertel (1968) the two matrices may be combined into a larger square matrix representing the interaction between the two systems.

FIGURE 1 ABOUT HERE

The data were then examined to determine whether they possessed the properties of a Markov chain.

The first property necessary, that each outcome belong to a finite set of outcomes is self-evident. Each officer state and each citizen state may be either polite, or impolite, but not both. There are only two possible states for each system.

The second property necessary is that the process be dependent at most upon the immediately preceding step. The "immediately preceding step" may be of one or more orders. In Figure 2 the concept of order as applied to the data under consideration is illustrated.

FIGURE 2 ABOUT HERE

If a chain were of zero order the state PI would be completely independent of the preceding state. A first order chain is one in which the state PI is dependent only on the immediately preceding state CI. A second order chain is one in which the state PI can be more accurately predicted from knowledge of the two preceding states, CI and PI, than from knowledge of only CI, and so on.

First it was necessary to determine whether a higher order was significantly different from a lower order in the dependency relation between an antecendent and a consequent state. A test which utilizes the X^2 distribution may be utilized to determine the best order (Pena, 1969).

A test of transition stability was then conducted. Are the dependencies similar at every step throughout the chain? Wherever you enter the chain, the probability of, for instance, PP-CP leading to PI should be approximately the same. Again, the stability of the transitions may be tested utilizing the X^2 distribution. Only if there are no significant differences between transitions at various stages of the chain is it possible to say that the probabilities "remain constant throughout the whole sequence" (Hertel, 1968).

Finally, if the data possess the properties of belonging to a finite set of outcomes, dependent upon only the immediately preceding state, and with stable transitions throughout the chain, then a final test may be made comparing actually observed frequencies at some point in the chain with probabilities predicted by the model.

If the process is Markovian one of the substantively interesting questions is how many steps are necessary to go from some particular state to some other particular state, since an immediate transition is not always possible. Another question of possible substantive interest is how long the process is likely to remain in a particular state? Are some states more stable than others?

It is obvious that if a process is to fit a Markovian model the data must pass some rather rigid tests, though these tests are in terms of significant differences, not perfect agreement. These tests are made difficult by the extremely varied nature of the data. Encounters were coded under a wide variety of conditions: whether they were radio calls or on scenes; what the reason for the encounter had been; e.g., crime against property, call for service, domestic dispute, and so on; the role configuration of the citizen system, e.g., only a violator present, or both a violator and a complainant present, or only a complainant present and so on; the characteristics of the citizen participants including sex, status and color. Of the more than two thousand encounters in the data base with officer-citizen interaction there was only a complainant present in about one thousand, a violator present in about 1200 and both a violator and complainant in a small fraction of the 1200. Since encounters lasted from only about a minute to more than an hour the number of stages in each occupied a very wide range. If one puts encounters of different lengths together then the number of transitions is gradually attenuated as later stages of the chain are reached. It is also possible that there are transition variations between encounters of extremely different lengths.

While the substantive model conceptualized the citizen configuration as a system it did not seem reasonable to consider all such systems similar in behavior. There was also the possibility that encounters initiated by citizens differed from those initiated by officers, and that radio calls differed from on scenes. Some preliminary analysis indicated that on scenes initiated by officers might be different in the first few steps from later stages of encounters.

Not only this, but the encounters in which an alleged violator, or an alleged violator and a complainant were present varied from instances in which no legal violation had occurred, to common misdemeanors and felonies. Other means of data analysis had indicated that all of these factors might effect interaction. Even if the officer system outputs are more or less constant, they will be effected by different proportions of outputs of citizen systems. In other words, if a matrix is a model of two different systems in interaction, and one of those systems remains the same no matter which other system is involved, it will still appear to behave differently because the behavior of the other systems is different (Raush, 1972). For instance, if the transition matrix which describes an only violator present system is different from one which describes an only complainant present system, although the matrix of the officer system remains exactly the same, the interaction of the same officer system with the two different citizen systems will produce very different results, results which might mask the actual stability of the officer system under both conditions.

A final limitation was that the programming available was not completely flexible. Data must be available in a form utilizable within the constraints of the program, as well as the economic constraints of computer time.

For all the above reasons it was decided to begin with some rather specific subsets of data: encounters 10-29 steps long, or 30 to 49 steps long, or

50 to 69 steps long, with only a violator present, and police discretion to arrest; and encounters grouped by the same length and role configuration characteristics but where no legal violation had occurred.

Tests for the Order of the Chain

The results displayed in Table 1 are suggestive that the null hypothesis that there is no difference between first and second orders must be rejected, and the hypothesis that the police-citizen interaction chains are second order or greater must be accepted.

TABLE 1 ABOUT HERE

Tests of Transition Stability

In order to estimate the possibility of stability encounters grouped by length and role configuration were divided into sections thirteen stages long. Transitions for the group as a whole were calculated for each thirteen stage section. X^2 was then utilized to test whether the transitions from the same section of encounters of different length or between sections of the same encounter group differed significantly from one another. Stability was inferred where it was possible to accept the null hypothesis. Where there were sampling zeros it was not always possible to make the test.

TABLE 2 ABOUT HERE

Of forty-eight tests displayed in Table 2 thirteen were significant, suggesting instability. Four of the thirteen were CP-OP to either CP or CI. The source of the significance lies in the difference between observed and expected frequencies in the small number of CP-OP CI transitions. There appear to be an unpredictable but small number of cases in which a polite citizen, responded to politely by the officer, then suddenly becomes impolite. The other instances of instability are spread rather evenly across the other possible transitions. On the whole it is possible to conclude that a considerable amount of stability exists in the second order chain, though it is by no means perfect.

Observed and Predicted Frequency Tests

It remains to test whether observed probabilities at some point in the chain differ from the predicted probabilities. Table 3 displays the result of one such test -- that of the ninth power of the transition matrix against the observed distribution.

TABLE 3 ABOUT HERE

It is evident that over all there is no significant difference between the observed and predicted distribution. If encounters are examined individually it is also evident that most do not display significant differences.

Time in State

Once a state of politeness or impoliteness is entered what is the likelihood of remaining in or leaving the state? Table 4 provides data for 152 encounters. It is evident that with one exception politeness states are much more enduring and stable than impoliteness states (politeness states last around four times longer). The one exception has few cases but is thought provoking. It appears that states in which a citizen tries to have the last impolite word are both rare, highly variable and rather apt to last a long time.

Discussion

It has been the author's intent to relate police-citizen encounters to general systems theory and, in turn, to test the fit of the interaction between the systems to a Markov Model. While the fit is not perfect it appears that the interaction observed between officers and citizens approaches that which might be expected if it were akin to a second order Markov chain. The fit is close enough to warrant further refinements and development of the model as well as specification of the conditions under which the model may or may not apply.

Substantively the approximation of the data to the model implies that much police-citizen interaction is highly oriented to immediate responses. A large part of either the officer's or citizen's reaction, in most cases, is dependent upon the other's and his own immediately preceeding statements. This approaches what Jones and Gerard (1967) have termed "mutual contingency", the actors take (at least) their own and the other's response into account. Since most encounters are relatively brief, occur between strangers in an only partially defined situation, and under conditions in which the actors may view each other as unpredictable, such immediate and mutual reactivity may not be unreasonable. Most police-citizen encounters are not deeply embedded in the past. Such lack of embeddedness may account not only for the brief and routine manner in which most occur, but the sudden and rather explosive nature of a few. Mostly they are stable because of the inertia of normative civility. Instability rapidly returns to balance except in the case where the citizen insistes on having the last impolite word, thereby refusing to acknowledge the final respect the officer believes due his role. Because officer and citizen -- usually strangers to one another -- attend mostly to immediate cues, a model which accounts for only the immediate past appears adequate. While these are _ex post facto_ suggestions they warrant testing against future data.

FIGURE 1

MATRIX REPRESENTATION OF THE TWO SYSTEMS

		Officer		Citizen	
		Polite	Impolite	Polite	Impolite
Officer	Polite	0		PP	PI
	Impolite			IP	II
Citizen	Polite	PP	PI	0	
	Impolite	IP	II		

FIGURE 2

ILLUSTRATION OF THE POSSIBLE ORDERS OF A HYPOTHETICAL CHAIN OF POLICE-CITIZEN INTERACTION

PP-CP-PP-CP-PI-CI-PI-CP-PP-CP

0.

1.

2.

3.

PP - Officer Polite

CP - Citizen Polite

PI - Officer Impolite

CI - Citizen Impolite

TABLE 1

SELECTED X^2 VALUES AND LEVEL OF SIGNIFICANCE FOR

DIFFERENCES BETWEEN OBSERVED AND EXPECTED FREQUENCIES

Number of Encounters	Total Length in Stages	Division of Length	X^2	p.	d.f.
24	10 - 29	first half	34.559	$< .001$	2
24	10 - 29	second half	29.718	$< .001$	2
12	30 - 49	first third	1.291	n.s.	2
12	30 - 49	second third	11.312	$< .001$	2
12	30 - 49	third third	21.427	$< .001$	2
10	50 - 69	first fifth	17.034	$< .001$	2
10	50 - 69	second fifth	21.235	$< .001$	2
10	50 - 69	third fifth	79.698	$< .001$	2

TABLE 2

INTERSECTION AND INTRASECTION TESTS OF STABILITY

FOR SELECTED GROUPS OF ENCOUNTERS

2a

Intrasection Transistions by Encounter

Sections	Encounter N	Code Transition	X^2	d.f.	p.
1/2 - 2/2	58	CP-OP	9.0572	1	< .005
1/2 - 2/2	58	OP-CP	.2549	1	n.s.
1/2 - 2/2	58	CP-OI	.0000	1	n.s.
1/2 - 1/2	58	OP-CI	6.635	1	< .01
1/2 - 1/2	58	CI-OP	.0000	1	n.s.
1/2 - 1/2	58	OI-CP	1.48	1	n.s.
1/2 - 1/2	58	CI-OI	2.2671	1	n.s.
1/2 - 1/2	58	OI-CI	1.08	1	n.s.
1/3 - 2/3 - 3/3	22	CP-OP	6.423	2	< .05
1/3 - 2/3 - 3/3	22	OP-CP	2.685	2	n.s.
1/3 - 2/3 - 3/3	22	CP-OI	1.612	2	n.s.
1/3 - 2/3 - 3/3	22	OP-CI	2.8	2	n.s.
1/3 - 2/3 - 3/3	22	CI-OP	15.571	2	< .005
1/3 - 2/3 - 3/3	22	OI-CP	4.607	2	n.s.
1/3 - 2/3 - 3/3	22	CI-OI	2.261	2	n.s.
1/3 - 2/3 - 3/3	22	OI-CP	1.734	2	n.s.
1/5 - 2/5 - $\frac{3+4+5}{5}$	10	CP-OP	.7975	2	n.s.
1/5 - 2/5 - $\frac{3+4+5}{5}$	10	OP-CP	4.13	2	n.s.
1/5 - 2/5 - $\frac{3+4+5}{5}$	10	CP-OI	.875	2	n.s.
1/5 - 2/5 - $\frac{3+4+5}{5}$	10	OP-CI	5.5	2	n.s.
1/5 - 2/5 - $\frac{3+4+5}{5}$	10	CI-OP	.1170	2	n.s.
1/5 - 2/5 - $\frac{3+4+5}{5}$	10	OI-CP	1.555	2	n.s.
1/5 - 2/5 - $\frac{3+4+5}{5}$	10	CI-OI	6.319	2	< .05

Intersection Transition Comparison for Equivalent Sections
in Three Groups of Different Length Encounters

Section	Code Transition	X^2	d.f.	p.
1	CP-OP	7.3862	2	< .01
1	OP-CP	.8423	2	n.s.
1	CP-OI	2.0408	2	n.s.
1	OP-CI	4.7932	2	n.s.
1	CI-OP	.1296	2	n.s.
1	OI-CP	2.2710	2	n.s.
1	CI-OI	4.4722	2	n.s.
1	OI-CI	2.4352	2	n.s.
2	CP-OP	6.1816	2	< .02
2	OP-CP	2.2674	2	n.s.
2	CP-OI	1.3621	2	n.s.
2	OP-CI	4.4457	2	n.s.
2	CI-OP	.7475	2	n.s.
2	OI-CP	3.1124	2	n.s.
2	CI-OI	4.3903	2	n.s.
2	OI-CI	4.3874	2	n.s.
3+	CP-OP	2.1586	1	n.s.
3+	OP-CP	8.8367	1	< .005
3+	CP-OI	.3025	1	n.s.
3+	OP-CI	4.7447	1	< .05
3+	CI-OP	20.0767	1	< .005
3+	OI-CP	1.5132	1	n.s.
3+	CI-OI	14.1217	1	< .005
3+	OI-CI	4.5324	1	< .05

TABLE 3

TESTS FOR DIFFERENCES BETWEEN OBSERVED AND PREDICTED PROBABILITIES AT EIGHTH STAGE OF THE CHAIN FOR SELECTED ENCOUNTERS

Number of Encounters	Total Number of Stages in All	X^2	d.f.	p.
13	456	2.58	23	n.s.
44	1381	2.94	23	n.s.
8	235	4.02	21	n.s.
5	224	13.90	11	n.s.

TABLE 4

TIME* IN STATE FOR 152 POLICE-CITIZEN ENCOUNTERS

State	Number of Periods of Time in State	Average Time in State	Standard Deviation	Variance
CP-CP	137	6.0	10.5	110.8
CP-OP	41	11.8	11.8	139.3
OP-OP	96	9.0	12.1	145.3
OP-CP	78	18.3	15.2	230.7
CI-CI	69	2.1	2.3	5.2
CI-OI	18	3.4	2.3	5.1
OI-OI	144	1.8	2.7	7.0
OI-CI	7	15.1	15.8	249.6

* Time in this case is defined as the number of consecutive identical measures of the state. The periods are also distinguished by initial and last component of the period (O = officer; C = citizen).

FOOTNOTES

1. The references are only illustrative - See V. J. Gupta, with Richard E. Sykes and John P. Clark et. al., The Local Police in the United States--An Annotated Bibliography. Observations 4, Mimeo, December 1972, pp. 258.

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