Chapter 31

Observations of Behavior and Sociometry

Everyone observes the actions of others. We look at other persons and listen to them talk. We infer what others mean when they say something, and we infer the characteristics, motivations, feelings, and intentions of others on the basis of these observations. We say, "He is a shrewd judge of people," meaning that his observations of behavior are keen and that we think his inferences of what lies behind the behavior are valid. This day-to-day kind of observation of most people, however, is unsatisfactory for science. Social scientists must also observe human behavior, but they are dissatisfied with uncontrolled observations. They seek reliable and objective observations from which they can draw valid inferences. They treat the observation of behavior as part of a measurement procedure: they assign numerals to objects, in this case human behavioral acts or sequences of acts, according to rules.

This seems simple and straightforward. Yet evidently it is not: there is much controversy and debate about observation and methods of observation. Critics of the point of view that observations of behavior must be rigorously controlled—the point of view espoused in this chapter and elsewhere in this book—claim that it is too narrow and artificial. Instead, say the critics, observations must be naturalistic: observers must be immersed in ongoing realistic and natural situations and must observe behavior as it occurs in the raw, so to speak. As we will see, however, observation of behavior is extremely complex and difficult.

Basically, there are two modes of observation: we can watch people do and say things and we can ask people about their own actions and the behavior of others. The principal ways of getting information are either by experiencing something directly, or by having someone tell us what happened. In this chapter we are concerned mainly with seeing and hearing events and observing behavior, and solving the scientific problems that spring from such observation. We also examine, if briefly, a method for assessing the interactions and interrelations of group members: sociometry. Sociometry is a special and valuable form of observation: group members who of course observe each other record their reactions to each other so that researchers can assess the sociometric status of groups.

PROBLEMS IN OBSERVING BEHAVIOR

The Observer

The major problem of observational behavior is the observer himself. One of the difficulties with the interview, recall, is the interviewer, because he is part of the measuring instrument. This problem is almost nonexistent in objective tests and scales. In behavioral observation the observer is both a crucial strength and a crucial weakness. Why? The observer must digest the information derived from observations and then make inferences about constructs. He observes a certain behavior, say a child striking another child. Somehow he must process this observation and make an inference that the behavior is a manifestation of the construct "aggression" or "aggressive behavior," or even "hostility." The strength and the weakness of the procedure is the observer's powers of inference. If it were not for inference, a machine observer would be better than a human observer. The strength is that the observer can relate the observed behavior to the constructs or variables of a study; he brings behavior and construct together. One of the recurring difficulties of measurement is to bridge the gap between behavior and construct.

The basic weakness of the observer is that he can make quite incorrect inferences from observations. Take two extreme cases. Suppose, on the one hand, that an observer who is strongly hostile to parochial school education observes parochial school classes. It is clear that his bias will invalidate the observation. He can easily rate an adaptable teacher as somewhat inflexible because he perceives parochial school teaching as inflexible. Or he may judge the actually stimulating behavior of a parochial school teacher to be dull. On the other hand, assume that an observer can be completely objective and that he knows nothing whatever about public or parochial education. In a sense any observations he makes will not be biased, but they will be inadequate. Observation of human behavior requires competent knowledge of that behavior, and even of the meaning of the behavior.

There is, however, another problem: the observer can affect the objects of observation simply by being part of the observational situation. Actually and fortunately, this is not a severe problem. Indeed, it is more of a problem to the uninstructed, who seem to believe that people will act differently, even artificially, when observed. Observers seem to have little effect on the situations they observe. Individuals and groups seem to adapt rather

\[\text{In their excellent chapter on observation in classrooms, Medley and Mitzel say that the observer should use the least judgment possible: only a judgment 'needed to perceive whether the behavior has occurred or not.' This means, of course, the least inference possible. While their argument is well taken, it is perhaps too strong. D. Medley and H. Mitzel, "Measuring Classroom Behavior by Systematic Observation." In N. Gage, ed., Handbook of Research in Teaching, Vol. II, ed. D. Meader, 1963, chap. 6 (see pp. 252-253). R. Wapnick and R. Lippman, "Systematic Observational Techniques," in G. Lindzey and E. Aronson, eds., The Handbook of Social Psychology, 2d ed. Reading, Mass.: Addison-Wesley, 1968, vol. II, chap. 13, p. 359, supports Medley and Mitzel's view. At the same time, he argues for a more active role of the observer, as Connell and Kahn argued for a more active role of the interviewer (see Chapter 18).} \]
Validity and Reliability

On the surface, nothing seems more natural when observing behavior than to believe that we are measuring what we say we are measuring. When an interpretive burden is put on the observer, however, validity may suffer (as well as reliability). The greater the burden of interpretation, the greater the validity problem. (This does not mean, however, that no burden of interpretation should be put on the observer.)

A simple aspect of the validity of observation measures is their predictive power. Do they predict relevant criteria dependably? The trouble, as usual, is in the criteria. Independent measures of the same variables are rare. Can we say that an observational measure of teacher behavior is valid because it correlates positively with superiors’ ratings? We might have an independent measure of self-oriented needs, but would this measure be an adequate criterion for observations of such needs?

An important clue to the study of the validity of behavioral observation measures would seem to be construct validity. If the variables being measured by an observational procedure are embedded in a theoretical framework, then certain relations should exist. Do they indeed exist? Suppose our research involves Bandura’s self-efficacy theory and that we have constructed an observation system whose purpose is to measure performance competence. The theory says, in effect, that perceived self-efficacy, the self-perception of competence, affects the competence of a person’s actual performance: the higher one’s self-efficacy, the higher the performance competence. If we find that self-perception of competence and measures of actual observed competence of doing certain prescribed tasks is positive and substantial, then the hypothesis derived from the theory is supported. But this is also evidence of the construct validity of the observation system.

The reliability of observation systems is a simpler matter, though by no means an easy one. It is often defined as agreement among observers. From this viewpoint, film and tape records can help achieve very high reliability. Agreement among observers, however, has potential defects. For example, the magnitude of an index of agreement is partly due to chance agreement and thus needs correction. Perhaps the safest course to follow is to use different methods of assessing reliability just as we would with any measures used in behavioral research: agreement of observers, reliability, and the analysis of variance approach.

Categories

The fundamental task of the observer is to assign behaviors to categories. From our earlier work on partitioning, recall that categories must be exhaustive and mutually exclusive. To satisfy the exhaustiveness condition, one must first define $U$, the universe of behaviors to be observed. In some observation systems, this is not hard to do. McGee and Snyder, testing the hypothesis that people who salt their food before they taste it perceive control of behavior as being more from within the individual (dispositional control) than from the environment (situational control), simply observed subjects’ salting of food in restaurants. In other observation systems it is more difficult. Many or most of the observation systems cited in the huge anthology of observation instruments, *Mirrors for Behavior*, are complex and hardly easy to use.

In keeping with the emphasis of this book that the purpose of most observation is to measure variables, we cite a classroom observation system from the highly interesting, even creative, work of Kounin and his colleagues. The system reported is more complex than the salt-tasting observation system but much less complex than many classroom observation systems. The variable observed was task-involvement, which was observed by videotaping 596 lessons and then observing playbacks of the tapes to obtain the involvement measures. These measures were categorized as high task-involvement and low task-involvement. The authors also measured continuity in lessons by creating categories that reflected greater or lesser continuity in lessons. When the children’s behavior was observed, they used the categories to record the pertinent observed behaviors.

Units of Behavior

What units to use in measuring human behavior is still an unsettled problem. Here one is often faced with a conflict between reliability and validity demands. Theoretically, one can attain a high degree of reliability by using small and easily observed and recorded units. One can attempt to define behavior quite operationally by listing a large number of behavioral acts, and can thus ordinarily attain a high degree of precision and reliability. Yet in so doing one may also have so reduced the behavior that it no longer bears much resemblance to the behavior one intended to observe. Thus validity may be lost.

On the other hand, one can use broad “natural” definitions and perhaps achieve a high degree of validity. One might instruct observers to observe cooperation and define

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6 Ibid., p. 122.
7 Medley and Mikel, op. cit., pp. 309ff. give a thorough exposition of the reliability of ratings in an analysis of variance framework. But their discussion is difficult, requiring considerable statistical background. (See chap. 26, above.) Hollebneck discusses reliability of observations when measures are normal. A. Hollebneck, "Problems of Reliability in Observational Research." In G. Sackett, ed., *Observing Behavior: Vol. 2. Data Collection and Analysis Methods*. Baltimore: University Park Press, 1978, chap. 5 (pp. 79-98). See, also, Welch, op. cit., pp. 403-406, and G. Rowley, "The Reliability of Observational Measures," *American Educational Research Journal*, 13 (1976), 51-59. Assessing reliability and agreement among observers are especially difficult problems of direct observation because the usual statistics depend on the assumption that measures are independent—and they are often not independent. It is likely that approaches to these problems will change radically in the coming decade with the rapid development of multivariate methods and time-series analysis and the availability of computer programs to expedite both recording and analysis of observational data. Such programs should become available for microcomputers and consequently be convenient and cheap though perhaps not easy to use.

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8 M. McGee and M. Snyder, "Attribution and Behavior: Two Field Studies," *Journal of Personality and Social Psychology*, 32 (1975), 185-190. The correlation between food salting and control attribution was .71.
9 A. Simon and E. Boyer, *Mirrors for Behavior*. Philadelphia: Research for Better Schools, 1970. This work has 14 volumes of behavior observation instruments! Most of these, 67 of 79, are for educational observations. Readers who intend to use behavior observation in their research should consult these volumes, especially vol. 1, which contains a general discussion, pp. 1-24.
cooperative behavior as "accepting other persons' approaches, suggestions, and ideas; working harmoniously with others toward goals," or some such rather broad definition. If observers have had group experience and understand group processes, then it might be expected that they could validly assess behavior as cooperative and uncooperative by using this definition. Such a broad, even vague, definition enables the observer to capture, if he can, the full flavor of cooperative behavior. But its considerable ambiguity allows differences of interpretation, thus probably lowering reliability.

Some researchers who are strongly operational in their approach insist upon highly specific definitions of the variables observed. They may list a number of specific behaviors for the observer to observe. No others would be observed and recorded. Extreme approaches like this may produce high reliability, but they may also miss part of the essential core of the variables observed. Suppose ten specific types of behavior are listed for cooperativeness. Suppose, too, that the universe of possible behaviors consists of 40 or 50 types. Clearly, important aspects of cooperativeness will be neglected. While what is measured may be reliably measured, it may be quite trivial or partly irrelevant to the variable cooperativeness.

This is the molar-molecular problem of any measurement procedure in the social sciences. The molar approach takes larger behavioral wholes as units of observation. Complete interaction units may be specified as observational targets. Verbal behavior may be broken down into complete interchanges between two or more individuals, or into whole paragraphs or sentences. The molecular approach, by contrast, takes smaller segments of behavior as units of observation. Each interchange or partial interchange may be recorded. Units of verbal behavior may be words or short phrases. Molar observers start with a general broadly defined variable, as given earlier, and observe and record a variety of behavior units on the one rubric. They depend on experience and knowledge to interpret the meaning of the behavior they observe. Molecular observers, on the other hand, seek to push their own experience, knowledge, and interpretation out of the observational picture. They record what they see—and no more.

Observer Inference

Observation systems differ on another important dimension: the amount of inference required of the observer. Molecular systems require relatively little inference. The observer simply notes that an individual does or says something. For example, a system may require the observer to note each interaction unit, which may be defined as any verbal interchange between two individuals. If an interchange occurs, it is noted; if it does not occur, it is not noted. Or a category may be "Strikes another child." Every time one child strikes another it is noted. No inferences are made in such systems—if, of course, it is ever possible to escape inferences (for example, "strikes"). Pure behavior is recorded as nearly as possible.

Observer systems with such low degrees of observer inference are rare. Most systems require some degree of inference. An investigator may be doing research on board of education behavior and may decide that a low inference analysis is suited to the problem and use observation items like "Suggests a course of action," "Interrupts another board member," "Asks a question," "Gives an order to superintendent," and the like. Since such items are comparatively unambiguous, the reliability of the observation system should be substantial.

Systems with higher degrees of inference required of the observer are more common and probably more useful in most research. The high inference observation system gives the observer labeled categories that require greater or lesser interpretation of the observed behavior. For example, suppose that dominance is to be measured. It can be defined as attempts by an individual to show intellectual (or other) superiority over other individuals, with little recognition of group goals and the contributions of others. This will of course require a high degree of observer inference, and observers will have to be trained so that there is agreement on what constitutes dominant behavior. Without such training and agreement—and probably observer expertise in group processes—reliability can be endangered. Similar remarks are pertinent when we try to measure many psychological and sociological variables: cooperation, competition, aggressiveness, democracy, verbal aptitude, achievement, and social class, for example.

It is not possible to make flat generalizations on the relative virtues of systems with different degrees of inference. Probably the best advice to the neophyte is to aim at a medium degree of inference. Too vague categories with too little specification of what to observe put an excessive burden on the observer. Different observers can too easily put different interpretations on the same behavior. Too specific categories, while they cut down ambiguity and uncertainty, may tend to be too rigid and inflexible, even trivial. Better than anything else, the student should study various successful systems, paying special attention to the behavior categories and the definitions (instructions) attached to the categories for the guidance of the observer.

Generality or Applicability

Observation systems differ considerably in their generality, or degree of applicability to research situations other than those for which they were originally designed. Some systems are quite general: they are designed for use with many different research problems. The well-known Bales group interaction analysis is one such general system. This is a low inference system in which all verbal and nonverbal behavior, presumably in any group, can be categorized into one of twelve categories: "shows solidarity," "agrees," "asks for opinion," and so on. The twelve categories are grouped in three larger sets: social-emotional-positive; social-emotional-negative; task-neutral.

Some systems, however, were constructed for particular research situations to measure specific variables. The salting food example, above, is quite specific, hardly applicable in other situations. The Kounin and Doyle system, while specifically constructed for Kounin's research, can be applied in many classroom situations. Indeed, most systems devised for specific research problems can probably be used, often with modification, for other research problems.

I want to emphasize that "small" observation systems can be used to measure specific variables. Suppose, for instance, that the attentiveness of elementary school pupils is a key variable in a theory of school achievement. Attentiveness (as a trait or habit) is and of itself has little effect on achievement: let's say the correlation is zero. But, the theory claims, it is a key variable because, with a certain method of teaching, it interacts with the method and has a pronounced indirect effect on achievement. Assuming that this is so, we must measure attentiveness. It seems clear that we will have to observe pupil behavior while the method in question and a "control" method are used. In such a case, we will have to find or devise an observation system that focuses on attentiveness. In assessing the influence of classroom environment, for example, Kenes found it necessary to measure

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attentiveness.11 He did this by observing students who were required to attend to tasks prescribed by the teacher. Scores that indicated attentiveness or the lack of it were assigned. This "small" observation system was reliable and apparently valid. It is likely that such targeted systems will be increasingly used in behavioral research, especially in education.

Sampling of Behavior

The last characteristic of observations, sampling, is, strictly speaking, not a characteristic. It is a way of obtaining observations. Before using an observation system in actual research, when and how the system will be applied must be decided. If classroom behaviors of teachers are to be observed, how will the behaviors be sampled? Will all the specific behaviors in one class period be observed, or will specified samples of specified behaviors be sampled systematically or randomly? In other words, a sampling plan of some kind must be devised and used.

There are two aspects of behavior sampling: event sampling and time sampling.12 Event sampling is the selection for observation of integral behavioral occurrences or events of a given class.13 Examples of integral events are temper tantrums, fights and quarrels, games, verbal interchanges on specific topics, classroom interactions between teachers and pupils, and so on. The investigator who is pursuing events must either know when the events are going to occur and be present when they occur, or as with classroom events, or wait until they occur, as with quarrels.

Event sampling has three virtues: One, the events are natural life situations and thus possess an inherent validity not ordinarily possessed by time samples. Two, an integral event possesses a continuity of behavior that the more piecemeal behavioral acts of time samples do not possess. If one observes a problem-solving situation from beginning to end, one is witnessing a natural and complete unit of individual and group behavior. By so doing, one achieves a whole and realistic larger unit of individual or social behavior. As we saw in an earlier chapter when field experiments and field studies were discussed, natural situations have an impact and a closeness to psychological and social reality that experiments do not usually have.

A third virtue of event sampling lies in an important characteristic of many behavioral events: they are sometimes infrequent and rare. For example, one may be interested in decisions made in administrative or legislative meetings. Or one may be interested in the ultimate step in problem solving. Teachers' disciplinary methods may be a variable.

11. J. Reeves, Educational Environment and Student Achievement. Melbourne: Australian Council for Educational Research, 1977, pp. 62–65. This study also used a larger carefully conceived and constructed observation system; see pp. 89–100. The focus of the study, however, was on "process" variables: achievement press (e.g., completion of homework), work habits and order, affiliation and warmth in the classroom, and so on. An influential school of thought in educational research emphasizes the importance of climate. Most of the measure of climate, however, is accomplished with questionnaires that measure climate by asking questions of students and only rarely by direct observation. For a good review see: C. Anderson, "The Search for School Climate: A Review of the Research," Review of Educational Research, 32 (1962), 388–420. Another strong influence has been family environment research. Marjoribanks outlines the background and origins of this research: K. Marjoribanks, Families and Their Learning Environments: An Empirical Analysis. London: Routledge & Kegan Paul, 1979, chap. 2.


13Wright, op. cit., p. 104.

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Such events and many others are relatively infrequent. As such, they can easily be missed by time sampling; they therefore require event sampling.14 Time sampling is the selection of behavioral units for observation at different points in time. They can be selected in systematic or random ways to obtain samples of behaviors. A good example is teacher behavior. Suppose the relations between certain variables like teacher alertness, fairness, and initiative, on the one hand, and pupil behavior, i.e., attentiveness, on the other hand, are studied. We may select random samples of teachers and then take time samples of their behavioral acts. These time samples can be systematic: three five-minute observations at specified times during each of, say, five class hours, the class hours being the first, third, and fifth periods one day and the second and fourth periods the next day. Or they can be random five-five minute observation periods selected at random from a specified universe of five-minute periods. Obviously, there are many ways that time samples can be set up and selected. As usual, the way such samples are chosen, their length, and their number must be influenced by the research problem.

Time samples have the important advantage of increasing the probability of obtaining representative samples of teacher behavior. This is true, however, only of behaviors that occur fairly frequently. Behaviors that occur infrequently have a high probability of escaping the sampling net, unless huge samples are drawn. Creative behavior, sympathetic behavior, and hostile behavior, for example, may be quite infrequent. Still, time sampling is a positive contribution to the scientific study of human behavior.

Time samples, as implied earlier, suffer from lack of continuity, lack of adequate context, and perhaps naturalness. This is particularly true when small units of time and behavior are used. Still, there is no reason that event sampling and time sampling cannot sometimes be combined. If one is studying classroom recitations, one can draw a random sample of the class periods of one teacher at different times and observe all recitations during the sampled periods, observing each recitation in its entirety.

RATING SCALES16

To this point, we have been talking only about the observation of actual behavior. Observers look at and listen to the objects of direct observation. They sit in the classroom and observe teacher-pupil and pupil-pupil interactions. Or they may watch and listen to a group of children solving a problem behind a one-way screen. There is another class of observational behavior, however, that needs to be mentioned. This type of observation

14If one takes the more active view of observation advocated by Weiss (see footnote 11), however, one can arrange situations to ensure more frequent occurrence of rare events.

15In a fascinating study of leadership and the power of group influence with small children, Merri points out that time sampling would show only leaders giving orders and the group obeying, whereas prolonged observations would show the inner workings of ordering and obeying. F. Merri, "Group Leadership and Institutionatization," Human Relations, 2 (1949), 22–29.


Although rating scales were mentioned earlier in this book, they were not systematically discussed. In reading what follows, the student should bear in mind that rating scales are really objective scales. As such, they might have been included in Chapter 29. Their discussion was reserved for this chapter because the discussion of Chapter 29 focused mainly on measures responded to by the subject being measured. Rating scales, on the other hand, are measures of individuals and their reactions, characteristics, and behaviors by observers. The contrast, then, is between the subject as he sees himself and the subject as others see him. Rating scales are also used to measure psychological objects, products, and stimuli, such as handwriting, concepts, essays, interview protocols, and objective test materials.
will be called remembered behavior or perceived behavior. It is conveniently considered
under the topic of rating scales.

In measuring remembered or perceived behavior, we ordinarily present observers with
an observation system in the form of a scale of some kind and ask them to assess an object
on one or more characteristics, the object not being present. In order to do this, they must
make assessments on the basis of past observations or on the basis of perceptions of what
the observed object is like and how it will behave. A convenient way to measure both
actual behavior and perceived or remembered behavior is with rating scales.

A rating scale is a measuring instrument that requires the rater or observer to assign
the rated object to categories or continua that have numerals assigned to them. Rating
scales are perhaps the most ubiquitous of measuring instruments probably because they
are seemingly easy to construct and, more important, easy and quick to use. Unfortu-
nately, the apparent ease of construction is deceptive and the ease of use carries a heavy
price: lack of validity due to a number of sources of bias that enter into rating measures.
Still, with knowledge, skill, and care, ratings can be valuable.

Types of Rating Scales

There are four or five types of rating scales. Two of these types were discussed in Chapter
29; check lists and forced-choice instruments. We consider now only three types and their
characteristics. These are the category rating scale, the numerical rating scale, and the
graphic rating scale. They are quite similar, differing mainly in details.

The category rating scale presents observers or judges with several categories from
which they pick the one that best characterizes the behavior or characteristic of the object
being rated. Suppose a teacher’s classroom behavior is being rated. One of the character-
istics rated, say, is alertness. A category item might be:

How alert is she? (Check one.)

Very alert
Alert
Not alert
Not at all alert

A different form uses condensed descriptions. Such an item might look like this:

Is she resourceful? (Check one.)

Always resourceful; never lacking in ideas
Sometimes flounders for ideas
Unresourceful; rarely has ideas

Numerical rating scales are perhaps the easiest to construct and use. They also yield
numbers that can be directly used in statistical analysis. In addition, because the numbers
may represent equal intervals in the mind of the observer, they may approach interval
measurement.17 Any of the above category scales can be quickly and easily converted to
numerical rating scales simply by affixing numbers before each of the categories. The
numbers 3, 2, 1, 0, or 4, 3, 2, 1, can be affixed to the alertness item above. A convenient
method of numerical rating is to use the same numerical system, say 4, 3, 2, 1, 0, with
each item. This is of course the system used in summated-rating attitude scales. In rating
scales, it is probably better, however, to give both the verbal description and the num-

17Guilford, op. cit., p. 264.

18Ibid., p. 268.

19Guilford’s advice is invaluable: ibid., pp. 264–268 and 293–296.

20Ibid., p. 279.

Weaknesses of Rating Scales

Ratings have two serious weaknesses, one of them extrinsic, the other intrinsic. The
extrinsic defect is that they are seemingly so easy to construct and use that they are used
indiscriminately, frequently without knowledge of their intrinsic defects. We will not
pause to mention the errors that can creep into the unskilful construction and use of rating
scales. Rather, we warn the reader against seizing them for any and all measurement
needs. One should first ask the question: Is there a better way to measure my variables? If
so, use it. If not, then study the characteristics of good rating scales, work with painstaking
and subject rating results to empirical test and adequate statistical analysis. 18

The intrinsic defect of rating scales is their proneness to constant or biased error. This
is not new to us, of course. We met this problem when considering response set. With
ratings, however, it is particularly threatening to validity. Constant rating error takes
several forms, the most pervasive of which is the famous halo effect. This is the tendency
to rate an object in the constant direction of a general impression of the object. Everyday
cases of halo are: believing a man to be virtuous because we like him; giving high praise to
Republican presidents and damning Democratic ones.

Halo manifests itself frequently in measurement, especially with ratings. Professors
assess the quality of essay test questions higher than they should because they like the
testee. Or they may rate the second, third, and fourth questions higher (or lower) than they
should because the first question was well answered (or poorly answered). Teacher eval-
uation of children’s achievement is influenced by the children’s docility or lack of docility
of halo. In rating individuals on rating scales, there is a tendency for the rating of one characteristic to influence the ratings of other characteristics. Halo is
difficult to avoid. It seems to be particularly strong in traits that are not clearly defined,
not easily observable, and that are morally important. 20

Two important sources of constant error are the error of severity and the error of
leniency. The error of severity is a general tendency to rate all individuals too low on all
characteristics. This is the tough marker: “Nobody gets an A in my classes.” The error of
leniency is the opposite general tendency to rate too high. This is the good fellow who
loves everybody—and the love is reflected in the ratings.

An exaggerating source of invalidity in ratings is the error of central tendency, the
general tendency to avoid all extreme judgments and rate right down the middle of a rating

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In graphic rating scales lines or bars are combined with descriptive phrases. The
alertness item, just discussed, could look like this in graphic form:

<table>
<thead>
<tr>
<th></th>
<th>Very</th>
<th>Alert</th>
<th>Not</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>rating</td>
<td>alert</td>
<td>alert</td>
<td>alert</td>
<td>alert</td>
</tr>
</tbody>
</table>

Such scales have many varieties: vertical segmented lines, continuous lines, unmarked lines,
lines broken into marked equal intervals (as above), and others. These are probably
the best of the usual forms of rating scales. They fix a continuum in the mind of the
observer. They suggest equal intervals. They are clear and easy to understand and use.
Guilford overpowers them a bit when he says, “The virtues of graphic rating scales are
many; their faults are few,” but his point is well taken. 19
scale. It manifests itself particularly when raters are unfamiliar with the objects being rated.

There are other less important types of error that will not be considered. More important is how to cope with the types listed above. This is a complex matter that cannot be discussed here. The reader is referred to Guilford's chapter in Psychometric Methods where many devices for coping with error are discussed in detail.22

Rating scales can and should be used in behavioral research. Their unwarranted, expedient, and unsophisticated use has been rightly condemned. But this should not mean general condemnation. They have virtues that make them valuable tools of scientific research: they require less time than other methods; they are generally interesting and easy for observers to use; they have a wide range of application; they can be used with a large number of characteristics. It might be added that they can be used as adjuncts to other methods. That is, they can be used as instruments to aid behavioral observations, and they can be used in conjunction with other objective instruments, with interviews, and even with projective measures.

EXAMPLES OF OBSERVATION SYSTEMS

Three or four observation systems were mentioned earlier. Other behavioral observation systems are summarized below to help the student get a feeling for the variety of systems that are possible and the ways in which such systems are constructed and used. In addition, the student may gain further understanding of when behavioral observation is appropriate.

Medley and Mitzel's Classroom Behavior Observation Record

One of the most carefully developed systems of classroom observation is the Observation Schedule and Record (OSCAR), which was designed to permit the recording of as many significant aspects as possible of what goes on in classrooms.23 The individual items were found to group themselves into three relatively independent and reliable dimensions: Emotional Climate, Verbal Emphasis, and Social Organization. That is, the items belonging to each of these dimensions, or factors, were combined and treated as variables. Two items from each of the first two dimensions, respectively, are: "Teacher demonstrates affection for pupil" (positive), "Pupil ignores teacher's question" (negative); "Pupil reads or studies at his seat," "Pupil (or teacher) uses supplementary reading matter." The third dimension reflects social grouping in classes—for example, a class broken up into two or more groups working independently. It has been seen that this is a low inference system.

Medley and Mitzel say that the three dimensions represent what are probably obvious differences between classes, but the OSCAR fails to tap aspects of classroom behavior related to achievement of cognitive objectives. They are probably too harsh on their own system. The three dimensions of OSCAR are important.

Time Sampling of Attending and Disruptive Behavior

In their study of the social status of handicapped children, Morrison, Fomess, and MacMillan used a time-sampling technique to record the behavior of all children in a classroom.24 This involved observing and recording the behavior of each child in turn during six-second intervals until a minimum of ten intervals of each child's behavior each day had been recorded. As part of this procedure, observations of attending and disruptive behavior were made. Attending behavior was defined as eye contact to teacher, to a reciting peer, or to task materials. Disruptive behavior was defined as activity incompatible with on-task activity: talks to peer when not permitted, hits classmate, and so on. Attending and disruptive behaviors were found to influence teachers' ratings of the students' behavior and academic competence.

Observation and Evaluation of College Teaching

In one of the relatively few—and better—studies of college teachers and teaching, Issacson and his colleagues, after considerable preliminary work on items and their dimensions or factors, had college students rate and evaluate their teachers based on their remembered observations and impressions.25 They used a 46-item rating scale and instructed the students to respond according to the frequency of the occurrence of certain behavioral acts and not according to whether the behaviors were desirable or undesirable. Their basic interest was in the dimensions or underlying variables behind the items. They found six such dimensions of which the first they thought to be related to general teaching skill.

Although the six factors are important because they seem to show various aspects of teaching—for example, Structure, which is the instructor's organization of the course and its activities, and Rapport, which is the more interactive aspects of teaching and friendliness—we concentrate on the first. Here are three of the items:

He put his material across in an interesting way.
He stimulated the intellectual curiosity of his students.
He explained clearly and his explanations were to the point.

The most effective item, however, was even more general:

How would you rate your instructor in general (all-around) teaching ability?
a. An outstanding and stimulating instructor
b. A very good instructor
c. A good instructor
d. An adequate, but not stimulating instructor
e. A poor and inadequate instructor

22 Systematic errors can be dealt with to some extent by statistical means. Guilford has worked out an ingenious method using analysis of variance. The basic idea is that variances due to subjects, judges, and characteristics are extracted from the total variance of ratings. The ratings are then corrected. An easier method was outlined by Ebel, who used analysis of variance to reliability of ratings. See Guilford, op. cit.; pp. 280-281, 383, 395-397; R. Ebel, "Estimation of the Reliability of Ratings," Psychométrie, 16 (1951), 407-424.

23 Method, with research data, is described in Medley and Mitzel, op. cit., pp. 278-280.

25 R. Issacson et al., "Dimensions of Student Evaluations of Teaching," Journal of Educational Psychology, 25 (1964), 344-351. A number of similar studies have been published since this study appeared, but it is still one of the best, I think. Note that here we have an observation system that was not devised deliberately to measure variables but rather to help evaluate teaching performance. Nevertheless, its two basic dimensions can of course be used as variables in research. A notable example of studies to evaluate college teachers is that researchers seem not to be aware that the purpose of such observation systems should be the improvement of instruction (or to use their dimensions as research variables) and not for research purposes. See F. Kerlinger, "Student Evaluation of University Professors," School and Society, 99 (1971), 355-356.
While we may question calling this study and others like it observation studies, there is certainly observation, though it is quite different in being remembered and indirect, global and highly inferential, and, finally, much less systematic in actual observation. We ask students to remember and rate behaviors that they may not have paid particular attention to. Nevertheless, the Isaacs et al. and other studies have shown that this form of observation can be reliably used in instructor and course evaluation.

**Behavior Scores (BSs)**

There are a number of important observation systems devised to study group interaction. The best-known is the Bates system mentioned earlier. Borgatta, too, devised a system, called Behavior System Scores (BSs), that is virtually an interaction analysis system. It has the virtues of being brief, fairly simple, and based on factor analysis. Its six categories apparently measure two basic dimensions: Assertiveness and Sociality. Examples of the categories of behavior in each of the factors are: assertions or dominant acts (draws attention, asserts, initiates conversation, etc.) and supportive acts (acknowledges, responds, etc.). Such a system may be useful in behavioral research whose focus is group interaction and behavior—decision-making groups, for example.

**ASSESSMENT OF BEHAVIORAL OBSERVATION**

There is no doubt whatever that objective observation of human behavior has advanced beyond the rudimentary stage. The advances, like other methodological and measurement advances made in the last ten to twenty years, have been striking. The growth of psychometric and statistical maturity and sophistication has been felt in the observation and assessment of actual and remembered behavior. Social scientific research can and will profit from these advances. Many educational research problems, for example, strongly demand behavior observations: children in classrooms interacting with each other and with teachers, administrators and teachers discussing school problems in staff meetings, boards of education working toward policy decisions. Both basic and applied research, especially research involving group processes and group decisions, can profit from direct observation. And it can be used in field studies, field experiments, and laboratory experiments. Here is a methodological approach that is essentially the same in field and laboratory situations.

The difficulty in using full-scale systems, like Medley and Mitze's, has undoubtedly discouraged the use of observation in behavioral research. But observations must be used when the variables of research studies are interactive and interpersonal in nature and when we wish to study the relations between actual behavior, like class management techniques or group interaction, and other behaviors or attribute variables. Important as it is asking about behavior, there is no substitute for seeing, as directly as possible, what people actually do when confronted with different circumstances and different people. Moreover, in much, perhaps most, behavioral research, it is probably not necessary to use the larger observation systems. As shown earlier, smaller systems can be devised for special research purposes. Keeves' limited system was highly appropriate for his purpose. In any case, scientific behavioral research requires direct and indirect observations of behavior, and the technical means of making such observations are becoming increasingly adequate and available. The next decade should see considerable understanding and improvement of methods of observation, as well as their increased meaningful use.

**SOCIOMETRY**

We constantly assess the people we work with, go to school with, live at home with. We judge them for their suitability to work with us, play with us, live with us. And we base our judgments on our observations of their behavior in different situations. We judge, we say, on the basis of our "experience." The form of measurement we now consider, sociometry, is based on these many informal observations. Again, the method is based on remembered observations and the inevitable judgments we make of people after observing them.

**Sociometry and Sociometric Choice**

Sociometry is a broad term indicating a number of methods of gathering and analyzing data on the choice, communication, and interaction patterns of individuals in groups. One might say that sociometry is the study and measurement of social choice. It has also been called a means of studying the attractions and repulsions of members of groups.

A person is asked to choose one or more other persons according to one or more criteria supplied by the researcher: With whom would you like to work? With whom would you like to play? He then makes one, two, three, or more choices among the members of his own group (usually) or of other groups. What could be simpler and more natural? The method works well for kindergartners and for atomic scientists.

Sociometric choice should be rather broadly understood: it may mean "choice of people"; it may mean "choice of lines of communication," "choice of lines of influence," or "choice of minority groups." The choices depend upon the instructions and questions given to individuals. Here is a list of sociometric questions and instructions:

- With whom would you like to work (play, sit next to, and so on)?
- Which two members of this group (age group, class, club, for instance) do you like the most (the least)?
- Who are the three best (worst) pupils in your class?
- Whom would you choose to represent on a committee to improve faculty welfare?
- What four individuals have the greatest prestige in your organization (class, company, team)?
- What two groups of people are the most acceptable (least acceptable) to you as neighbors (friends, business associates, professional associates)?

Obviously, there are many possibilities. In addition, these can be multiplied simply by asking: Who do you think would choose you to . . . and Whom do you think the group would choose to . . . Subjects can also be asked to rank others using sociometric criteria, providing there are not too many to rank. Rating scales can be used. Members of a group or organization can be asked to rate each other using one or more criteria. For example, we can phrase the sociometric instructions something like this: "Here is a list of the members of your group. Rate each according to whether you would like to work with him on a committee to draft a set of bylaws. Use the numbers 4, 3, 2, 1, 0—4 meaning you would like to work with him very much, 0 you would not want to work with him at all."
all, and the other numbers representing intermediate degrees of liking to work with him." Clearly, other methods of measurement can be used. The main difference is that sociometry always has such ideas as social choice, interaction, communication, and influence behind it.

**METHODS OF SOCIOMETRIC ANALYSIS**

There are three basic forms of sociometric analysis: sociometric matrices, sociograms or directed graphs, and sociometric indices. Of methods of sociometric analysis, sociometric matrices, to be defined presently, perhaps contain the most important possibilities and implications for the behavioral researcher. Sociograms are diagrams or charts of the choices made in groups. We shall discuss sociograms or directed graphs very little since they are either used more for practical than for research purposes or their analysis is mathematical and difficult, requiring much more space than we can spare. Sociometric indices are single numbers calculated from two or more numbers yielded by sociometric data. They indicate sociometric characteristics of individuals and groups.

**Sociometric Matrices**

We learned earlier that a matrix is a rectangular array of numbers or other symbols. In sociometry we are usually concerned mainly with square, or \( n \times n \) matrices, \( n \) being equal to the number of persons in a group. Rows of the matrix are labeled \( i \); columns are labeled \( j \); and \( i \) and \( j \), of course, can stand for any number and any person in the group. If we write \( a_{ij} \), this means the entry in the \( i \)th row and \( j \)th column of the matrix, or, more simply, any entry in the matrix. It is convenient to write sociometric matrices in this way. These are matrices of numbers expressing all the choices of group members in any group.

Suppose a group of five members has responded to the sociometric question, "With whom would you like to work on such-and-such a project during the next two months? Choose two individuals." The responses to the sociometric question are, of course, choices. If a group member chooses another group member, the choice is represented by 1. If a group member does not choose another, the lack of choice is represented by 0. (If rejection had been called for, 1 could have been used.) The sociometric matrix of choices, \( C \), of this hypothetical group situation is given in Table 31.1.

It is possible to analyze the matrix in a number of ways. But first let us be sure we know how to read the matrix. It is probably easier to read from left to right, from \( i \) to \( j \). Member \( i \) chooses (or does not choose) member \( j \). For example, \( a \) chooses \( b \); \( c \) chooses \( d \) and \( e \). Sometimes it is convenient to speak passively, "\( b \) was chosen by \( a \), and \( d \) and \( e \)." Or "\( c \) was chosen by no one." 28

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
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<td>b</td>
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<td>e</td>
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</tbody>
</table>

\( \Sigma = 2 \)

4 Individual \( i \) chooses individual \( j \). That is, the table can be read by rows: \( a \) chooses \( b \) and \( c \), and \( d \) and \( e \). It can also be read by columns: \( b \) is chosen by \( a \), \( d \), and \( e \). The sums at the bottom indicate the number of choices each individual receives.

The analysis of a matrix usually begins by studying it to see who chose whom. With a simple matrix this is easy. There are three kinds of choice: simple or one-way, mutual or two-way, and no choice. We look first at simple choices. (This was discussed in the preceding paragraph.) A simple one-way choice is where \( i \) chooses \( j \), but \( j \) does not choose \( i \). In Table 31.1, \( c \) chose \( d \), but \( d \) did not choose \( c \). We write: \( i \rightarrow j \), or \( c \rightarrow d \). A mutual choice is where \( i \) chooses \( j \) and \( j \) also chooses \( i \). In the table, \( a \) chose \( b \) and \( b \) chose \( a \). We write: \( i \leftrightarrow j \), or \( a \leftrightarrow b \). We might count mutual choices in Table 31.1: \( a \leftrightarrow b \), \( a \leftrightarrow e \), \( b \leftrightarrow e \).

The extent to which any member in chosen is easily seen by adding the columns of the matrix. Obviously, \( e \) is "popular": he was chosen by all the other group members; \( a \) and \( b \) received 2 and 3 choices, respectively. Evidently \( c \) is not at all popular: no one chose him; \( d \) is not popular either: he received only 1 choice. If individuals are allowed unlimited choices, that is, if they are instructed to choose any number of other individuals, then the row sums take on meaning. 29 We might call these sums indices of, say, gregariousness.

There are other methods of matrix analysis that are potentially useful to researchers. For example, by relatively simple matrix operations one can determine cliques and chains of influence in small and large groups. These matters, however, are beyond the scope of this book.

**Sociograms or Directed Graphs**

The simplest analyses are like those just discussed. But with a matrix larger than the one in Table 31.1 it is almost impossible to digest the complexities of the choice relations. Here sociograms are helpful, provided the group is not too large. We now change the name "sociogram" to "directed graph." This is a more general mathematical term that can be applied to any situation in which \( i \) and \( j \) are in some relation \( R \). Instead of saying "\( i \) chooses \( j \)," it is quite possible to say "\( i \) influences \( j \)," or "\( i \) communicates to \( j \)," or "\( i \) is a friend of \( j \)," or "\( i \) dominates \( j \)." In symbolic shorthand, we can write, generally: \( iRj \). Specifically, we can write for the examples just given: \( iCj \) (\( i \) chooses \( j \)), \( iJj \) (\( i \) influences \( j \)), \( iCj \) (\( i \) communicates to \( j \)), \( IFj \) (\( i \) is a friend of \( j \)), \( IDj \) (\( i \) dominates \( j \)). Any of these

28 Subjects can be told to choose one, two, three, or more other persons. There seems to be a common number of choices. The number allowed should be dictated by the research purposes. See Lindsey and Byrne, op. cit., pp. 435-456.
interpretations can be depicted by a matrix such as that of Table 31.1 and by a directed graph. A directed graph is given in Figure 31.1.

We see at a glance that c is the center of choice. We might call him a leader. Or we might call him either a likable or competent person. More important, notice that a, b, and e choose each other. This is a clique. We define a clique as three or more individuals who mutually choose each other.30 Looking for more double-headed arrows, we find none. Now we might look for individuals with no arrowheads pointing at them: c is one such individual. We can say that c is not chosen or neglected.

Note that directed graphs and matrices say the same thing. We look at the number of choices a receives by adding the 1's in the a column of the matrix. We get the same information by adding the number of arrowheads pointing at a in the graph. For small and medium-size groups and for descriptive purposes, graphs are excellent means of summarizing group relations. For larger groups (larger than 20 members?) and more analytic purposes, they are not as suitable. They become difficult to construct and to interpret. Moreover, different individuals can draw different graphs with the same data. Matrices are general, and, if handled properly, not too difficult to interpret. Different individuals must, with the same data, write exactly the same matrices.

Sociometric Indices

In sociometry many indices are possible. Three are given below. The student will find others in the literature.

A simple but useful index is:

$$C_{ij} = \frac{\sum x_{ij}}{n-1}$$

(31.1)

where $C_{ij}$ = the choice status of Person j; $x_{ij}$ = the sum of choices in Column j; and n = the number of individuals in the group (n − 1 is used because one cannot count the individual himself). For C of Table 31.1, $C_{ij} = 4/4 = 1.00$ and $C_{ij} = 2/4 = .50$. How

31 Lawrence F. Feather, Social Pressures in Informal Groups. New York: Harper & Row, 1959, p. 144. This book is not only a report of highly interesting research; it also contains a valuable method for identifying cliques in groups. See also, Glancer and Glaser, op. cit., pp. 326–327, which succinctly outlines methods of the multiplication of binary matrices 11.05, whose application yields useful insights into group structure.

32 For a discussion of the basic measurement aspects of sociometric measures, especially their reliability and validity, see Lindsey and Byrne, op. cit., pp. 475–483.


Observations of Behavior and Sociometry

well or how poorly chosen an individual is is revealed by CS. It is, in short, his choice status. It is of course possible to have a choice rejection index. Simply put the number of 0's in any column in the numerator of Equation 31.1.

Group sociometric measures are perhaps more interesting. A measure of the cohesiveness of a group is:

$$Co = \frac{\sum (i \leftrightarrow j)}{n(n-1)} / 2$$

(31.2)

Group cohesiveness is represented by $Co$ and $\sum (i \leftrightarrow j) = \text{sum of mutual choices (or mutual pairs). This useful index is the proportion of mutual choices to the total number of possible pairs. In a five-member group, the total number of possible pairs is 5 things taken 2 at a time:}$

$$\frac{(5)}{2} = \frac{5(5 - 1)}{2} = 10$$

If, in an unlimited choice situation, there were 2 mutual choices, then $Co = 2/10 = .20$, a rather low degree of cohesiveness. In the case of limited choice, the formula is:

$$Co = \frac{\sum (i \leftrightarrow j)}{dn/2}$$

(31.3)

where d = the number of choices each individual is permitted. For C of Table 31.1 $Co = 3/(2 \times 5/2) = 3/5 = .60$, a substantial degree of cohesiveness.

**RESEARCH USES OF SOCIOMETRY**

Because the data of sociometry seem so different from other kinds of data, students find it difficult to think of sociometric measurement as measurement. There is no doubt that sociometric data are different. But they are the result of observation, and they are measures.32 They are useful, for example, in classifying individuals and groups. In the Bennington College study, Newcomb measured individual prestige by asking students to name five students they would choose as most worthy to represent Bennington College at an important gathering of students from all types of American colleges.33 He then grouped students by frequency of choice and related this measure of sociometric prestige to political and economic conservatism. In reading the examples of this section, the student should clearly realize that sociometry is a method of observation and data collection that, like many other methods of observation, obtains measures of variables.

**Prejudice in Schools**

In studying the manifestation of prejudice against blacks and Jews in schools, Smith used the simple procedure of asking all the students of entire grades of high schools to name their five best friends.34 (Smith calls it "a straightforward approach that has been digni-
Sociometry and Social Status

In the Morrison et al. study of the determinants of social status among mildly handicapped students cited earlier (footnote 23), social status (the dependent variable) was measured by asking the children in classes to select one of four responses for each of their classmates: a smiling face (acceptance), a straight-mouthed face (no preference), a frowning face (rejection), and a question mark (nonacquaintance). A weighted average score for each child was calculated as follows: 3 = acceptance, 2 = tolerance (no preference), and 1 = rejection. These averages were the social status scores, which were correlated with other variables, e.g., disruptive behavior, teacher rating of behavior, achievement. The two strongest influences on social status were teacher rating of cognition (positive) and student rating of behavior (negative).

Race, Belief, and Sociometric Choice

In a field experiment designed to test Rokeach’s controversial hypothesis that differences in beliefs are more influential in determining prejudice than differences in race, Rokeach and Mezei used a realistic employment situation and an ingenious sociometric task. White and black male applicants for various jobs in two mental hospitals were involved individually with four confederates of the experimenters in discussions of rule-oriented and permissive ways of handling patient problems. Two of the confederates were white, two were black; one white and one black confederate espoused the rule-oriented position; the other white and black confederates espoused the permissive position. This arrangement, then, constituted the race and belief conditions. After about 12 minutes of discussion the experimenter came into the room and asked the five individuals—including the experimental subject, of course—to write down the names of two of the four individuals with whom he would most prefer to work. This, of course, a sociometric task whose purpose was to test the prediction that the subjects would express more preference for those individuals whose opinions they shared than for those of the same race. In general, the prediction was supported.

Sociometry is a simple, economical, and naturalistic method of observation and data collection. Whenever such human actions as choosing, influencing, dominating, and communicating, especially in group situations, are involved, sociometric methods can usually be used. They have considerable flexibility. If defined broadly, they can be adapted to a wide variety of research in the laboratory and in the field. Their quantification and analysis possibilities, though not generally realized in the literature, are rewarding. The ability to use the simple assignment of 1’s and 0’s is particularly fortunate, because powerful mathematical methods can be applied to the data with uniquely interpretable and meaningful results. Matrix methods are the outstanding example. With them, one can discover equilibria in groups, communication and influence channels, patterns of cohesiveness, connectedness, hierarchization, and so on.

Study Suggestions

1. The student should study one or two behavior observation systems in detail. For students of education, the Medley and MitzeI system will yield high returns. Other students will want to study one or two other systems. The best source for educational systems is Medley and MitzeI’s chapter (see footnote 1). It is authoritative and clear with many examples. The two best general references are the Heyns and Lippitt chapter (footnote 2) and the Weiss chapter (footnote 3) in the first and second editions of the Handbook of Social Psychology. An anthology of 79 observation systems has been published in cooperation with Research for Better Schools, Inc., a regional education laboratory (see footnote 7). The researcher who intends using observations should consult this huge collection of systems. The student of education will find excellent summaries and discussions of educational observation systems in: M. Dunkin and B. Biddle, The Study of Teaching, New York: Holt, Rinehart and Winston, 1974. The following articles are valuable: R. Boice, “Observational Skills,” Psychological Bulletin, 93 (1983), 3-29; J. Herbert and C. Attridge, “A Guide for Developers and Users of Observation Systems and Manuals,” American Educational Research Journal, 12 (1975), 1-20. Boice points out the lack of training for making observations of behavior and makes suggestions for such training. Herbert and Attridge provide criteria for observation systems. They also point out that knowledge of such systems is limited.

2. Sociometry has been neglected by behavioral researchers and methodologists. As its importance and analytic usefulness become better known and appreciated, and as computer programs are written to handle large amounts of data generated, mathematical and statistical methods of sociometric and related data analysis will probably exert a stronger influence on behavioral research. The student is encouraged to explore mathematical treatments of sociometric data. The Kemeny, Snell, and Thompson reference (footnote 28) is a good introduction, though the student needs knowledge of elementary matrix algebra (which, fortunately, is not difficult). An introduction to the subject is: E. Pedhazur, Multiple Regression in Behavioral Research: Explanation and Prediction, 2d ed. New York: Holt, Rinehart and Winston, 1982, Appendix A, pp. 773-783. A highly valuable guide to mathematical and statistical analysis is the following article: M. Glanzner and R. Glaser, “Techniques for the Study of Group Structure and Behavior: I. Analysis of Structure,” Psychological Bulletin, 56 (1959), 317-332.

3. An investigator, studying the influence patterns of boards of education, obtained the following matrix from one board of education. (Note that this is like an unlimited choice situation because each individual can influence all or none of the members of the group.) Read the matrix: $i_{ij}$ influences $j$.

$$
\begin{pmatrix}
  a & b & c & d & e \\
  a & 0 & 0 & 1 & 1 & 0 \\
  b & 0 & 0 & 0 & 0 & 1 \\
  c & 1 & 0 & 0 & 1 & 0 \\
  d & 1 & 0 & 0 & 0 & 0 \\
  e & 0 & 1 & 0 & 0 & 0 \\
\end{pmatrix}
$$

(a) What conclusions can you reach from study of this matrix? Is the board divided? Is there likely to be conflict?