

Effective Size and Defendant Bias in Eyewitness Identification Lineups*

Roy S. Malpass†

Two aspects of fairness in eyewitness identification lineups are discussed: the effective size of a lineup, and the degree of bias towards or away from the defendant. Procedures are proposed for measuring both aspects of lineup fairness and a range of hypothetical examples is given. An appendix discusses and explains procedural and computational details, and provides a table of critical ranges of identification proportions for lineups of varying sizes and for different numbers of observers.

INTRODUCTION

The fairness of eyewitness identification lineups has been a frequent object of concern (Doob & Kirshenbaum, 1973; Levine & Tapp, 1973; Wall, 1965; Wells, 1978; Woocher, 1977). While model rules for conducting eyewitness identifications have been developed (LaSota & Bromley, 1974), these are general and do not contain explicit methods for determining the degree to which lineups depart from a precisely defined state of "fairness." Doob & Kirshenbaum (1973) define a biased lineup as "one where a person who was not a witness to the crime (a mock witness) is more likely to pick the suspect out of the lineup than we would expect by chance (where chance is defined as $1/N$, N being the number of people in the lineup)" (p. 290). Wells, Leippe, & Ostrom (1979) argue that Doob & Kirshenbaum's measure does not change appropriately in response to adding either *null* or *perfect* foils¹ to a lineup of a given

*The author would like to express thanks to Alvin G. Goldstein for suggesting the appendix, and for comments on an early version of the manuscript. Thanks are also due Patricia G. Devine for helpful comments on many versions of the manuscript.

†Behavioral Science Program, State University of New York at Plattsburgh.

¹*Null* foils are those which draw no identifications from mock witnesses. *Perfect* foils are those which draw exactly the number of mock witnesses identifications expected by chance, on the basis of the lineup's nominal size.

nominal size. They suggest that there is a need for a summary statistic that will reflect the effects of these changes. They propose two other potential indices: D/n (where D is the number of mock witnesses choosing the defendant, and n is the number of mock witnesses), and its reciprocal transformation, n/D , which reflects the "functional size" of a lineup. They point out that while identification lineups may nominally be composed of N individuals their functional size may be smaller. Wells et al. (1979) prefer the latter measure "because of the imagery connoted by functional size since it reflects the number of feasible lineup members" (p. 288). Functional size and nominal size are equal when D equals the number of identifications of a given member of the lineup expected by chance alone. Estimating numerically the degree to which a given lineup departs from its nominal size is important in a number of respects. It provides a methodology for examining the fairness of eyewitness identification lineups and provides a basis for comparisons between studies of eyewitness identification. It could aid in answering questions about the equivalence of corporal and photographic lineups, and the effects of information given to witnesses prior to their identification attempts. The calculation of functional size is shown in Table 1 for a number of distributions of mock witness choices in 5-person lineups. For lineup A, for example, $n = 100$, and $D = 20$. The distribution of choices is exactly what would be expected by chance, and the functional size equals 5, which is the nominal size of the lineup.

There are a number of difficulties with this way of measuring the fairness of a lineup. First, functional size is not bounded at the upper end, so that it is possible to obtain functional sizes larger than nominal size. Lineup B in Table 1 illustrates this. With 10 mock witnesses choosing the defendant the functional size equals 10. If no mock witness chooses the defendant the functional size of the lineup is infinite. It does not seem sensible for the functional size of a lineup to exceed the number of actual choice alternatives available from which witnesses can choose (nominal size). Second, there are two bases for a departure of functional size from nominal size. The first is that the defendant may be chosen with greater than chance expectation, drawing

Table 1. Lineup Choice Distributions for 10 Hypothetical Lineups, with Functional Size and Effective Size

Lineup	Defendant	Foils				Number of witnesses	Functional size ^a	Effective size ^a
		1	2	3	4			
A	20	20	20	20	20	100	5.0	5.0
B	10	22	23	22	23	100	10.0	4.5
C	25	19	19	19	18	100	4.0	4.75
D	25	25	25	13	12	100	4.0	4.25
E	25	35	14	13	13	100	4.0	4.0
F	25	30	25	10	10	100	4.0	4.0
G	25	30	30	8	7	100	4.0	3.75
H	25	55	8	6	6	100	4.0	3.0
I	25	75	0	0	0	100	4.0	1.5
J	60	10	10	10	10	100	1.67	3.0
K	80	10	10	0	0	100	1.25	1.6

^aDefined in the text.

choices from the foils, resulting in functionally fewer foils. The second is that one of the foils may be chosen with greater than chance expectation, drawing choices from other foils (but not the defendant), resulting in functionally fewer foils. While the functional size index addresses the first of these, it is insensitive to the distribution of choices among the foils and therefore does not address the second. Yet the distribution of mock witness choices across the foils is a critical factor in determining the degree of departure of a lineup from its nominal size. The importance of the distribution of mock witness choices across the foils is illustrated in lineups C–I in Table 1. While the number of mock witnesses choosing the defendant remains the same, the distribution of choices over the foils varies widely. The conceptual definition of functional size implies that functional size of a lineup is the number of individuals in the lineup who have at least the proportion of identifications expected by chance. If this interpretation is correct then the functional size of lineup C should be closer to 5 than 4 since each of the foils is nearly perfect; that is, each foil is identified with a frequency very close to chance expectation (20). Likewise the functional size of lineup I seems closer to 2 than 4 since only two lineup members are identified with frequencies greater than zero. The remaining lineup alternatives are nonfunctional lineup members (null foils).

We agree with Wells et al. (1979) on the need for a descriptive index of the departure of lineups from nominal size, and we agree that the issue focuses on the number of good foils present in the lineup. We do not agree, however, that a measure which ignores the distribution of choices among the foils measures the goodness of these foils, and we do not agree that the departure of a lineup from its nominal size and the degree of bias present towards or away from the defendant are the same thing. We believe that, despite its name, “functional size” is more nearly an index of bias than an index of the number of good foils in a lineup. Below we propose an alternative measurement of lineup size, compare the alternative with the functional size index (Wells et al., 1979), and discuss separately the measurement of bias towards or away from the defendant.

THE EFFECTIVE SIZE OF EYEWITNESS IDENTIFICATION LINEUPS

Conceptual Definition

The effective size of a lineup represents the degree to which the lineup presents to mock witnesses fewer effective choice alternatives than the nominal size of the lineup (the number of individuals in the lineup). A lineup's effective size is the result of subtracting from nominal size the degree to which members of the lineup fail to fulfill their *nominal chance expectation*. Nominal chance expectation is $1/N(n)$, where N is the number of people in the lineup (nominal size), and n = the total number of mock witnesses making a lineup choice. For a 5-person lineup, with 100 mock witnesses, nominal chance expectation equals $1/5 (100) = 20$. Any member of the lineup who is identified less than this frequency is not fulfilling his/her expectation, is to that extent effectively less than one complete member of the lineup, and is consequently not a completely feasible lineup alternative. Thus the distribution of choices across the foils in a lineup affects the effective size of a lineup: the greater the degree to which foils fall

below nominal chance expectation, and the more foils which fall below it, the smaller will be the effective size of the lineup. Further, two nominal lineup alternatives, each of which is chosen with $\frac{1}{2}$ of the nominal chance expectation, add up to one unit of nominal chance expectation, or one effective lineup alternative.

Measurement of Effective Lineup Size

Measuring effective size based on this conceptual definition proceeds as follows:

(1) Find the adjusted nominal size (N_a) by subtracting from nominal size (N) the number of foils receiving no identifications (null foils). Use N_a to find the adjusted nominal chance expectation (E_a). E_a equals $1/N_a(n)$, where n is the number of mock witnesses.

(2) For each nonnull foil whose observed frequency of identification is less than E_a ,

- (a) subtract its observed frequency (O) from the E_a ,
- (b) sum these differences, and
- (c) divide this sum by E_a .

This provides the degree to which these lineup foils, taken together, fall short of fulfilling their adjusted nominal chance expectation. The resulting number is the number of persons effectively absent from the lineup.

(3) Subtract the result of (2c) above from the adjusted nominal size of the lineup. This result is the lineup's effective size.² If this result is expressed as a percentage of nominal size [(effective size/nominal size) \times 100] the percentage reduction of effective size from nominal size will be apparent.

Comparison of Effective Size and Functional Size Measures

Table 1 contains illustrations of these two measures applied to a range of 5-person lineups. Note again that for lineup A, where the distribution of choices is exactly as expected by chance, functional size and effective size both equal nominal size. The two measures differ on all the remaining lineups. These differences all derive from the fact that effective size is influenced by the distribution of choices among the foils, whereas functional size is completely insensitive to this distribution.

(1) Consider lineup B from Table 1. When the defendant is identified less fre-

²The following equation is an expression for effective size which is more amenable to programming for machine calculation from raw data:

$$\text{Effective lineup size} = N_a - \left[\frac{\sum_{i=1}^{N_a} |O_i - E_a|}{2E_a} \right]$$

where N_a is the adjusted nominal number of alternatives in the lineup; O_i is the observed frequency of mock witnesses choosing the i th lineup alternative; and, E_a is the adjusted nominal chance expectation, which equals the total number of mock witnesses making a choice, divided by N_a . This is equivalent to the process described above. It uses absolute quantities from all the nonnull lineup foils, which will result in the $O_i - E_a$ sum being twice that obtained if only those alternatives where $E_a > O$ are considered. Thus the sum of these absolute quantities is divided by $2E_a$ (rather than E_a) to retrieve the original value.

quently than nominal chance expectation, functional size is greater than nominal size. According to the conceptual definition of effective size a lineup is effectively smaller than nominal size to the extent that any member of the lineup, including the defendant, fails to fulfill the nominal chance expectation. Effective size decreases as the proportion of mock witness choices falls below nominal chance expectation, regardless of whether the lineup member is the defendant or a foil.

(2) Lineups C through I from Table 1 illustrate changes in effective size in response to changes in the distribution of choices across the foils, while functional size remains invariant.

(3) Wells et al. (1979) note three characteristics of the functional size index: that it distinguishes between a one-person lineup (a "show-up") and an N -person lineup with $N - 1$ foils, that as perfect foils are added the functional size increases proportionately, and that as null foils are added the functional size remains constant. We shall discuss these briefly in turn.

(a) Distinction between a one- and an N -person lineup: Both functional and effective size measures make this distinction. When the defendant draws all of the choices, both show a lineup size of 1.

(b) Both effective size and functional size increase proportionately as perfect foils are added, so long as "perfect" is defined as the nominal chance expectation under the new nominal lineup size. In any case, both indexes increase as new foils are added so long as they are not null foils.

(c) Both effective size and functional size remain constant as null foils are added.

(4) Effective size considers the lineup as an aggregate, treating all of its members equally, as should be the case in the view of a mock witness confronted with an ideally fair lineup. For all of the lineups in Table 1 (excepting A) exchanging the choice frequencies of the defendant with one of the foils results in a change of the functional size, while effective size remains invariant. For example, in lineup J, the functional size is 1.67. If the defendant's choice frequency (60) is exchanged with that of any other member of the lineup the functional size increases to 10. Effective size remains constant, at 3.0 (the defendant, plus the four foils who among themselves add up to only two units of nominal chance expectancy). This leads us to suggest that despite its name, functional size is more an indication of bias towards the defendant and less an indicator of the size of the lineup as an aggregate. Strictly speaking, then, they are not directly comparable.

Effective size is a descriptive index constructed to reflect the degree to which some lineup members are chosen by mock witnesses less frequently than expected by chance. There are a number of approaches to evaluating the statistical information upon which the index is based. To evaluate the discrepancies of identification frequencies from expectation, singly, each lineup alternative could be tested against chance expectation by conventional methods of testing the significance of a proportion (see, for example, Bruning & Kintz, 1977). To evaluate whether the lineup taken as an aggregate contains a significant deviation from chance expectation a chi-squared test could be used. It is important to point out, however, that the finding that there is a statistically significant discrepancy from chance expectation with respect to a particular foil or with respect to the lineup as a whole is merely a beginning. This finding by itself does not constitute an evaluation of the degree to which the lineup is unfair. The

degree of fairness of a lineup is a matter to be decided on the basis of other criteria, and is not fundamentally a statistical question.

DEFENDANT BIAS

A limitation of effective size is that it considers the lineup only as an aggregate, and does not focus uniquely on the defendant. The effective size of a lineup does not in itself provide an index of bias towards or away from the defendant. Effective size can depart from nominal size when the defendant is chosen more than expected, or less. Two aspects of a lineup need evaluation: its effective size and the degree of defendant bias. Doob and Kirshenbaum (1973) define defendant bias as the difference between the observed proportion of identifications made of the defendant and the proportion expected by chance [defendant bias = $D/n - 1/N = (O - E)$, where D is the number of mock witnesses identifying the defendant, n is the number of mock witnesses, N is the nominal size of the lineup, O is the observed proportion of mock witnesses identifying the defendant, and E is the proportion of mock witnesses expected to identify the defendant by chance]. Thus a 6-person lineup which is unbiased would have the defendant identified by mock witnesses exactly 1/6th of the time. We agree with Doob and Kirshenbaum (1973) that bias towards or away from the defendant should be expressed as the difference between the observed proportion of identifications made of the defendant and the proportion of defendant identifications expected by chance. We propose, however, that effective size rather than nominal size be used as the basis for the calculation of chance expectation (adjusted chance expectation). If certain lineup members are indeed less than fully feasible alternatives, they should not be accorded the equality with other lineup members implicit in determining chance expectation by $1/nominal\ size$. To do so implies that all lineup members are equal. If they are not, a number that reflects the inequality is a conceptually superior basis for estimating an adjusted chance expectation. Effective size reflects the degree of this inequality.

Thus our proposal is that defendant bias and effective size are different aspects of fairness in eyewitness identification lineups and that the degree to which bias towards or away from the defendant is present should be determined on the basis of the lineup's effective size. Conventional statistical methods can be used to determine whether the difference between the observed proportion of identifications is significantly different from the adjusted chance expectation (expressed as a proportion), given the size of the sample of mock witnesses. We note again, however, that a statistically significant departure does not necessarily indicate a meaningful departure from fairness in the legal context.

EVALUATING THE FAIRNESS OF LINEUPS

We have not yet commented on the use of the effective size index or the measurement of defendant bias to evaluate the fairness of lineups, or the criteria on which such an evaluation might be made. A discussion of some applications is given by Wells et al. (1979). Clearly the effective size concept can be used before an identification has taken place to prepare a lineup which will survive criticism and which is

demonstrably fair. This procedure would probably be used only in important cases because of the expense and time demands inherent in it. So the use of ideas such as effective lineup size may well find more frequent application as an instrument of the defense in discrediting eyewitness testimony, or prosecutors as a means of bolstering a case by showing the fairness of a lineup. Imagine a situation where a defendant was identified from a lineup of nominal size 8, and that the eyewitness testimony was an important part of the evidence against him. Were a suitable photograph of the lineup available, and a large pool of mock witnesses accessible (100, for example), the defense attorney might find that the effective size of the lineup was 5.2, and that the defendant was identified by 20 mock witnesses. The defense attorney might try to make a case for bias in the lineup by virtue of the discrepancy of effective from nominal lineup size of 2.8 foils (effective lineup alternatives) and the observation that an identification frequency of 20 was considerably more than the expected 12.5 identifications (nominal chance expectation), in fact, statistically significantly different from the nominal expectation. The prosecuting attorney could attempt to respond by pointing out (1) that lineups of nominal size 5, while small, are within the lower limits of acceptable lineup sizes. Thus there is nothing inherently wrong with a lineup of nominal or effective size of approximately 5; (2) that the figure for chance expectancy that is relevant is not in fact nominal chance expectation, but chance expectation based on the effective size of the lineup. After all, we know that the effective size of the lineup is smaller than nominal, so should we not use this information to make a more informed judgment about the expected frequencies of mock witness identification, on the basis of which we can assess defendant bias? He might point out that an identification rate of 20 in 100 is very close to chance expectation in a lineup that has 5.2 effective persons in it (19.23). The defense might respond that a reduction to an effective size of 5.2 from nominal size of 8 is a 35% reduction, arguing that such a large reduction implies a badly constructed lineup. The scenario raises the question with which this paper began: How can we assess the fairness of an eyewitness identification lineup? There appear to be two levels on which one can pose the question, and at least four attributes of lineups that can be considered. The first level of analysis is the level of the lineup as a unit. Evaluative criteria that can be applied are (1) minimum effective size acceptable, (2) the maximum acceptable percentage reduction of effective size from nominal size, and (3) standards for evaluating the statistical significance of departures of the lineup choice distribution from chance expectation, by means of the chi-squared test. Standards should be developed so that these criteria can be applied appropriately. LaSota and Bromley (1974) suggest that lineup sizes greater than 6 are acceptable, and this figure could equally well be applied to effective lineup size. The maximum acceptable percentage reduction of effective size, indeed the correlates of effective size reduction, are not determined. On an intuitive basis, however, it seems reasonable to require that effective size be no smaller than 80% of nominal size to be considered fair. A statistically significant chi-squared at a conventional probability such as $p = .05$ tells us only that there is a detectable difference in the lineup from nominal chance expectation. Whether this results in unfairness should be visible in other criteria.

The second level of analysis is the level of the individual lineup member. The one of most interest, obviously, is the defendant. A lineup is fair if it is not biased towards or away from the defendant. The distinction drawn above between nominal and effec-

tive size of lineups raises the question of the basis for calculating chance expectation for the frequency of mock witness identifications. Our proposal is that effective size be used as a basis for calculating an adjusted chance expectation figure, and that this figure be used in place of nominal chance expectation in estimating the degree of defendant bias present in a lineup. If the conceptualization of effective size is compelling, and the associated measurement technique sufficiently close to the conceptual meaning of the term, we should use this thinking. A cautionary note should be inserted, however. The use of adjusted chance expectation calculations will be valid and useful to exactly the extent that measures such as effective size demonstrate the validity of the claims made for them. The empirical data have yet to be obtained. It is not obvious what standards should be applied to the defendant bias judgment. Such standards should depend on an analysis of the consequences of various decision rules, under different conditions. As a starting point, however, the conventional 5% confidence limits on either side of the adjusted chance expectation, with a sample size of 100 mock witnesses, is a guideline that does not seem too stringent. These, and confidence limits based on smaller samples, are provided in the Appendix for lineups of sizes 5 to 10.

While it is the case that if there is defendant bias there will necessarily be a reduction in the effective size of the lineup, it is not necessary that lineups with effective size lower than nominal size contain defendant bias. Choices of some lineup members must be biased, but it need not be the defendant. Thus while the two levels of analysis are related, they are not redundant. If we were to focus on one as being the more important, we would choose defendant bias because it focuses on the individual of concern. But we note that defendant bias, as presented here, is itself based on the calculation of and adjustment for the lineup's effective size.

APPENDIX FOR LAWYERS AND POLICE: DETERMINING EFFECTIVE SIZE OF LINEUPS, AND DEFENDANT BIAS

Determining the effective size of a lineup or the extent of defendant bias requires lineup choices by a number of mock witnesses. The number of mock witnesses required is determined by the degree of accuracy desired in determining the statistical significance of departures from nominal size, and the degree of defendant bias. In general only substantial departures of these from expectation are of interest, so very large samples of lineup choices are not necessary. In practice 100 mock witnesses is probably sufficient, and even smaller numbers can be useful. Clearly 100 is a large number of people for whom to arrange a viewing of a corporeal lineup. An alternative is to provide a suitable photograph of the lineup for mock witnesses. While there are some suggestions that photographic lineups are adequate surrogates for corporeal lineups, some studies report fewer accurate identifications in photographic lineups (Egan, Pittner, & Goldstein, 1977). The degree to which photographic lineups lead to similar effective size and defendant bias calculations is not yet known.

The procedures outlined here for obtaining mock witness judgments may seem cumbersome and costly to those unfamiliar with this kind of data collection. An investment at the pretrial level is probably a good investment, however. The process is in no way mysterious, and the relevant experience can be gotten with relative ease. There

are a number of alternatives to doing it one's self. A good one is to enlist the aid of professionals. For example, you may be able to interest faculty in a nearby college or university in consulting with you. A place to start is with those teaching the statistics or research methods course in the Psychology or Sociology Departments. Data collection such as that outlined here will seem very straightforward to them, and it is possible that you may be able to obtain both their advice on how to go about collecting mock witnesses judgments and their aid in accomplishing it. If you do this, be sure to agree beforehand on very specific data collection procedures, very specific instructions about the characteristics of the sample of mock witnesses to be obtained, and clear, written instructions to be given the mock witnesses.

(1) Obtain a high-quality color negative or transparency of the lineup at which important eyewitness identifications were made. Be sure that facial expressions are similar, that eyes are open, that postures and other behavioral characteristics are representative of those displayed by the lineup participants during the identification process. This negative should be made into a good quality 11×14 -in. color print which can be displayed to mock witnesses. High-quality 35-mm photographic equipment, used expertly, is probably sufficient for this purpose. Larger negatives or transparencies are more desirable because of the resulting increase in clarity. Smaller negatives or Polaroid prints smaller than 8×10 in. are unacceptable. Some expense at this point will preserve the usefulness of the remainder of these procedures. An inadequate photograph will render the entire process invalid.

(2) The following procedures can be administered by a research assistant, undergraduate student, intern, or person in a similar role.

Mock witnesses should be chosen so as to be generally representative of the community. Mock witness judgments are better gathered from shoppers at a shopping mall on a weekend, for example, than from the membership attending a Rotary Club luncheon or a meeting of the American Legion. If your community's pool of prospective jurors is representative, the presiding judge cooperative, and the case not coming before panels selected from this particular pool, this might be a source of mock witnesses.

Information given mock witnesses should include (a) a general description of the crime, and (b) a general description of the suspect. The descriptions might include the suspect's age, height, approximate weight, general body build, hair and eye color, and any other relevant characteristics. Obviously the foils as well as the suspect should share these characteristics.

Instructions to mock witnesses should include a true statement of the use to be made of their judgments. Mock witnesses should be instructed to choose one of the individuals in the photograph as the individual most likely to have committed the offense described.

(3) Computational steps.

(a) Arrange the mock witnesses choices as in Table 1, so that the suspect's choice frequency is in position 1. Nominal size is the number of individual members of the lineup that mock witnesses could possibly choose.

(b) Find N_a (adjusted nominal size) by subtracting from nominal size (N) the number of lineup alternatives that received no identifications (null foils).

(c) Find the adjusted chance expectation (E_a) for lineup identification frequency by multiplying the total number of mock witnesses (n) by $1/N_a$.

(d) For each nonnull lineup alternative whose frequency of identification is less than the adjusted chance expectation (E_a), subtract the observed identification frequency from E_a .

(e) Sum these differences.

(f) Divide this sum by E_a .

(g) Finally, subtract this result from the adjusted nominal size of the lineup (N_a). This figure is the lineup's effective size.

Test your computational procedures by applying them to the choice frequencies provided in Table 1. You should obtain the same effective sizes displayed in the table.

(4) To test the statistical significance of the departure of the distribution of choices from nominal chance expectation, consult an appropriate statistics text or handbook (Siegel, 1956) for the chi-squared one-sample test.

(5) To calculate defendant bias, (a) obtain the adjusted chance expectation for the defendant by 1/effective size. (b) Find the difference between the adjusted chance expectation and the observed proportion of mock witness choices of the defendant (observed proportion = choice frequency/total No. of mock witnesses).

(6) To test the statistical significance of defendant bias, consult an appropriate statistics text or handbook for the significance of a proportion. Critical values of proportions of identifications made of the defendant are given in Table A for lineups of various nominal sizes, for varying numbers of mock witnesses. Proportions of identifications outside of the indicated critical range imply a bias towards or away from the defendant that is unlikely (has a probability of .025 or less) to occur by chance alone. In principle the table can be used for either nominal or effective size. Effective size, however, will frequently not yield whole numbers, and to be precise the expected proportion of identifications and the associated confidence limits would have to be

Table A. Expected Proportions of Identifications and Critical Ranges for Varying Numbers of Mock Witnesses and Varying Nominal Lineup Sizes^a

Number of mock witnesses		Lineup size					
		5	6	7	8	9	10
50	expected proportion	.20	.1667	.1429	.1250	.1111	.1000
	critical range	.0891 —	.0633 —	.0459 —	.0333 —	.0240 —	.0168 —
75	critical range	.3109	.2670	.2399	.2167	.1982	.1832
	critical range	.1095 —	.0823 —	.0637 —	.0502 —	.0400 —	.0321 —
100	critical range	.2905	.2510	.2221	.1998	.1822	.1679
	critical range	.1216 —	.0936 —	.0743 —	.0602 —	.0495 —	.0412 —
		.2784	.2397	.2114	.1898	.1727	.1588

^aCritical ranges are calculated based on a two-tailed confidence interval, with $\alpha = .05$. Obtained proportions of identification of the defendant falling outside the appropriate range indicate that the lineup is biased.

calculated in each case. Note again, however, that statistical criteria are not in and of themselves a basis for evaluating the fairness of a lineup, or the importance of whatever degree of (or direction of) defendant bias is present.

(7) As noted above, an alternative to 4 and 6 is to contact the person in the Psychology or Sociology Departments of a nearby college who teaches statistics or research methods, and ask them to advise you on the statistical evaluation of the choice frequencies.

REFERENCES

- Bruning, J.L. & Kintz, B.L. *Computational handbook of statistics (2nd Ed.)* Glenview, Illinois: Scott, Foresman & Co., 1977.
- Doob, A.N., & Kirshenbaum, H.M. Bias in police lineups—Partial remembering. *Journal of Police Science and Administration*, 1973, **1**, 287-293.
- Egan, D., Pittner, M., & Goldstein, A.G. Eyewitness identification: Photographs vs. live models. *Law and Human Behavior*, 1977, **1**, 199-206.
- LaSota, J.A., Jr., & Bromley, G.W. *Model Rules: Eyewitness Identification*. Tempe, Arizona: College of Law, Arizona State University, 1974.
- Levine, F.J., & Tapp, J.L. The psychology of criminal identification: The gap from Wade to Kirby. *University of Pennsylvania Law Review*, 1973, **5**, 1079-1131.
- Siegel, S. *Nonparametric statistics for the behavioral sciences*, New York: McGraw-Hill, 1956.
- Wall, P. *Eyewitness identification in criminal cases*. Springfield, Illinois: Charles C. Thomas, 1965.
- Wells, G.L. Applied eyewitness-testimony research: System variables and estimator variables. *Journal of Personality and Social Psychology*, 1978, **36**, 1546-1557.
- Wells, G.L., Leippe, M.R., & Ostrom, T.M. Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 1979, **3**, 285-293.
- Woocher, F.D. Did your eyes deceive you? Expert psychological testimony on the unreliability of eyewitness identification. *Stanford Law Review*, 1977, **29**, 969-1030.