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# The Uses and Effects of Forensic Science in the Adjudication of Felony Cases

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**ABSTRACT:** This paper describes the uses and effects of forensic and other forms of evidence on the judicial processing of criminal cases. To achieve this goal, several data gathering approaches were used: surveys of laboratory scientists, interviews with prosecutors and defense attorneys, issuance of hypothetical case scenarios to prosecuting attorneys, exit surveys of citizens discharged from jury service, and a review of several thousand randomly chosen felony case filings in five prosecutors' offices. Aside from drug and alcohol related cases, firearms, bloodstains, fingerprints, hair, and semen are the leading categories of scientific evidence examined in felony prosecutions. Taking into account a variety of other sociodemographic and evidentiary factors, the authors find that scientific evidence makes little difference in prosecutors' decisions to charge defendants, or for that matter in the determination of guilt or innocence of charged defendants. Confessions emerge as the principal form of evidence influencing decisions to convict or acquit defendants. Forensic science reports and testimony have their greatest impact at the time of sentencing, when convicted defendants are more likely to go to prison and for longer periods of time where scientific evidence is presented.

**KEYWORDS:** jurisprudence, criminalistics, physical evidence, surveys

Law school courses in criminal evidence presume the preeminence of evidence in determining the outcomes of cases, at least in the adjudication of guilt or innocence. Legal realists, and their modern day social science adherents, by contrast, emphasize "extralegal"—sociological, demographic, and political—considerations in the disposition of cases. Somewhere between these two extremes lies reality. Evidence plays an important but far from exclusive role in the determination of a defendant's guilt or innocence and sentence. But this summary evaluation itself is vague. *Where* between the two polar views does truth actually lie? And of particular interest to this research, what is the value or effect of scientific (forensic science) evidence when compared with other types of evidence, such as complainant and eyewitness testimony, recovered property, and incriminating statements or alibis made by the defendant to the police? This paper seeks to assess the unique contribution of forensic

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evidence to the charging, plea negotiation, trial, and sentencing stages of criminal case adjudication.

Evidence could be expected to be the supreme predictor of case processing. The legal community has declared that evidence be the key determinant of trial outcomes; consequently, the opportunities for extraneous or extralegal considerations to affect decisions are carefully limited by rules of evidence which judges enforce, by careful scrutiny and selection of jurors (voir dire) and by appellate review. Yet the role of evidence in the decision of whether to charge, its importance in plea negotiations, or the assessment of appropriate punishment are left to the discretion of the decisionmaker. The legal community clearly expects that evidence should play some role in all these decisions, but how much weight may be given to nonevidentiary factors (for example, defendant and witness demographics) is ambiguous.

## Scientific Evidence and the Administration of Justice: What Do We Know?

Scientific evidence is thought to be intrinsically more reliable than other forms of evidence, given its physical nature and the precision of measurements performed on it by impartial, forensic science examiners:

> This is evidence that does not forget. It is not absent because human witnesses are. *It is factual evidence.* Physical evidence cannot be wrong; it cannot perjure itself; it cannot be wholly absent. Only its interpretation can err. Only human failure to find it, study and understand it, can diminish its value [*1*].

Just as our society has grown increasingly dependent upon scientific advances to speed communications, process information, and control disease, our judicial process has become more reliant on scientific approaches in the assessment of evidence. Since the late 1960s, the number of crime laboratories in the United States has more than tripled, spurred on by three factors: increasing levels of violent crime and illicit drug use; landmark judicial decisions curbing questionable police interrogation practices as well as informal judicial pressure at the local level to upgrade scientific assessments of evidence; and the presence of Federal monies to underwrite the expansion of laboratory facilities [*2,3*].

Beginning in the 1960s, a number of studies have placed the rates of usage of scientific evidence at a very low level [*4-6*]. In 1963, Parker estimated fewer than 1% of criminal violations receive a forensic science examination. The low rates of usage have made the assessment of the effects of scientific evidence difficult to measure:

> The involvement of the crime laboratory in the total body of crime has been so miniscule as to preclude judgment as to the impact of criminalistics on the criminal justice system [*5*].

Reliance on physical evidence and the use of forensic science laboratories continued to grow, even though there was an absence of rigorous studies evaluating its role in the investigation of crimes and the adjudication of defendants.

Kalven and Zeisel's 1966 study, *The American Jury* [*7*], included a brief overview of the use of expert witnesses at trial. No experts appeared in about three quarters of criminal trials studied, with prosecutors employing experts four times as often as defense attorneys. Lassers' 1967 survey of capital cases before the Illinois Supreme Court found that prosecutors used scientific evidence in 25% of cases, but it also revealed what he considered an inordinate reliance on confessions and witness testimony at the expense of scientific evidence [*8*]. Calspan Corporation found physical evidence occasionally instrumental in inducing guilty pleas from defendants and decisive in about 40% of trials where scientific evidence was presented [9]. Peterson et al. [*10*] found higher rates of clearance and conviction in offenses with scientifically analyzed evidence. None of these studies, however, included adequate consideration of other evidentiary and extralegal factors which could also have influenced case outcome.

Despite the absence of studies demonstrating its effectiveness, police and judicial literature has called for greater reliance on scientific evidence in court [*8,11*], with most practitioners and legal scholars expressing the belief that forensic evidence can have a major influence on adjudication of cases:

> Scientific evidence impresses lay jurors. They tend to assume it is more accurate and objective than lay testimony. A juror who thinks of scientific evidence visualizes instruments capable of amazingly precise measurement of findings arrived at by dispassionate scientific tests. In short, in the mind of the typical lay juror, a scientific witness has a special aura of credibility [*12*].

## Approach

A multisite research project was undertaken to address the effects of forensic science evidence on decisions to charge defendants, to determine their guilt or innocence, and to decide the severity of their sentences. A variety of data gathering strategies was employed to develop insights at each of several decision junctures:

- A mail survey of all crime laboratories in North America to determine their scientific capabilities and laboratory directors' attitudes toward various types of scientific evidence.
- A random sampling of felony case filings in six jurisdictions (Chicago and Peoria, Illinois; Kansas City, Missouri; Oakland, California; and New Haven and Litchfield, Connecticut) over three different calendar years (1975, 1978, and 1981), and the tracking of these cases from the point of charging to final disposition.[5] These samples enabled us to determine rates of usage of scientific evidence as well as an estimate of the effects of such evidence on case outcome.
- Interviews with prosecutors, defense attorneys, and forensic science examiners in all sites to determine trial participants' perceptions of the value of forensic science evidence relative to other forms of potential evidence.
- Distribution of a set of paper and pencil hypothetical cases to trial attorneys in the Cook County, Illinois State's Attorney's Office to gauge the relative effects of eye witnesses, confessions, and tangible and scientific evidence on criminal case processing.
- Exit surveys of several hundred jurors who had just returned verdicts in felony trials in Chicago to record their views of scientific evidence and expert witnesses relative to other evidence they heard at trial.

[5]A range of jurisdictions was selected so as to provide a broad picture of forensic science evidence utilization patterns. Peoria and Chicago, IL, Kansas City, MO, and Oakland, CA, were locations included in an earlier study of police use of forensic science evidence [*10*]. Continuation of the research in those sites permitted an examination of physical evidence utilization from the point of initial collection of evidence at the crime scene, through its analysis in the laboratory, to its ultimate usage in the courts. The Connecticut jurisdictions were added to achieve greater geographical, organizational, and caseload diversity.

Collectively, these sites span the continuum of very large jurisdictions (Chicago) to small cities and towns (Peoria and Litchfield), and reflect attendant differences in crime rates and the policies and practices of their respective criminal justice systems. The crime laboratories themselves represent different organizational structures: municipal (Chicago and Oakland); regional (Kansas City and Peoria); and a centralized state facility (Connecticut). The reader may wish to consult the full technical report *Forensic Science and the Courts: The Uses and Effects of Scientific Evidence in Criminal Case Processing* (Center for Research in Law and Justice, Chicago, 1986) for a full discussion of study site characteristics, various data gathering and analysis procedures, and research findings and policy recommendations.

The years 1975, 1978, and 1981 were selected to construct the profile of rates of usage of scientific evidence because we believed a six-year time period was sufficient to determine if the dramatic expansion of crime laboratories during the mid-to-late 1970s had resulted in the greater use of scientific evidence in court. Also, 1975 was the earliest year in prospective locations in which laboratory and prosecutor files were preserved and accessible, and 1981 was the latest year for which most cases had reached a final disposition when data collection began in 1983.

These different approaches enabled us to contrast the views of professional (legal and scientific) personnel and lay persons with actual case dispositions regarding those factors which are most important in predicting case outcome.

**Rates of Usage of Scientific Evidence**

In 1983 there were more than 300 crime laboratories across the United States, most (80%) situated within police agencies [3]. According to the laboratories' own reports, the bulk of their casework concerns the identification of drugs and alcohol. Only about one quarter of their caseload addresses evidence derived from violent and property crimes. The review of prosecutor case files in the six study sites revealed the presence of forensic science laboratory reports in about one third of cases, but this percentage varies widely as a function of offense type. Virtually all murder and drug prosecution files contain laboratory reports, but only 10 to 20% of attempt murders. On the average, one third of burglary files contain scientific reports, but less than 20% of robberies. These variations in rates appear to be a function of the seriousness of the charged offense, the availability of evidence in particular types of crimes, the information which may be derived from such evidence, and how prosecutors and courts view the importance of forensic evidence in proving the elements of a given offense.

Five categories of scientific evidence appear most frequently in prosecutor files (with descending frequency): drugs, fingerprints, firearms, blood and bloodstains, and semen. This pattern of usage suggests that laboratories are most likely to be asked to analyze evidence that is *mandatory* for prosecution of a case (as with drugs). In a related manner, laboratories are also commonly requested to test for the presence of semen in samples taken from victims of alleged rape to establish that sexual intercourse did occur. Another major priority concerns the request for examinations of evidence having the potential of *conclusively* linking the defendant with a crime and with which jurors are familiar, as with fingerprints or firearms. From a prosecutor's standpoint, there is less interest in evidence whose analysis may only partially (or probabilistically) link a defendant with a crime, for example, bloodstains, hair, or other trace evidence.

Laboratory directors generally concur with the priorities of prosecutors and cite drugs, fingerprints, and firearms as the most influential of all forms of regularly examined evidence. They are more dubious, as are prosecutors, about the significance of *trace* evidence which may be collected in an investigation. Correlatively, laboratory scientists believe their examinations of evidence to have their greatest impact in drug and homicide prosecutions. Forensic scientists also believe their examinations to have substantial impact in rapes, whereas prosecutors are less certain about the value of physical evidence in such cases.

Although we frequently read or hear about the importance of more esoteric forms of evidence (for example, hairs, fibers, glass, paint, soil) in accounts of celebrated crimes, our research shows they *rarely* appear in cases routinely processed through the criminal courts. This is both a function of the infrequency with which such evidence is recovered from the scenes of crimes and analyzed in the laboratory as well as the more limited information which examiners may obtain from it. The low rates of usage are the result of a host of factors, but four in particular: (1) insufficient crime scene and laboratory resources to collect and examine evidence; (2) mandatory analysis of suspected controlled substances in any drug prosecution which serves to displace other types of evidence which prosecutors perceive to be nonessential to their case; (3) prosecutorial and related legal personnel who are unfamiliar or uncomfortable with scientific evidence; and (4) an overloaded judicial system in which key actors (such as prosecutors) elect not to use the full range of scientific services because they are perceived to be costly and sometimes an impediment to the rapid disposition of cases.

We also attempted to determine if there are clear trends in the rates of usage of scientific evidence. With the nationwide increase in the number of laboratories, the greater sophistication of techniques and instruments, and a judicial system growing more receptive to this type of information, we might expect to find an increase in use. This, however, is *not* the case. Between 1975 and 1981, rates were fairly steady across offense types and jurisdictions (see Table 1). Rates of usage of scientific evidence were actually *lower* in most offense categories, except for murder, robbery, and drug prosecutions. Only in Peoria had there been a substantial increase in rates of usage across several offense categories.[6]

## Charging

What role does evidence play in the prosecutor's decision to charge a suspect with a crime? There are two somewhat competing perspectives. One school of thought views the prosecutor's decision as highly discretionary [*13,14*], whereas the other views the state of the evidence as the controlling, if not the exclusive, force in the prosecutor's charging decision [*15-17*]. The study completed by Calspan in 1974 suggested that physical evidence was occasionally instrumental in inducing guilty pleas from defendants [*9*], but an inadequate data base prevented the authors from making statistically supportable conclusions.

Although the case file analysis did not permit us to examine the movement of cases from the time of arrest to the point of prosecutorial charging, we did learn how scientists and prosecutors viewed the importance of forensic science evidence in making charging decisions via interviews and our hypothetical case analysis. In addition, an earlier companion project

TABLE 1—*Rates of usage of scientific evidence by offense category over 1975-1981, %.*

| | City/Year | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Chicago | | | Peoria | | | Kansas City | | | Oakland | | | Litchfield | | | New Haven | | |
| Offense | 75 | 78 | 81 | 75 | 78 | 81 | 75 | 78 | 81 | 75 | 78 | 81 | 75 | 78 | 81 | 75 | 78 | 81 |
| Murder | 94 | 87 | 90 | 100 | 100 | 100 | 100 | 100 | 94 | 100 | 92 | 90 | 100 | 100 | ... | 100 | 100 | 100 |
| Attempt murder/ aggravated battery | 14 | 09 | 10 | 04 | 11 | 10 | 27 | 05 | 19 | 13 | 11 | 09 | 16 | 13 | 00 | 19 | 36 | 20 |
| Rape | 82 | 64 | 78 | 38 | 24 | 53 | 25 | 60 | 51 | 61 | 45 | 46 | 24 | 24 | 14 | 33 | 36 | 31 |
| Robbery | 05 | 03 | 02 | 04 | 19 | 22 | 19 | 08 | 10 | 07 | 16 | 11 | 15 | 12 | 08 | 12 | 13 | 17 |
| Burglary | 15 | 12 | 13 | 25 | 35 | 31 | 16 | 25 | 19 | 30 | 35 | 21 | 11 | 02 | 10 | 35 | 43 | 40 |
| Theft | 17 | 02 | 05 | 04 | 14 | 17 | 08 | 13 | 09 | 22 | 13 | 05 | 33 | 14 | 03 | 08 | 17 | 00 |
| Drugs | 94 | 90 | 97 | 96 | 81 | 93 | 97 | 100 | 98 | 98 | 100 | 98 | 97 | 86 | 87 | 98 | 100 | 97 |

[6]Peoria is also the only site in our study which experienced substantial expansion of crime scene and laboratory resources during the period covered by the study.

[*10*] found that charges are generally more likely to be filed for arrests in which physical evidence is collected and examined than cases without such scientific evidence.

Laboratory directors think forensic science evidence is of moderate importance in decisions to charge defendants with a crime. Prosecutors, on the other hand, think forensic science evidence relatively unimportant in decisions to charge, relying instead on statements of eyewitnesses. The classic exception to this would be the necessity of having a laboratory report in charging a defendant with drug possession. One of the primary reasons prosecutors note that forensic science evidence is not normally considered in decisions to charge is that laboratory results typically are not available at the time these decisions have to be made. If forensic science laboratories are to have a greater effect at this stage of the justice process, resources will have to be expanded to enable laboratories to examine evidence and report results much more rapidly.

We also examined the charging decision via our hypothetical case review. The pencil-and-paper hypothetical cases varied in the strength of forensic science and tangible (something physical, like stolen property) evidence, if the defendant was identified by an eyewitness, and if the defendant confessed to the crime.[7] Prosecutors were asked to indicate the most likely path of disposition for each case, beginning at the point of charging and extending through sentencing.

At the point of charging, it is in the *absence* or *weakness* of several forms of evidence (including the forensic science) where prosecutors think charges would be *declined.* In the hypothetical attempt murder (see Table 2), for example, this is only where the defendant fails to confess to the crime, there are no eyewitnesses, *and* no forensic science evidence that prosecutors predict they would not file formal charges against the defendant. For rapes, it is where tangible and forensic science evidence only weakly associate the defendant with the offense that they are unlikely to charge.

## Conviction—Plea Bargaining and Trials

The role of evidence in plea negotiations is uncertain due to the inconsistent, varying character of plea discussions themselves. Neubauer characterized them as "mini-trials" [*18*], (with a corresponding consideration of evidence of the defendant's guilt), while most re-

[7]The respondents included all 165 prosecuting attorneys in the felony trial division of the State's Attorney's Office in Chicago who were asked to complete a questionnaire. Sixty-five percent of the questionnaires were returned (one hundred and eighteen). Questionnaires were developed consisting of brief, one-page descriptions of four crimes: a rape, a robbery, an attempted murder and a burglary. The cases varied with respect to: (1) presence/absence of an eyewitness who could identify the defendant as the individual responsible for the offense; (2) strength (strong/weak) of association between defendant and crime due to tangible evidence either found on the defendant or left by the defendant at the scene of the crime; (3) presence/absence of an oral confession by the defendant, and (4) strength of forensic science evidence (five levels) in terms of the certainty with which it linked the defendant to the crime.

The presentation of the case was varied such that for any prosecutor, the strength of the tangible evidence, forensic science evidence, and eyewitness identification were held constant across all cases read. Prosecutors were asked to assume that certain other facts associated with the cases that might have influenced their case processing decisions were constant across all the cases.

For each of the four types of crime, prosecutors were asked to indicate the most likely path of disposition for the case, given that the defendant had orally confessed to the crime though refused to sign a statement. Prosecutors were then asked to indicate the most likely pattern of case disposition given that the defendant had *denied* committing the crime. Thus, each prosecutor indicated what he/she believed to be the most likely pattern of case disposition for eight cases. Confession by the defendant is manipulated within subjects, while eyewitness identification, tangible evidence, and forensic science evidence vary between subjects.

The results were analyzed within the framework of a repeated measures analysis of covariance. The study consisted of a 2 (strength of tangible evidence) by 2 (eyewitness identification) by 5 (strength of forensic science evidence) between subject design and one two-level, within-subjects factor (whether or not the defendant confessed).

TABLE 2—*Adjusted cell means for charging decision: interaction of availability of forensic science evidence, eyewitness identification, and confession for attempted murder.*[a]

| | Forensic Science Evidence | | No Forensic Science Evidence | |
|---|---|---|---|---|
| | Eyewitness Identification | | | |
| Confession | Yes | No | Yes | No |
| Yes | 2.99 | 2.97 | 2.99 | 2.99 |
| No | 2.97 | 1.76 | 3.00 | 1.52 |

[a]Codes: 1 = no charge approved; 2 = lesser charge approved; 3 = full charge approved.

searchers have emphasized negotiations over *sentence* [*19,20*] as the centerpiece of the plea process with less attention paid to the evidence. Can we assume, then, that evidence plays little or no role in plea bargaining because it is not discussed (much or at all) in plea conferences? The lack of dispute over evidence, or the choice by courtroom actors to avoid talking about the evidence, does not necessarily imply a trivial level of influence. Indeed, quite the opposite may be true. The impact of the evidence may be so clear that neither prosecution nor defense feels the need to discuss it.

Lagoy [*21*] and McDonald [*22*] found prosecutors very concerned with the nature of the evidence associated with a case. Eisenstein and Jacob [*23*] found strength of evidence to be associated with likelihood of conviction and sentence imposed, but this review was insufficiently precise to assess the impact of scientific or any other specific kind of evidence. Feeney et al.'s [*24*] study of robbery and burglary arrests found evidence to be the most important factor in predicting conviction. Forst's [*25*] review of felony and serious misdemeanor arrests found certain police activities and types of evidence to increase the likelihood of conviction—these behaviors included locating two or more witnesses to the crime, making *prompt* arrests, and locating tangible (but not necessarily *scientific*) evidence.

The Calspan study [*9*] cited earlier found the appearance of physical evidence to be associated with guilty pleas, but because this study did not control for other forms of evidence or extralegal factors (race, prior criminal record, relationship between suspect and victim, and so forth), these results must be reviewed cautiously. Similarly, the study published by Peterson et al. [*10*] found lower dismissal and higher conviction rates for offenses having scientific evidence. This research also was limited by its failure to take into account other important evidentiary and extralegal considerations.

In the present study, we initially focused on whether the defendant was convicted or not. In a subsequent section we will discuss charge reductions and sentencing, but for the time being we are concerned with whether or not the accused was convicted of any crime. Conviction is the "normal" outcome in most criminal (felony) courts. The figures approach a 90% conviction rate in Oakland (88%) and New Haven (86%) and a three-quarters conviction rate in Chicago (74%) and Peoria (73%). Only in Kansas City (67%) and Litchfield (66%) are rates of conviction as low as two thirds.

We were interested in seeing if forensic science evidence makes a discernible difference in conviction rate. Also, what is the contribution of forensic science evidence vis-a-vis other kinds of information and does the effect of scientific evidence hinge upon the presence or absence of other forms of evidence, for example, witnesses, confessions, or extralegal factors—age, race, or gender of the defendant?

On average, our sample of prosecutor filings reveals that 70 to 80% of cases result in conviction, usually through a plea to the top charge. Typically, only 5 to 10% of cases are resolved at trial. Overall, we find the conviction rate of cases with scientific evidence not to be significantly higher or different from cases without forensic science evidence. Only in Peoria do cases having a laboratory report result in higher conviction rates (78 versus 71%, $p = 0.04$).

We next tested if the *results* of the laboratory examinations are related to case outcome. Table 3 displays these results, and we see that conviction rates tend to be higher when forensic science evidence associates the defendant with the crime. Peoria is a prototype of this condition wherein conviction is fully ten percentage points higher when the evidence associates the defendant with the crime, as compared with cases where evidence is merely identified, helps to reconstruct the crime, fails to associate the defendant with the crime, or is not examined at all. Chicago mirrors Peoria almost exactly, except that the differences in Chicago are not statistically significant, because there are so few forensic science associations (29 in Chicago compared with 98 in Peoria).

Oakland and New Haven also follow the pattern of the Illinois jurisdictions, but the increases in conviction in the "association" category (3 to 4%) are not large enough to be statistically significant. In Kansas City, however, a different pattern emerges. The "failure to associate" category has many fewer convictions (46%) than any of the other categories, indicating that in Kansas City—though not elsewhere—defendants are sometimes the beneficiaries of laboratory tests that *fail* to link them with the crime. The fact that there is not a clear *linear* relationship between the strength of association of the forensic evidence and case outcome means that this four-level variable must be recoded into simpler bivariate categories (for example, the evidence is or is not examined, or does or does not associate the defendant with the crime) in subsequent multivariate analyses.

To assess the individual impact of forensic science evidence on case outcome, however, it is necessary to control for other types of evidence and extralegal factors which may also influence the disposition. We controlled for approximately a dozen other factors (the reader is referred to the full technical report [*26*] for a complete discussion of these variables), but eight emerged as significant either by themselves, or in combination with forensic science evidence, in the multivariate analyses:

*Tangible Evidence*—Something physical, like personal possessions or stolen property, that may link a suspect with a crime but which is *not* examined scientifically.

*Seriousness of the Incident*—Extent of personal injury to the victim, including possible use of a weapon.

TABLE 3—*Forensic science evidence and conviction.*

| Results of Laboratory Testing | Chicago | Oakland | Kansas City | Peoria | New Haven |
|---|---|---|---|---|---|
| Association | 83%[a] | 93% | 72% | 86% | 89% |
| Identification/ reconstruction | 74% | 89% | 72% | 75% | 86% |
| No evidence examined | 77% | 89% | 67% | 71% | 85% |
| Failure to associate | 75% | 87% | 46%[b] | 73% | 75% |
| $X$ | N/S | N/S | 7.2 | 9.5 | N/S |
| $p$ | . . . | . . . | 0.06 | 0.02 | . . . |
| $N$ | 917 | 946 | 889 | 1052 | 440 |

[a]Only 29 cases.
[b]Only 26 cases.

*Defendant Statements*—Statements of defendants ranging from alibis to outright confessions.

*Witnesses*—The number and ability of witnesses to recount the alleged crime and identify the defendant.

*Arrest*—This variable describes if the defendant was apprehended at or near the crime scene.

*Victim/Defendant Relationship*—Measures if the defendant and victim knew one another before the crime.

*Prior Record*—A measure of the prior arrest and conviction record of defendant.

*Defendant Demographics*—Age, sex, and race of the defendant.

We are particularly interested in seeing if any relationships between forensic science evidence and conviction withstand controls for these other variables. We are also interested in seeing if forensic science evidence *acts in combination (interacts) with* other evidentiary or extralegal factors in affecting case outcome.

We have chosen stepwise logistic regression analyses to give a relatively precise estimate of the effect of each independent variable upon the dependent variable (conviction/no conviction), controlling for other measured independent variables.[8]

The coefficients which appear in Table 4 are the logarithms of the net increase/decrease in odds of conviction contributed by particular variables. Only variables that are statistically significant ($p < 0.05$) are included. The variables in the model are not particularly successful in explaining case outcome variation,[9] as indicated by the modest percentage of outcomes correctly predicted ("Predicted Probabilities"). The Kansas City and Peoria models are most successful, correctly predicting 68 and 69% of the outcomes.

There are three variables that stand out from among the many examined, in that they prove to be significant predictors of conviction in three or more locations.

1. Age: Younger defendants are more likely to be convicted than older defendants in three sites.
2. Incriminating statements: The original four-level variable was recoded into three dichotomies (IEV1, IEV2, and IEV3) [*26*]. Generally, cases with outright confessions are significantly more likely to lead to conviction than any other type of utterance.
3. Tangible evidence: Cases with tangible items of evidence linking a defendant with a crime are more likely to result in convictions than cases without such evidence.

**Forensic Science Evidence**

We found that the forensic science evidence variable emerged by itself as a significant predictor in only one jurisdiction—Peoria. However, the forensic science variable did interact with other variables in two additional cities to have a significant effect on case outcome. To discuss the influence of forensic science evidence and its interaction with other variables, we need to present a short discussion of how the original four-level forensic science variable was recoded.

The reader will recall that our initial bivariate analysis of forensic science evidence and case outcome determined that the relationship between the two was nonlinear. Lacking such

[8]We used the stepwise LOGIST procedure to fit the logistic multiple regression model to a single binary (0 or 1) dependent variable and to determine the best variable to be added to the model at any given step. Maximum likelihood estimates were computed in this procedure using the Newton-Raphson method. The model chi-square is twice the difference in log likelihood of the final model from the likelihood based on intercept only. The "Predicted Probabilities" statistic is the percentage of concordant pairs correctly predicted by the model. For a full discussion of this procedure, see *S.A.S. Supplemental Library Users' Guide,* edited by Patti Reinhard (S.A.S. Institute Inc., 1980).

[9]Eisenstein and Jacob [*23*] also explained little of the variation in conviction in their sites (12% in Baltimore, 15% in Chicago, 17% in Detroit, using multiple discriminant function analysis).

TABLE 4—*Conviction: stepwise logistic regression by site (log odds).*

| | All Cases | | | | |
|---|---|---|---|---|---|
| Conviction Rate | Chicago 79% | Oakland 91% | Kansas City 69% | Peoria 77% | New Haven 87% |
| Defendant statements | −0.51[a] (IEV3) | −0.45[a] (IEV1) | −0.36[a] (IEV2) −0.62[a] (IEV3) | −0.28[a] (IEV1) −0.46[a] (IEV3) | −0.77[a] (IEV1) |
| Defendant's age | −0.02[b] | −0.03[b] | . . . | −0.02[a] | . . . |
| Tangible evidence | 0.36[a] (TEV1) | . . . | 0.47[a] (TEV1) | 0.81[a] (TEV1) | . . . |
| Forensic science evidence | . . . | . . . | 0.22[b] (FEV1 IEV1) | 0.33[b,c] 0.57[a,d] | 0.02[b] (FEV1 SER2) |
| Prior relationship | . . . | . . . | −0.73[a] | −0.39[b] | . . . |
| Arrested at/near crime scene | . . . | . . . | 0.48[a] | 0.46[a] | . . . |
| Seriousness | −0.01[a] (SER2) | . . . | . . . | −0.10[b] (SER1) | . . . |
| Prior record | . . . | . . . | −0.26[a] | . . . | . . . |
| Eyewitnesses | . . . | . . . | . . . | 0.76[a] | . . . |
| Predicted probabilities | 62% | 60% | 68% | 69% | 63% |
| Model chi-square | 33.31[a] | 16.87[a] | 88.95[a] | 87.43[a] | 16.08[a] |
| *N* | 719 | 774 | 762 | 909 | 310 |

[a]Significant at 0.01.
[b]Significant at 0.05.
[c]FEV1.
[d]FEV2.

a linear relationship, we believe there to be two basic questions about the relationship between forensic science evidence and case outcome which are worthy of exploring: the first is the effect on having *any* kind of forensic science laboratory report in a case versus having none at all; the second is the effect of having forensic science evidence which *associates* the defendant with the crime versus cases where evidence is analyzed but yields no such association. In the latter situation, material may be identified or classified in some fashion, but does not demonstrate a linkage between the defendant and the crime. The former dichotomy (lab report versus no lab report) was labelled FEV1 and the latter (association versus no association) was labelled FEV2. Statistical tests showed these two dichotomous variables not to be collinear, neither with one another nor with forensic science interaction terms described in the next section.

The reader will recall that although there tended to be a general pattern for conviction rates to be higher when the forensic science evidence links the defendant with the crime, the only city where this bivariate relationship was significant (at the 0.05 level) was in Peoria (Kansas City was very close at 0.06). Consequently, it is not surprising to find that Peoria is the only city where forensic science evidence withstands the controls for all other variables. In fact, *both* relationships—FEV1 and FEV2—proved to be significant while controlling for other factors.

## Forensic Science Interactions

For the purpose of this study we also wish to see if either of the recoded forensic science variables (FEV1 and FEV2) interacts with other variables in its effect on conviction rates. Although it is quite possible that the remaining independent variables interact with one another in their effects upon the convict/no-convict decision, we choose not to profile such possibilities in this particular study, given its primary objective of detailing the influence of scientific evidence on case outcome.

The search for forensic science interaction terms was limited principally to "sister" evidence categories: defendant statements, tangible evidence, availability of eyewitnesses, and crime seriousness. Crime seriousness was added as a potential interaction variable, given its importance to police investigators and crime laboratory examiners in deciding which physical evidence to gather and to analyze [*10*].

The interaction of forensic science evidence with other variables assumed statistical significance in explaining case outcome in two of the five study sites (Kansas City and New Haven). In Kansas City, the presence or absence of a laboratory report (FEV1) interacts with statements uttered by the defendant (IEV1) to affect case outcome. Specifically, it is in the *absence* of a defendant statement that the presence of a laboratory report is associated with an increased likelihood of conviction and its absence associated with a lower probability of conviction.

The other significant interaction involving forensic science evidence takes place in New Haven, where FEV1 interacts with crime seriousness (SER2) to influence case outcome. Recall that the original seriousness variable was constructed ordinally, classifying offenses from least to most serious. Our bivariate examination of this seriousness variable and conviction rate found theirs to be a nonlinear relationship. That is, conviction rate did not always consistently increase (or decrease) as crimes became more or less serious. As a result, we employed three different coding schemes: SER1 (the original ordinal variable), SER2 (a cubic transformation) which classified the most and least serious crimes in the same category, and SER3 which used a quadratic transformation to plot crime seriousness. SER3 would emerge as the best "fit" for the data if there were *two* changes in direction of a curve plotting crime seriousness by rate of conviction. In other words, as offenses become more serious, rates of conviction might rise, then fall, only to rise again.

In New Haven, FEV1 (presence/absence of a lab report) interacts with SER2 (which classified progressively more and less serious cases into the same category) in its effect on conviction. Here it is the *absence* of a laboratory report which combines with the *most* and *least* serious cases to *reduce* the likelihood of a conviction. The most serious offenses would include murders and other violent crimes committed with a firearm and which resulted in great bodily injury. The least serious offenses are thefts and minor property crimes. The presence of a laboratory report tended to "smooth out" this relationship by supporting higher conviction rates at both ends of the seriousness continuum.

## Effects of Forensic Science Evidence on Probability of Conviction

The logistic regression equation also enables us to estimate the *probability* of gaining a conviction where independent variables are set at prescribed levels. These "prescribed" levels are somewhat arbitrary and may be varied depending upon one's interest. In the following "typical" example, categorical variables were set at their modal levels and the continuous variable (age) at its mean.[10] We first examine the effect of the presence or absence of a

[10]For the example given in the text, independent variables were set at the following levels:

IEV1 = 1 (defendant makes no statement)
IEV3 = 0 (only one defendant statement variable is considered at a time)
AGE = 27 (the mean age of all defendants)
TEV1 = 1 (no tangible evidence)
FEV1 = −1, 0.5 (the forensic variable contrasts "other" laboratory reports with "associative reports)
NEWID = 1 (one or more witnesses)

laboratory report (FEV1) on the probability of conviction in the Peoria study site. In this example, the probability of conviction increases 18 percentage points (from 71 to 89%), when conviction rates of cases without laboratory reports are compared with those with laboratory reports.

Using the same equation, we can test the effect of an associative laboratory finding versus a nonassociative report (FEV2). With the remaining independent variables set at the same levels as in the previous example (and FEV1 = 0), we find the conviction rate to be 59% when the laboratory report yields nonassociative results and 95% when the scientific report yields associative results. In Peoria, therefore, it appears that it is the *content* of the laboratory report (FEV2) which exerts the greater effect on conviction rate.

The report/no report forensic science variable (FEV1) interacted with other independent variables in two jurisdictions to produce a significant effect on conviction. In Kansas City, it is where defendants make *no* statements that FEV1 has its primary effect—principally *lowering* conviction rates when *absent.* In New Haven, FEV1 works to keep conviction rates high at the extreme ends of the seriousness continuum where, without laboratory reports, there is a tendency for conviction rates to be lower.

In sum, then, the importance of the forensic science variable appears to be *primarily* along the report/no report dimension (FEV1) rather than the *content* of the report, that is, if the report associated the defendant with the crime or not (FEV2). It should be noted, however, that in Peoria, where both FEV1 and FEV2 are significant, FEV2 is the stronger of the two.

When we aggregate offenses of a similar nature, we find forensic science evidence has its greatest main effect on the conviction of defendants charged with murder, burglary, and

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RELAT = −1 (no prior victim/suspect relationship)
PROXCRIM = 1 (the defendant was not apprehended at the crime scene)
SER1 = −4 (a minor theft or burglary)

The probability of conviction may be expressed by the following equation:

$$\log \frac{p}{1-p} = -(0.28)(\text{IEV1}) - (0.46)(\text{IEV3}) - (0.02)(\text{AGE}) + (0.81)(\text{TEV1}) + (0.33)(\text{FEV1}) + (0.57)(\text{FEV2}) + (0.76)(\text{NEWID}) - (0.39)(\text{RELAT}) + (0.46)(\text{PROXCRIM}) - (0.10)(\text{SER1}) + 1.26\ (\text{intercept})$$

where

$$\text{FEV1} = -1:\ p\ (\text{probability of conviction}) = \frac{\text{antilog } 0.396}{(\text{antilog } 0.396) + 1}$$

(no laboratory report)

$$= \frac{2.488}{3.488} = 0.71$$

where

$$\text{FEV1} = 0.5:\ p\ (\text{probability of conviction}) = \frac{\text{antilog } 0.891}{(\text{antilog } 0.891) + 1}$$

(laboratory report)

$$= \frac{7.78}{8.78} = 0.89$$

theft.[11] Our survey of crime laboratory directors found that they believe forensic science evidence to be most important in deciding the outcomes of drug related, homicide, and rape cases. They believe forensic science evidence to be of moderate importance in arsons and burglaries and minimal importance in aggravated batteries, robberies, and larcenies.

The presence of any type of laboratory report increases the rate of conviction for burglaries by about 17 percentage points, while lab reports associating the defendant with the crime prove to be significant in murders and thefts (conviction rates are about 5 to 10 percentage points higher in cases with laboratory reports). For rapes, the absence of a laboratory report leads to significantly *lower* conviction rates where defendants have also offered alibis to law enforcement officials. Under such circumstances, the conviction rate drops by *more than half* when the laboratory report is absent.

In our hypothetical cases, we find generally that prosecutors expect a very high proportion of cases to result in conviction. We are able to identify significant explanatory variables only for rape and attempt murder cases. Both rapes and attempt murders are expected to result in conviction less often when there is no eyewitness identification *or* weak tangible evidence and no confession. For the attempt murder it also appears that conviction is expected to be less likely in two situations: in the absence of a confession and when forensic science evidence weakly associates the defendant with the offense; and when both the tangible and forensic science evidence weakly associate the defendant with the offense. Again, we note that prosecutors appear to think in terms of the *absence* of evidence which may weaken their cases and lead to acquittal. The presence of forensic science evidence, regardless of the certainty with which it connects the defendant with the crime, is predicted to result in higher rates of conviction.

The outcomes of the hypothetical case decisions are in agreement with our case file sample and our interviews with prosecutors in two basic respects. First, the perception of prosecutors that most cases will result in conviction is in fundamental agreement with our case sample. Second, it is when cases either lack evidence or have two or more forms of weak evidence, including forensic, that prosecutors reduce their expectations for conviction.

## Charge Reduction and Sentencing

We next focus upon sentencing and the factors which influence it. There are strong indications that charge reductions play a major role, or why else would court actors—prosecutors and defense attorneys—bother about the charge or charges with which to convict a defendant. Some have argued, however, that charge reductions are merely illusions designed to induce defendants to plead guilty, designed to convince defendants that their attorney has obtained a "good deal" when, in fact, such is not the case.

Court actors *do* bother about which charges to convict on. In three sites—Chicago, Oakland, and Peoria—about 20% of convicted defendants are convicted of a "reduced" charge. In New Haven, 30% of defendants are convicted on a reduced charge. In Kansas City, slightly more than half of convicted defendants (57%) are convicted of a reduced charge. Thus, charge bargaining is an integral part of plea bargaining in all sites, especially in Kansas City. (For our purpose here, both convictions on lesser, related charges (for example, armed robbery to robbery) and convictions on lesser, unrelated charges (for example, rape to attempted robbery) are treated as "charge reductions."

Our data verify that charge reductions do lead to fewer instances of incarceration and

[11]We simply consolidated all crimes of the same type from the five jurisdictions and reran our stepwise regressions. We did not weight or manipulate our sampled cases in any other fashion, as one would have done had our sites been chosen for their representativeness of court and laboratory systems across the nation. We are simply looking for "trends" in the contributions of various evidence types in selected felonies, and our data should be viewed as such.

shorter periods of incarceration. Defendants convicted of the most serious charge are between 10 and 20 percentage points more likely to be sentenced to incarceration than those who are not. The same is true for length of incarceration, where differences range between 9 months (Oakland) and 4 years (Kansas City).

We first examine the evidentiary and extralegal factors which influence whether these factors influence sentencing directly, indirectly (through charge reduction), or both. Our working hypothesis is that forensic science evidence (along with a range of other factors) makes a significant difference in the charge reduction and sentencing decisions. Where forensic science evidence exists, and particularly where it associates the defendant with the crime, the frequency of charge reduction—all other things being equal—should be lower, since the state's case can be presumed *not* to be weak. At sentencing directly, forensic science evidence may also make a difference. The certainty that the defendant committed the offense, which forensic science evidence sometimes provides, may induce the judge to incarcerate the defendant rather than grant probation or, where incarceration is mandated, to increase the length of incarceration.

Defendants are convicted of reduced charges in about 20% of prosecutions. Using this as our dependent variable, we find that the absence of a prior criminal record, a prior relationship between the defendant and victim, and cases resolved by pleas all lead to convictions on a reduced charge (see Table 5).

Only in Oakland does the presence of a laboratory report associating the defendant with the crime significantly *increase* the rate of conviction to the top charge. It is here that the presence of a laboratory report associating the defendant with the crime increases the likelihood of a conviction to the top charge by about 10 percentage points. In the only jurisdiction (Kansas City) where a forensic science variable interacts with another evidence variable, it is

TABLE 5—*Charge reduction: stepwise logistic regression by site (log odds).*

| Conviction on Most Serious Charge | All Cases | | | | |
|---|---|---|---|---|---|
| | Chicago 81% | Oakland 76% | Kansas City 43% | Peoria 77% | New Haven 70% |
| Prior relationship | −1.41[a] | −0.42[b] | . . . | −0.57[a] | −0.77[b] |
| Prior record | 0.32[b] | . . . | 0.43[a] | . . . | 0.42[a] |
| Case disposition (trial) | −1.78[a] | . . . | 1.72[a] | 0.90[b] | . . . |
| Race (black) | . . . | 0.39[b] | . . . | 0.59[a] | . . . |
| Seriousness of incident | . . . | . . . | . . . | −0.18[a] (SER2) | −0.07[a] (SER3) |
| Forensic science evidence | −0.04[a] (FE1SER3) | −0.40[b,c] 0.13[a,d] | 0.57[b] (FE2IEV2) | . . . | −0.08[a] (FE1SER3) |
| Eyewitnesses | . . . | −0.71[b] | . . . | . . . | . . . |
| Defendant age | . . . | . . . | 0.04[a] | . . . | −0.04[b] |
| Gender (female) | 2.88[a] | . . . | . . . | . . . | . . . |
| Defendant statement | . . . | . . . | . . . | . . . | 0.71[a,e] −0.89[a,f] |
| Predicted probabilities | 82% | 63% | 69% | 60% | 78% |
| Model chi-square | 36.56[a] | 39.44[a] | 64.29[a] | 35.05[a] | 64.71[a] |
| *N* | (567) | (700) | (520) | (683) | (269) |

[a]Significant at 0.01.
[b]Significant at 0.05.
[c]FEV2.
[d]FEV1, SER1.
[e]IEV2.
[f]IEV3.

where the defendant issues a statement (alibi) which may weaken the prosecutor's case that a forensic report associating the defendant with the crime increases the likelihood of a conviction to the top charge. The difference in these alibi cases is rather dramatic, with conviction rates to the top charge 30 percentage points higher where a lab report associates the defendant with the crime.

Our offense specific analysis shows that forensic science evidence exerts a singular main effect only in the crime of burglary, where laboratory reports are associated with convictions to the top charge. The presence of a laboratory report increases the probability of conviction to the top charge by a hefty 20 percentage points when controlling for other variables. In several other offense categories, the presence of a laboratory report acts in combination with an incriminating statement to lead to convictions to the top charge.

Our hypothetical data are not dissimilar from these case file results. There is, however, only one offense category (burglary) where data permitted an analysis of this variable. Results generally showed the frequently noted disjunctive rule: the absence of different forms of evidence or the finding of only tentative forensic evidence in a distant location lead prosecutors to predict the defendant would plea to a reduced charge. When the defendant denies committing the crime, when there are no eyewitnesses, and when forensic science evidence is either recovered in a distant location or only tentatively associates the defendant with the crime scene, chances that prosecutors will think the case will be pled to a lesser charge are increased.

Sentencing in felony courts involves two distinct, if related, stages: whether or not to incarcerate a defendant, and, if so, for how long a term. Prior research has indicated, sometimes in a very detailed way, that the factors associated with these two steps may vary substantially [*23*]. Thus, it is appropriate that the two stages be analyzed separately, to test for differential influences.

We first examine the decision whether to incarcerate or not. Convicted defendants are likely to face imprisonment everywhere except Kansas City. In Oakland 79% of convicted defendants are incarcerated; the figure drops to 73% in Chicago, 70% in New Haven, 63% in Peoria, and 40% in Kansas City. These figures include incarceration in both state prisons as well as county jails; nevertheless, in both instances, defendants are removed from the community and lose their freedom for a period of time.

Nonevidentiary factors predominately explain the nature and severity of sanctions given convicted defendants. Prior record of the defendant overwhelms most other factors in the decision about incarceration. The more serious the crime, and being convicted of the original charge are also associated with sentences of incarceration (see Table 6). Typically, no evidentiary factors influence the decision to incarcerate the defendant. The presence of forensic science evidence, however, proves to be an important predictor in two sites (New Haven and Chicago), where the likelihood of incarceration is about 20 percentage points higher in cases with a laboratory report than in those without forensic evidence. In the aggregated offense analysis, similar factors are important predictors of sentence severity. In addition, rapists and burglars who choose to take their cases to trial are significantly more likely to be sentenced to incarceration when convicted than those who have plea bargained. Forensic science evidence is a factor in the sentencing of defendants who are convicted of attempt murder/aggravated battery and robbery, where felons are 30 to 35% more likely to be incarcerated when forensic science evidence is present.

The second sentencing question we address centers on the *length* of incarceration. How do evidentiary variables, extralegal factors, and charge reductions influence the decision as to length of time imposed? Here we employ stepwise multiple regression analysis inasmuch as our dependent variable is interval level (months of incarceration).

The two most important variables predicting length of incarceration in every site are seriousness of the incident and the presence or absence of a charge reduction (Table 7). Surprisingly, the presence of a laboratory report is associated with the length of sentence in four of

TABLE 6—*Incarceration: stepwise logistic regression by site (log odds).*

| | All Cases | | | | |
|---|---|---|---|---|---|
| Incarceration Rate | Chicago 73% | Oakland 79% | Kansas City 40% | Peoria 63% | New Haven 70% |
| Prior record | 0.90[a] | 0.62[a] | 1.18[a] | 0.85[a] | 0.94[b] |
| Charge reduction | 0.70[a] | 0.50[b] | . . . | 0.68[a] | 0.74[b] |
| Seriousness of incident | 0.31[a,c]<br>0.05[a,d] | 0.15[a,c]<br>0.05[a,d] | 0.29[a,c] | 0.18[a,c] | 0.52[a,c] |
| Case disposition (trial) | . . . | . . . | 2.04[a] | . . . | . . . |
| Gender (female) | −1.61[a] | . . . | . . . | −1.00[a] | . . . |
| Forensic science evidence | 0.86[a]<br>(FEV1)<br>0.21[a]<br>(FEV1SER1)<br>−2.32[a]<br>(FEV2SER2) | −0.34[b]<br>(FEV1TEV1)<br>0.04[a]<br>(FEV1SER3) | . . . | 0.03[a]<br>(FEV1SER3) | 1.55[a]<br>(FEV1)<br>0.50[a]<br>(FEV1SER1) |
| Arrested at/near crime scene | . . . | . . . | . . . | −0.58[a] | . . . |
| Defendant statements | . . . | . . . | −0.32[b]<br>(IEV2) | . . . | 0.65[b]<br>(IEV2) |
| Prior relationship | −0.75[b] | −0.58[b] | . . . | . . . | . . . |
| Race (black) | 0.65[b] | . . . | . . . | . . . | . . . |
| Predicted probabilities | 84% | 69% | 79% | 75% | 79% |
| Model chi-square | 192.24[a] | 71.36[a] | 185.87[a] | 127.27[a] | 73.08[a] |
| *N* | (563) | (697) | (520) | (591) | (269) |

[a]Significant at 0.01.
[b]Significant at 0.05.
[c]SER1.
[d]SER3.

the five locations. In three (Chicago, Oakland, and New Haven) of the four sites where forensic science evidence is significant, it is simply the appearance of a laboratory report (regardless of content) which is associated with longer sentences (on average, a net difference of 30 months). Only in Peoria are cases containing forensic science evidence linking the defendant with the crime more likely to result in longer periods of incarceration (by about 20 months).

We can only speculate as to why forensic science evidence has a greater direct effect on sentencing length than for charge reduction and incarceration. One possible explanation might be that laboratory results vividly document the character and degree of violence associated with the crime (for example, testing for blood, examining weapons and firearms), thereby leading to a "deservedly" longer sentence of incarceration. Another related explanation might be that it is the most serious and violent offenses that are more likely to generate forensic science evidence and laboratory analysis, because they are the most serious (from the prosecutor's point of view, at least, who commonly requests laboratory reports of collected evidence). When forensic science evidence is compared with the seriousness of the offense, we do find a moderate correlation (the highest being about $p = 0.13$ in Chicago and New Haven) but nothing approaching collinearity. Given this moderate relationship, plus incorporation of offense class (violent, property, victimless) into the seriousness variable, we are reasonably confident the forensic science evidence variable is not merely a "masked" offense variable. Whatever the precise explanation, there is a clear association between forensic science evidence and length of incarceration, while controlling for a range of other variables.

The aggregated offense analysis finds that forensic science evidence registers its major

TABLE 7—*Length of incarceration: stepwise multiple regression by site (betas).*[a]

| | All Cases | | | | |
|---|---|---|---|---|---|
| | Chicago | Oakland | Kansas City | Peoria | New Haven |
| Mean Length (months) | 70 | 24 | 57 | 31 | 40 |
| SD | (99) | (40) | (85) | (59) | (44) |
| Charge reduction | 0.26[b] | 0.12[b] | 0.45[b] | 0.18[b] | 0.19[b] |
| Seriousness of incident | 0.50[b] (SER1) | 0.48[b] (SER1) | 0.47[b] (SER1) | 0.23[b] (SER1) | 0.24[b] (SER1) |
| Case disposition (trial) | ... | 0.18[b] | 0.18[b] | ... | ... |
| Forensic science evidence | 0.17[b] (FEV1) | 0.26[b] (FEV1) | ... | −0.11[c] (FEV2) | 0.20[b] (FEV1) |
| | | 0.26[b] (FE1SER1) | | −0.97[b] (FE1TEV1) | |
| Arrested at/near crime scene | −0.09[c] | −0.11[b] | ... | −0.23[b] | ... |
| Prior record | 0.31[b] | 0.27[b] | ... | 0.44[b] | ... |
| Gender | ... | −0.09[c] | ... | −0.11[c] | ... |
| Defendant age | −0.08[c] | ... | −0.13[c] | ... | ... |
| Defendant statements | −0.14[b] | ... | ... | ... | ... |
| Eyewitnesses | ... | ... | ... | ... | 0.15[c] |
| $R^2$ | 0.38 | 0.31 | 0.46 | 0.33 | 0.16 |
| $N$ | (400) | (545) | (207) | (358) | (187) |

[a]Dependent variable: the log transformation of length of sentence (months).
[b]Significant at 0.01.
[c]Significant at 0.05.

impact for the crimes of attempt murder/aggravated battery, rape, robbery, and burglary. Longer sentences are given defendants where laboratory reports are present. Holding other independent variables at their median values, the presence of a laboratory report adds about 23 months to attempt murder sentences, 27 months to robbery terms, and 4 months to theft sentences. In two offense categories (robbery and theft), the presence of an associative laboratory finding has an even greater effect on sentence length under conditions where defendant statements are absent or constitute a plausible alibi.

For our hypothetical case data, we are able to conduct analyses for three offense types: attempt murder, robbery, and burglary. No evidentiary factors emerge as predictive of length of sentence for attempt murders. For the robbery and burglary offenses, as in our earlier analyses, it is the *absence* of evidentiary factors which are related to sentence length. In robbery, it is where defendants *fail* to confess to the crime, and the tangible and forensic science evidence only *weakly* associate the defendant with the offense *or* there is a lack of a confession, eyewitness identification and weak tangible evidence that prosecutors expect a reduction in sentence length (of about three years). For defendants convicted of burglary, it is in the *absence* of a confession, forensic science evidence, and an eyewitness identification that prosecutors expect sentence length to be shorter than usual (by about two years).

The most significant pattern that emerges from our analysis of conviction, charge reduction, and sentencing is the shift in classes of variables that influence these decision stages. With respect to the decision whether to convict, evidentiary variables that speak to the defendant's factual guilt or innocence assume prime importance. Did the defendant admit his guilt or incriminate himself? Did tangible evidence link the defendant with the crime or crime scene? The one prime variable not fitting this explanation is the age factor, where *younger* defendants have a greater likelihood of being convicted.

With respect to the decision to reduce charges, these types of evidentiary variables recede into the background. They are replaced by variables that speak to the character or aggravation of the incident. Was there any prior relationship between the defendant and victim? Was the victim harmed? Additionally, system processing characteristics become important—is the case disposed by plea or at trial? Finally, defendant background characteristics (usually referred to as "extralegal") also assume greater importance. Does the defendant have a prior record of arrests? Of conviction? How old is the defendant? Is he or she black or white?

With respect to the decisions about incarceration and length of incarceration, system processing and defendant background characteristics become even more important. Was a charge reduction obtained? What is the defendant's prior record? Or gender? Among the evidentiary variables, only seriousness of the incident (and for length of sentence, forensic science evidence and location of arrest) is uniformly brought into the decision about sentence. Table 8 summarizes these patterns.

In sum, forensic science evidence plays a rather limited role in the decision to convict—when compared with the effects of defendant statements, tangible evidence, and the age of the defendant. While other evidentiary variables generally diminish in importance at the charge reduction stage, forensic science evidence, principally via interactions with the seriousness of the crime, exerts a substantial effect in supporting convictions on the top charge. At the point of sentencing, the influence of forensic science evidence assumes its greatest strength, emerging as a significant variable in four of the five jurisdictions. It is length of sentence in particular where forensic science evidence exerts a substantial *main* effect in all jurisdictions except for one, free from the interactive limitations which characterize its effects on all preceding judicial decisions.

Forensic scientists themselves believe forensic science evidence to have its least impact at the point of sentencing. We should remember that scientists seldom receive feedback from the courts about the outcomes of the cases in which their examiners testify, not to mention

TABLE 8—*Summary of influences upon conviction, charge reduction, and sentencing.*

| | Number of Sites in which Variable is Associated with[a] | | | |
|---|---|---|---|---|
| | | | Sentencing | |
| Variable | Conviction | Charge Reduction | In-Out | Length |
| Nature of Evidence: | | | | |
| Forensic science evidence | * | * | * | **** |
| Tangible evidence | *** | | | |
| Defendant statements | ***** | | * | * |
| Number of eyewitnesses | * | * | | * |
| Arrested at/near crime scene | ** | ** | * | *** |
| Seriousness of incident | ** | ** | **** | ***** |
| Prior relationship | ** | **** | * | |
| System Processing Characteristics: | | | | |
| Charge reduction | NA | NA | ***** | ***** |
| Mode of disposition | NA | *** | *** | ** |
| Type of defense attorney | | | ** | |
| Defendant Background: | | | | |
| Prior record | * | *** | ***** | *** |
| Age | *** | ** | * | ** |
| Gender | | * | ** | ** |
| Race | | ** | ** | |

[a]Based upon multivariate analyses, Tables 4, 5, 6, and 7.

the great majority of cases where experts do not testify and the reports alone serve as the scientific evidence. Our data indicate that laboratories seldom receive any form of feedback in this latter group of cases.

## Trial

The legal profession presumes that evidence is to be the primary consideration in the trial process. Kalven and Zeisel [7] found in their landmark study of jury decision making that most (about 75%) juries in criminal cases follow the evidence presented and reach verdicts identical to those of law trained judges (that is, consistent with the evidence). There may be departures, as a result of sympathy for particular types of defendants, unpopular laws, or a belief that the punishment prescribed by law is too severe, but these are exceptions to a general pattern of jury behavior guided by the evidence.

With respect to scientific evidence, practitioners and legal scholars alike share the belief that scientific evidence has a major influence on the decisions of lay jurors. Directors of crime laboratories estimate that their examiners testify in court in less than 10% of the cases they examine. Consequently, it is principally the reports themselves which convey scientific information to various users in the criminal justice system. Despite the infrequency with which examiners testify in court, laboratory examiners believe their examinations have their greatest impact at the trial stage. Prosecutors, too, share the opinion that juries are particularly impressed by forensic science evidence. They believe that juries "love to play detective" and that physical evidence adds to the credibility of the prosecutor's case. Indeed, prosecutors admit that they sometimes fear going into a trial without forensic science evidence if they think the jury will expect it. In such situations, prosecutors will go to great lengths to explain why they are not introducing physical evidence. Consistent with this, our survey of jurors immediately after their discharge from service in criminal cases indicates that they believe forensic science experts to be the most persuasive of all witnesses who appear before them.

Laboratory examiners believe that police investigators and prosecutors have the best understanding of scientific evidence and that judges and defense attorneys have a moderately good understanding. They believe police officers, administrators, and jurors to have the poorest. Prosecutors believe that jurors are quite capable of understanding most scientific evidence presented to them. Prosecutors will add, however, that it is principally *they* who are critical to the comprehensibility of forensic science evidence. In other words, the prosecutor believes it is up to him/her to *interpret* the scientific testimony into terms readily understandable to a lay jury.

In the jury portion of the study, we distributed questionnaires to 372 jurors in 31 felony trials. We received 290 completed questionnaires, 80% of which were completed by jurors in the courtroom and 20% of which were returned through the mail. Table 9 summarizes the number of questionnaires returned, broken down by offense charged and case outcome.

Jurors indicated to us they believed they understood the scientific and physical evidence presented to them at least as well as, and commonly better than, other evidence in the case. About one quarter of the citizens who had served on juries which were presented with scientific evidence believed that had such evidence been absent, they would have changed their verdicts—from guilty to not guilty.

Prosecutors indicate that they think *judges* are more experienced and better prepared to consider complex scientific testimony than a jury. They expect that if forensic science testimony is to be a critical component in their case and the defense likely to attack the forensic science expert, the defense would likely demand a jury trial.

Our multivariate analysis of trial verdict shows two factors to be significant predictors: as police officers' testimony becomes more persuasive and as jurors' understanding of physical evidence improves, jurors are more inclined to find the defendant guilty. The *ease* with which jurors reach their verdicts is influenced by a different set of factors. As crime labora-

TABLE 9—*Juror responses: offense case outcome.*

| Most Serious Offense Charged | Number of Trials | Convictions/ Nonconvictions | Number of Juror Responses | % of Total |
|---|---|---|---|---|
| (1) Murder | 11 | 9/2 | 98 | 34 |
| (2) Attempt murder | 7 | 6/1 | 70 | 24 |
| (3) Armed robbery | 4 | 4/0 | 37 | 13 |
| (4) Rape/deviant sexual assault | 3 | 2/1 | 32 | 11 |
| (5) Controlled substance | 2 | 1/1 | 18 | 6 |
| (6) Attempted arson | 2 | 1/1 | 18 | 6 |
| (7) Unlawful use of weapons | 1 | 1/0 | 11 | 4 |
| (8) Burglary | 1 | 1/0 | 5 | 2 |
| Total | 31 | 25/6 | 290 | 100 |

tory examiners become more persuasive in their testimony, jurors find their decisions easier; however, it is where jurors find the defendant's testimony *less* persuasive that they have an easier time making up their minds.

Our discussions with defense attorneys elicited a variety of tactics they use to challenge forensic science evidence, ranging from efforts to have the evidence ruled inadmissible (on search and seizure or chain of custody grounds) to attacks on the expert's qualification or intense cross-examination of the expert's conclusions. Usually, however, defense counsel will attempt to "explain away" the physical evidence by supplying a reasonable and lawful explanation for its presence. If the above tactics cannot be used, defense counsel will usually stipulate to the evidence and attempt to draw as little attention to it as possible. Contrary to a commonly expressed attitude that defense attorneys distrust the analyses and testimony of "prosecution" experts, defense counsel we interviewed are basically satisfied with the competence and nonpartisanship of forensic scientists with whom they have contact.

## Findings and Recommendations

The major findings and policy implications of this study are summarized below.

### *Why Haven't the Rates of Usage of Forensic Science Evidence Increased?*

Our examination of case file data in six jurisdictions over the 1975–1981 time period reveals that rates of usage of scientific evidence have not increased appreciably. What accounts for this? This is an important question since the impact of such evidence in the criminal justice process is limited by the *extent* to which it is used. Even though it may have impact in cases in which it is used, if it is used in only a small minority of cases then its effect on criminal case processing *en toto* will be limited.

Only in the jurisdiction of Peoria have rates of usage of scientific evidence increased across several offense categories. We think it is not coincidental that Peoria has also experienced the most dramatic increase in crime scene and laboratory resources from the early 1970s until the present day. The regional crime laboratory doubled in size during this period and the crime scene unit of the police department experienced similar expansion and upgrading of services. None of the other jurisdictions in our study experienced comparable growth in this period (1975–1981).

Crime laboratories have experienced chronic problems in obtaining adequate funding from their parent police agencies, receiving on average less than one half of 1% of the police budget. These limited funds, the more fundamental economic woes of state and local governments, the drying up of Federal (LEAA) monies to underwrite improvements or expansion, and the lack of interest by the police in the disposition of arrests as cases move through the court system have all contributed to this steady state condition.

A second limiting factor at the laboratory level continues to be the dominance of drug evidence. In many laboratories around the nation any growth in personnel or scientific resources has been justified by the growing influx of drug and narcotic evidence. As was explained earlier in this paper, drug cases are one of the few offense classifications which require a scientific analysis for prosecution. Laboratories fight a continuing battle to manage this drug caseload so that it does not displace or overwhelm their ability to respond to other forms of evidence.

A third scientific factor that should be considered is the dramatic increase in sophistication and array of tests available to forensic scientists during this period—for example, in the area of bloodstain and biological fluid analysis. These new procedures require greater bench time on the part of analysts which, in turn, limits the number of cases which can be accommodated.

Also, this period witnessed much greater concern about the quality of results emanating from laboratories. Forensic science laboratories devote more time to proficiency testing, duplicate analyses of evidence, and supervisory review of examinations. All such procedures mandate greater examiner time and limit both the volume of cases that can be processed and the speed with which test results can be forwarded to legal decision makers.

From prosecutorial and judicial perspectives, there unquestionably exists a more favorable climate toward greater use of scientific evidence, but there have been few specific forces to require it. The prosecutor is the critical agent at this point since it is he/she who determines what evidence is to be used in the determination of guilt or innocence. Prosecutors are faced with rising caseloads and probably are no more knowledgeable scientifically today than they were ten years ago. There is a feeling among prosecutors that crime laboratories are understaffed and overworked and that they should only request analyses of evidence where it is essential. Defense attorneys, similarly, are no better trained and very rarely are in a position to introduce or request more scientific evidence. The same holds true for the judiciary where few judges have taken an active role in seeing that forensic science evidence is used more regularly in the courtroom.

### *Why Does Forensic Science Evidence Have Impact in Some Jurisdictions but Not in Others?*

As with the previous question, there is no simple answer. By rights we must take stock of the entire justice process in local communities and address such questions as the fitness of technicians to search crime scenes and gather evidence, the skill and ingenuity of laboratory examiners in processing evidence, and the ability of prosecutors to question effectively expert witnesses and to bring out the favorable aspects of the evidence. A multijurisdictional study such as ours, however, is not equipped to look in-depth at the criminal justice systems in each location. There are, however, some fundamental differences detected in our review of case files and interviews of laboratory scientists, police officers, and judicial personnel which shed light on this question.

Our ability to explain variations in the conviction rate of criminal cases depends, in part, on the distribution of case outcomes. Most of our jurisdictions have such high rates of conviction that it is extremely difficult to account for variations in case disposition. It was in the cities of Peoria and Kansas City, where conviction rates are lowest, that we are moderately successful in predicting case outcome. It is also in these two cities where our several evidentiary factors account for much of this explanation. Therefore, it is in those locations where police and prosecutors do the least screening prior to charging that the evidence accounts for more of the variation in case disposition. It was also in Peoria, and to some degree Kansas City, where the forensic science evidence proves to be a significant predictor in explaining the conviction/nonconviction decision. Conversely it was in the two jurisdictions (Oakland and New Haven) where the greatest amount of precharge screening of cases takes place, that conviction rates are highest and also where *none* of the evidentiary variables (besides defendant statements) emerge as important predictor variables.

Is there anything about the forensic science evidence results in Peoria and Kansas City that distinguish them from the other locations? Although their overall reliance upon scientific evidence is not that different from our other study sites, we do find that these two locations use fingerprint and firearms evidence to a greater degree than other jurisdictions, and more importantly, they have the greatest fraction of lab results which associate defendants with crimes. Prosecutors in Peoria and Kansas City receive laboratory results which associate the accused with the victim or the crime scene a higher percentage of the time than prosecutors in the other locations. It is important to note, too, that it is these same categories of fingerprints and firearms that can *conclusively* associate a person with another person, location, tool, or weapon.

Our interviews also indicate that prosecutors are more comfortable using scientific evidence in a jurisdiction like Peoria than in a more pressurized, high-volume location like Chicago-Cook County. The attitude in Peoria appears to be a reflection of a lighter caseload and greater opportunity for personal interaction among attorneys, crime scene officers, and laboratory examiners. Since examiners appear in about one in four cases which go to trial in Peoria, prosecutors have greater face-to-face contact with scientists and more experience in the direct examination of experts and the presentation of results to judges and juries.

A comment is also in order regarding the effect of scientific evidence on the sentencing of convicted defendants. The reader will recall that the presence of forensic science evidence is associated with longer sentences while controlling for other variables in four of the five locations. Apparently, then the forensic science evidence contributes to the certainty of a defendant's guilt as well as his/her culpability. This may be accomplished where the evidence associates the defendant with the crime, graphically documents the severity of the act, or possibly corroborates the prosecutor's theory as to how the crime was committed. Although such a finding was not expected, it is nonetheless an important one which should be recognized in any discussion of scientific evidence and the processing of criminal defendants.

### *Is the Use of Forensic Science Evidence Voluntary or Obligatory?*

Do prosecutors seek out scientific evidence for what it may contribute to their cases, or do they feel obliged to use it for fear they may lose the case if it is absent? Although our case file analysis sheds little light on this issue, our interviews and hypothetical cases in Chicago suggest that both perspectives on scientific evidence are important considerations.

As often as prosecutors would stress the added value of having physical or scientific evidence in a case, they would note the potential danger of proceeding with a case absent of scientific evidence, yet where it might be expected. Judges and jurors seem to be persuaded by the argument that scientific evidence should have been found in a given case and that its absence indicates an inadequate investigation by the police and prosecutor, which in turn may lead to the acquittal of the defendant.

Probably more striking are the results of our hypothetical cases which demonstrate that prosecutors believe that it is either the absence of scientific evidence altogether, or its presence in a weakened form, which can lead to a less desirable case outcome. The classic circumstance is a situation where the prosecution already lacks a confession or an eyewitness to the crime but also lacks tangible or scientific clues where they think the case will be lost.

Such an attitude toward scientific evidence may also be cited as a reason why forensic science evidence is not being used more than at present. If the predominant reason for the use of scientific evidence is to guard oneself against a charge of not conducting a thorough investigation, then there may be less support for the active growth and development of forensic science services than in a situation where the evidence is seen as information which could help *win* cases.

We believe some users of forensic science evidence support its use because it is the "professional" thing to do. Others cast it in even more pragmatic terms, "If that's what the jury expects, and it can help my case, then that's what I'll give them." This attitude may prevail even though the prosecutor believes other evidence in the case to be more compelling. This orientation is also related to a concern on the part of some prosecutors that they really do not understand the scientific procedures used to examine evidence and find working with experts to be difficult and frustrating. Such attitudes do not promote the increased use of scientific evidence, but rather perpetuate the almost mystical quality of forensic science findings.

### *Where Should Law Enforcement Agents Concentrate Their Evidence Gathering Resources?*

Our case file analysis indicates that defendant statements (confessions) are the most critical form of evidence in explaining convictions. Tangible evidence is next most important, followed by scientific evidence and finally eyewitnesses. These conclusions are tempered by the observation that the eyewitness variable used in this study failed to capture the credibility of witnesses and that, in aggregate, our collection of independent variables failed to account for substantial variation in the outcomes of sampled cases. As noted earlier, however, these cases were so strong to begin with that, with the exception of defendant statements, *none* of the evidentiary factors was particularly successful in predicting case outcome.

In the two jurisdictions with the least amount of precharge screening, the ability to predict case outcome is substantial, and *all* classes of evidence (including forensic) emerge as important predictors. When we approach sentencing, although general emphasis moves to *non*evidentiary factors in the case, the forensic science evidence stands out as the single most important type of *evidence* influencing the severity of sanctions. We interpret this as an indication that judges are more likely to punish severely where forensic science evidence is available. Therefore, although we cannot forecast that greater usage of forensic science evidence will increase conviction rates, its increased use might lead to the imposition of more severe penalties.

Our second recommendation is for justice officials to devote greater attention to the *content* of laboratory reports and their proper interpretation. Throughout our examination of the data, we found decision makers to be more concerned that some (any) type of laboratory report was available than with the nature of findings contained within such reports. Although findings which identify substances and "reconstruct" a criminal offense can be important, we feel the more critical question to be, "Does the evidence associate the defendant with the crime scene or victim?" Perhaps it is because such a small percentage of laboratory reports actually do address the question of the defendant's association with the crime that such results seem to have little impact upon case disposition and why legal practitioners are not more reliant upon them.

Prosecutors and jurists need to devote more attention to understanding what scientific examinations can yield and how to present those results in an accurate and nonbiased fashion. More training, greater exposure to scientists, and fewer organizational barriers to reach the laboratory would be a significant beginning. Prosecutors should not look to laboratories as "insurance," as a means to save a losing case, or merely to comply with judge or jury expectations. Such practices can distort and demean the potential utility of such evidence and should be replaced by procedures which allow for the full consideration of scientific information in all cases where such evidence is available.

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