Rate of false conviction of criminal defendants who are sentenced to death

Samuel R. Gross  
*University of Michigan Law School, srgross@umich.edu*

Barbara O'Brien  
*Michigan State University College of Law*

Chen Hu  
*American College of Radiology Clinical Research Center*

Edward H. Kennedy  
*University of Pennsylvania School of Medicine*

Available at: https://repository.law.umich.edu/articles/1591

Follow this and additional works at: https://repository.law.umich.edu/articles

Part of the Courts Commons, Criminal Law Commons, and the Law Enforcement and Corrections Commons

**Recommended Citation**


This Article is brought to you for free and open access by the Faculty Scholarship at University of Michigan Law School Scholarship Repository. It has been accepted for inclusion in Articles by an authorized administrator of University of Michigan Law School Scholarship Repository. For more information, please contact mlaw.repository@umich.edu.
Rate of false conviction of criminal defendants who are sentenced to death

Samuel R. Grossa, Barbara O'Brienb, Chen Huc, and Edward H. Kennedyd

a University of Michigan Law School, Ann Arbor, MI 48109; b Michigan State University College of Law, East Lansing, MI 48824; c American College of Radiology Clinical Research Center, Philadelphia, PA 19103; and d Department of Biostatistics and Epidemiology, University of Pennsylvania School of Medicine, Philadelphia, PA 19104

Edited by Lee D. Ross, Stanford University, Stanford, CA, and approved March 25, 2014 (received for review April 5, 2013)

The rate of erroneous conviction of innocent criminal defendants is often described as not merely unknown but unknowable. There is no systematic method to determine the accuracy of a criminal conviction; if there were, these errors would not occur in the first place. As a result, very few false convictions are ever discovered, and those that are discovered are not representative of the group as a whole. In the United States, however, a high proportion of false convictions that do come to light and produce exonerations are concentrated among the tiny minority of cases in which defendants are sentenced to death. This makes it possible to use data on death row exonerations to estimate the overall rate of false conviction among death sentences. The high rate of exonerations is concentrated among death-sentenced defendants who appear to be driven by the desire to avoid execution, but the proportion of innocent death-sentenced defendants who are removed from death row and resentenced to life imprisonment, after which the likelihood of exoneration drops sharply. We use survival analysis to model this effect, and estimate that if all death-sentenced defendants remained under sentence of death indefinitely, at least 4.1% would be exonerated. We conclude that this is a conservative estimate of the proportion of false conviction among death sentences in the United States.

In the past few decades a surge of hundreds of exonerations of innocent criminal defendants has drawn attention to the problem of erroneous conviction, and led to a spate of reforms in criminal investigation and adjudication (1–3). All the same, the most basic empirical question about false convictions remains unanswered: How common are these miscarriages of justice?

False convictions, by definition, are unobserved when they occur: If we know that a defendant is innocent, he is not convicted in the first place. They are also extremely difficult to detect after the fact. As a result, the great majority of innocent defendants remain undetected. The rate of such errors is often described as a “dark figure” (4) an important measure of the performance of the criminal justice system that is not merely unknown but unknowable.

However, there is no shortage of lawyers and judges who are sufficiently confident that the number of false convictions is negligible. Judge Learned Hand said so in 1923: "Our [criminal] procedure has always been haunted by the ghost of the innocent man convicted. It is an unreal dream" (5, p. 649). And in 2007, Justice Antonin Scalia wrote in a concurring opinion in the Supreme Court that American criminal convictions have an “error rate of 0.027 percent or, to put it another way, a success rate of 99.973 percent” (6, p. 182). This would be comforting, if true. In fact, the claim is silly. Scalia’s ratio is derived by taking the number of known exonerations at the time, which were limited almost entirely to a small subset of murder and rape cases, using it as a measure of all false convictions (known and unknown), and dividing it by the number of all felony convictions for all crimes, from drug possession and burglary to car theft and in some tax evasion.

To actually estimate the proportion of erroneous convictions we need a well defined group of criminal convictions within which we identify all mistaken convictions, or at least most. It is hard to imagine how that could be done for criminal convictions generally, but it might be possible for capital murder.

The rate of exonerations among death sentences in the United States is far higher than for any other category of criminal convictions. Death sentences represent less than one tenth of 1% of prison sentences in the United States (7), but they accounted for about 12% of known exonerations of innocent defendants from 1989 through early 2012 (2), a disproportion of more than 130 to 1. A major reason for this extraordinary exoneration rate is that far more attention and resources are devoted to death penalty cases than to other criminal prosecutions, before and after conviction.

The vast majority of criminal convictions are not candidates for exoneration because no one makes any effort to reconsider the guilt of the defendants. Approximately 95% of felony convictions in the United States are based on negotiated pleas of guilty (plea bargains) that are entered in routine proceedings at which no evidence is presented. Few are ever subject to any review whatsoever. Most convicted defendants are never represented by an attorney after conviction, and the appeals that do take place are usually perfunctory and unrelated to guilt or innocence.

Death sentences are different. Almost all are based on convictions after jury trial, and even the handful of capital defendants who plead guilty are then subject to trial like sentencing hearings, usually before juries. All death sentences are reviewed on appeal; almost all are reviewed repeatedly. With few exceptions, capital defendants have lawyers as long as they remain on death row. Everyone, from the first officer on the scene of a potentially capital crime to the Chief Justice of the United States, takes capital cases more seriously than other criminal prosecutions, and knows that everybody else will do so as well. And everyone from defense lawyers to innocence projects to governors and state and federal judges is likely to be particularly careful to avoid the execution of innocent defendants.

This extraordinary difference in resources and attention generates two related effects. (i) Advocates for a defendant are much more likely to pursue any plausible postconviction claim of innocence if the defendant is under sentence of death. (ii) Courts

Significance

The rate of erroneous conviction of innocent criminal defendants is often described as not merely unknown but unknowable. We use survival analysis to model this effect, and estimate that if all death-sentenced defendants remained under sentence of death indeﬁnitely at least 4.1% would be exonerated. We conclude that this is a conservative estimate of the proportion of false conviction among death sentences in the United States.

Author contributions: S.R.G. and B.O. designed research; S.R.G. and B.O. performed research; C.H. and E.H.K. analyzed data; and S.R.G. and B.O. wrote the paper.

The authors declare no conflict of interest.

This Direct Submission article had a prearranged editor.

Freely available online through the PNAS open access option.

1To whom correspondence may be addressed. E-mail: srgross@umich.edu.

The authors declare no conflict of interest.

This article contains supporting information online at www.pnas.orglookup/suppl/doi:10.1073/pnas.1306417111/DCSupplemental.
(and other government actors) are much more likely to consider and grant such a claim if the defendant is at risk for execution. As a result, false convictions are far more likely to be detected among those cases that end in death sentences than in any other category of criminal convictions.

The high exoneration rate for death sentences suggests that a substantial proportion of innocent defendants who are sentenced to death are ultimately exonerated, perhaps a majority. If so, we can use capital exonerations as a basis for estimating a lower bound for the false conviction rate among death sentences.

Since 1973, when the first death penalty laws now in effect in the United States were enacted (8), 143 death sentenced defendants have been exonerated, from 1 to 33 y after conviction (mean = 10.1 y) (9). In a previous study we found that 2.3% of all death sentences imposed from 1973 through 1989 resulted in exoneration by the end of 2004 (7). A study by Risinger (10) estimated that had biological samples been available for testing in all cases, 3.3% of defendants sentenced to death between 1982 and 1989 for murders that included rape would have been exonerated by DNA evidence through February 2006. That estimate, however, is based on a small number of exonerations (n = 11) (10). Both studies were limited to convictions that occurred 15 y or more before the study date, and so include a high proportion of all exonerations that will ever occur in the relevant groups. Nonetheless both studies underestimate the false conviction rate for death sentenced defendants because they do not reflect exonerations that occur after the study period, and do not include false convictions that are never detected at all.

Capital defendants who are removed from death row but not exonerated typically because their sentences are reduced to life imprisonment no longer receive the extraordinary level of attention that is devoted to death row inmates. (This applies as well to those who are executed or die on death row from other causes.) If they are in fact innocent, they are much less likely to be exonerated than if they had remained on death row. As a result, the proportion of death sentenced inmates who are exonerated understates the rate of false convictions among death sentences because the inclusive rate for possible errors is largely abandoned once the threat of execution is removed.

In other words, the engine that produces an exoneration rate that is a plausible proxy for the rate of false conviction among death sentenced prisoners is the process of reinvestigation and reconsideration under threat of execution. Over time, most death sentenced inmates are removed from death row and resentenced to life in prison at which point their chances of exoneration appear to drop back to the background rate for all murders, or close to it. Thus, we will get a better estimate of the rate of false capital convictions if we are able to estimate what the rate of capital exonerations would be if all death sentences were subject for an indefinite period to the level of scrutiny that applies to those facing the prospect of execution” (7). This study does just that.

### Current Study

**Data.** We examine exonerations among defendants sentenced to death from the beginning of the “modern” death penalty in the United States in 1973, after the Supreme Court invalidated all prior death sentencing laws (11), through the end of 2004. Our data come from two sources. (i) Death sentences since 1973 are tracked by the Bureau of Justice Statistics (BJS) of the Department of Justice, which maintains data on the current status of all death sentenced defendants in that period (12). We know that 7,482 defendants were sentenced to death in the United States from January 1973 through December 2004, and we know when (if ever) each defendant was removed from death row by execution, death by other means, or legal action by courts or executive officials. (ii) The Death Penalty Information Center maintains a list of defendants who were sentenced to death in the United States and exonerated since the beginning of 1973 (13), including 117 who were sentenced to death after January 1, 1973 and exonerated by legal proceedings that began before the end of 2004. We collected additional data on these cases from public records and media sources, expanding on the dataset used by Gross and O’Brien (7). We were able to match on several key variables 108 of the 117 death sentence exonerations in this period to specific cases in the BJS database to produce the database we analyzed.

Table 1 displays the status of the 7,482 death sentenced defendants we studied as of December 31, 2004, the final day of our study period. On that date, 12.6% of these defendants had been executed, 1.6% were exonerated, 4% died of suicide or natural causes while on death row, 46.1% remained on death row, and 35.6% were removed from death row but remained in prison after their capital sentences or the underlying convictions were reversed or modified.

Table 1 is a snapshot of the status of those defendants at the end of the study period. (It would look quite different if it displayed the status of death sentenced defendants at the end of 1985, for example, or 2000.) It cannot be used directly to estimate the rate of exonerations because exonerations are a function of time. Many of the defendants on death row at the end of 2004 had only been there for a year or two, far less than the mean of 10.1 y from conviction to exonerations for all capital exonerations since 1973.

Over time, many of those who remained on death row at the end of 2004 will be removed (or already have been); most will end up with sentences of life imprisonment. If the pattern for death sentences from 1973 through 1995 holds, over two thirds of prisoners sentenced to death will have the judgments against them overturned. The majority will remain in prison for life (14, 15), but some will be exonerated and released.

**Threat of Execution.** A central variable of interest is whether an exonation took place while the defendant was still under threat of execution (for detailed information, see SI Materials and Methods).
we treat him as exonerated under threat of execution because the

Meth.ods,

sentenced to death in Oklahoma in 1988, and awarded a new
defendant was made after he left death row. This sort of delay is
exonerations that benefited from the extraordinary levels of ef
at the time of exoneration is more demanding. We identify
defendants who were under threat of execution to focus on
considering whether to do so. For example, Ronald Williamson was
death row and ran to their conclusion two years later.

We also count an exoneration as under threat if the process
that ultimately led to the exoneration began while the defendant
was on death row, even if the final decision to release the de-
endent was made after he left death row. This sort of delay is
common for defendants who are removed from death row when
their convictions are reversed by reviewing courts but not re-
leased until months or years later when the prosecution decides
to dismiss the charges. In some cases the process is more elab-
orate. For instance, John Thompson was sentenced to death in
Louisiana in 1985 (13). In 2001 he sought a new trial based on
newly discovered evidence, but received only a reduction in his
sentence to life imprisonment. Thompson successfully appealed
the denial of a new trial and was acquitted in 2003. Thus, al-
though his death sentence was vacated 2 y before his acquittal,
we treat him as exonerated under threat of execution because the
legal proceedings that led to exoneration began while he was on
dead row and ran to their conclusion two years later.

We define an exoneration under threat of execution as an
exoneration that is the result of legal proceedings that were
initiated while the defendant was on death row. The date we
assign to an exoneration is the date of removal from death row,
the last date on which the exoneration can be initiated and still
count as under threat, not the date on which the process was
completed. Using these criteria, we determined that 107 of the
117 exonerations that occurred before the end of 2004 were
under threat of execution, and 10 exonerations were not under
that threat. The significance of this classification is apparent
from Table 1. Of defendants sentenced to death since 1973,
35.8% had been resentenced to a prison term by the end of 2004.
However, only 8.5% of capital exonerations (10 of 117) came
from this group even though these prisoners were, by definition,
at a later stage of their imprisonment than those who remained
on death row. (Except for those who are exonerated and a very
small group who are resentenced to lesser penalties and even-
tually released, all prisoners who are sentenced to death do
ultimately die in prison. They all start out on death row, some
stay there until death by execution by other means, and the rest
eventually are moved to the general prison population where
they remain until they die.)

Our estimate of the rate of false convictions among death
sentenced defendants is based on the hypothesis that death
sentenced prisoners who remain under threat of execution are
far more likely to be exonerated than those who remain in prison
but no longer face that threat. We use a Cox proportional haz-
ards model with a time dependent covariate to test that hypoth-
ese. We find, consistent with expectations, that death sentenced
defendants who are no longer under threat of execution had
a rate of exoneration approximately one eighth of that for
defendants who remained on death row, 0.131 (P < 0.0001)
(with 95% confidence interval of 0.064-0.266) (SI Materials
and Methods, section 3).

Analysis. Our task is to estimate the cumulative probability over
time of the event of interest, exoneration, in the population of
death sentenced defendants who remain under threat of execu-
tion. The temporal measure (t) is time from conviction. Esti-
mating this probability is complicated by the structure of the

Fig. 1. The status of death sentenced defendants and the occurrence of exonerations, by time from conviction. The black line represents the total num-
ber of all death sentenced defendants by time from conviction and the gray line the number of defend-
ants who remained on death row (DR) and were therefore available for exoneration under threat of execution by time from conviction. The three areas
between the black and gray lines display the di-
positions of those defendants who were removed
from death row over the time period by mode of
removal: execution, suicide or death from natural
causes, and legal proceedings (court orders or exec-
utive clemency). A minority of defendants who
were removed from death by legal proceedings were ex-
onerated. The plus symbols mark exonerations by
date measured in time from conviction. The 10 blue
plus symbols (on the gray line) mark exonerations
that were not under threat of execution by the date
of the completion of the exoneration. The 107 red
plus symbols (on the gray line) mark exonerations
that were initiated under threat of execution by the
date of removal of the defendants from death row.
population for two reasons. (i) Individual defendants joined this population across a 32-y period. Their duration in the study period varied from 1 to 32 y. (ii) All death sentenced defendants began, at conviction, under threat of execution, but for most that threat, and their membership in the population of interest, ended with execution. The cases were usually has been exonerated under threat of execution within several years, usually because they were removed from death row by execution (943 of 7,482). Some executed defendants may have been innocent, and, although none has been exonerated after execution (9), they might have been exonerated if they had remained alive and on death row. How ever, we expect that the proportion of innocent defendants is not independent of time to execution. Because the assumption of independence may be violated, sensitivity analysis is necessary.

Specifically, (i) 13% of death sentenced inmates were removed from death row by execution (943 of 7,482). Some executed defendants may have been innocent, and, although none has been exonerated after execution (9), they might have been exonerated if they had remained alive and on death row. How ever, we expect that the proportion of innocent defendants is
lower among those who are executed than among those who remain on death row (7) (SI Materials and Methods, section 4).

The threat of execution is the engine that drives the process of exonerating innocent death row prisoners, and it is likely that this process becomes more painstaking as inmates approach their execution dates. This concern about executing innocent defendants also drives a second bias: (ii) It increases the proportion of innocent defendants among the 36% of death row inmates who were removed from death row and resentenced to prison but not exonerated (2,675 or 7,482). Courts and executive officials explicitly recognize that it is appropriate to take the possibility of innocence into account in deciding whether to reverse a conviction for procedural error or commute a death sentence to life imprisonment, and a wealth of anecdotal evidence suggests that this practice is widespread (SI Materials and Methods, section 4).

As a result, those who are resentenced to punishments less than death are more likely to be innocent than those who remain on death row.

In short, we believe that (i) executed defendants are less likely to have been exonerated if they had remained on death row than those who in fact remained on death row, and (ii) defendants who were removed from death row but remained in prison are more likely to have been exonerated if they had remained under threat of execution.

These two biases are not equivalent in magnitude. Nearly three times as many unexonerated death sentenced defendants were resentenced to prison (2,675) as executed (943). Even a modest increase in the proportion of innocent defendants among death sentenced prisoners resentenced to life imprisonment, compared with those who remain on death row, would more than offset a complete absence of innocent defendants among those who are executed.

We use competing risks methodology (18), along with explicit assumptions about the counterfactual probability of exoneration for those who were executed or resentenced to prison, to develop a sensitivity analysis for the Kaplan Meier estimate of the cumulative exoneration rate. First, we estimate the cumulative incidence of exoneration subject to the competing risks of execution and resentencing by 21.4 years after conviction, on the assumption that censoring by recency, suicide, or natural death was independent of these three event processes. The estimates of the probabilities of removal from risk of exoneration by execution under threat of execution, by execution itself, or by resentencing, are 2.2% (1.7%, 2.7%), 23.8% (22.3%, 25.3%), and 48.3% (46.7%, 50.0%), respectively. Thus, a defendant sentenced to death has an expected 22.2% chance of being exonerated while under threat of execution by 21.4 years after conviction, assuming those executed or resentenced had zero chance of being exonerated (i.e., allowing for the competing risks of execution and resentencing) (SI Materials and Methods, section 3).

Consider instead the assumption that, had they remained on death row, (i) those who were executed would have had zero chance of exoneration, and (ii) those who were resentenced would have had twice the chance of exoneration as the entire population of defendants sentenced to death. This yields the following estimate of the cumulative probability of execution of exoneration: had those who were exonerated or resentenced instead remained on death row: 2.2% + 0 (23.8%) + 2 (2.2%) (48.3%) = 4.4%.

Using the Delta method, the confidence interval for this estimate is 3.41 to 5.28%, assuming that the cumulative incidences of exoneration and resentencing have zero covariance.

A zero probability of exoneration for executed defendants had they remained on death row is necessary, for the purposes of this estimate, a conservative assumption. We believe that the assumed probability of exoneration for those who were removed from death row and resentenced to prison, twice the mean for the population, is reasonable. We conclude that the Kaplan Meier estimate we obtain is conservative. Indeed the same result we would obtain if we assume that the probability of exoneration for those resentenced to prison, had they remained on death row, is equal to or greater than 1.77 times the population average [2.2% + 0 (23.8%) + 1.77 (2.2%) (48.3%) = 4.1%].

Estimating false convictions from exonerations. Because there is no general method to accurately determine innocence in a criminal case, we use a proxy, exonerations: an official determination that a convicted defendant is no longer legally culpable for the crime for which he or she was convicted. There will be misclassifications. Some exonerated defendants are guilty of the crimes for which they were sentenced to death. We expect that such errors are rare, given the high barriers the American legal system imposes on convicted defendants in persuading authorities to reconsider their guilt (13, 7) (SI Materials and Methods, section 4). To date, one such case has come to light, and has been reclassified (19). Monte Carlo simulations reveal that the effect of such misclassifications on the cumulative rate of exoneration is linear: If 10% of exonerated defendants were in fact guilty, the mean cumulative rate of innocence for death sentenced defendants would be 3.7% rather than 4.1% (95% confidence interval of 3.3% to 4.0%); if 20% were guilty, the mean rate would be 3.3% (95% confidence interval of 2.8% to 3.7%) (SI Materials and Methods, section 3).

On the other side, some innocent defendants who remained on death row for more than 21.4 years were not exonerated and were misclassified as guilty. Some may still be exonerated; some may be executed; and many will likely die in prison, on death row or off, of natural causes or suicide. In the absence of better data we assume that the probability of a legal campaign to exonerate any prisoner under threat of death who has a plausible innocence claim is 1, and we assume that the probability of success for an innocent prisoner who remains under such threat for at least 21.4 years is also 1. These are necessarily conservative assumptions. To the extent that these probabilities are in fact less than 1, our estimate will underestimate the actual rate of false convictions.†

The distribution of possible misclassifications is asymmetrical: 261 defendants remained on death row longer than 21.4 years, whereas only 107 were exonerated under threat of execution. Unless the process of death row exonerations is assumed to be unrealistically thorough, it is likely that the number of innocent death sentenced defendants misclassified as guilty exceeds the number of guilty defendants exonerated under threat of execution and misclassified as innocent. [The proxy we use (the exonerate rate) is also important in its own right: It is a direct measure of the rate of death sentencing of defendants later determined to be legally not guilty.]

Taken together, the sensitivity analysis and the likely net effects of misclassification both point in the same direction and suggest that our 4.1% estimate of the rate of false conviction among death sentenced defendants is conservative.

Discussion

We present a conservative estimate of the proportion of erroneous convictions of defendants sentenced to death in the United States from 1973 through 2004, 4.1%. This is a unique finding; there are no other reliable estimates of the rate of false conviction in any context. The main source of potential bias is the accuracy of our classification of cases as true or false convictions. On that issue it is likely that we have an undercount, that there are more innocent death row defendants who have not been identified and exonerated than guilty ones who have been exonerated in error.

The most charged question in this area is different: How many innocent defendants have been put to death (6)? We cannot estimate that number directly but we believe it is comparatively

†A reviewer of an earlier draft suggested an alternative analytic approach. The suggested approach postulates a campaign process that gives some but not all death-sentenced defendants the opportunity to be exonerated. Identification of the false conviction rate is then based on independence assumptions between innocence and removal from death row. With more complete data of the sort required for the best realization of this approach, we believe that it would offer a particularly valuable supplement, and test of the robustness of our findings and conclusions.

7234 | PNAS | Gross et al.
low. If the rate were the same as our estimate for false death sentences, the number of innocents executed in the United States in the past 35 y would be more than 50 (20). We do not believe that has happened. Our data and the experience of practitioners in the field both indicate that the criminal justice system goes to far greater lengths to avoid executing innocent defendants than to prevent them from remaining in prison in definitely. One way to do so is to disproportionately reverse death sentences in capital cases in which the accuracy of the defendants' convictions is in doubt and to resentence them to life imprisonment, a practice that makes our estimate of the rate of error conservative. However, no process of removing potentially innocent defendants from the execution queue can be foolproof. With an error rate at trial over 4%, it is all but certain that several of the 1,320 defendants executed since 1977 were innocent (21).

It is possible that the death sentencing rate of innocent defendants has changed over time. No specific evidence points in that direction, but the number and the distribution of death sentences have changed dramatically in the past 15 y (22). One change, however, is unlikely to have much impact: the advent of DNA identification technology. DNA evidence is useful primarily in rape rather than homicide investigations. Only 13% of death row exonerations since 1973 (18 of 142) resulted from postconviction DNA testing (13), so the availability of preconviction testing will have at most a modest effect on that rate.

Unfortunately, we cannot generalize from our findings on death sentences to the rate of false convictions in any broader category of crime. Capital prosecutions, and to a lesser extent murder cases in general, are handled very differently from other criminal cases. There are theoretical reasons to believe that the rate of false conviction may be higher for murders in general, and for capital murders in particular, than for other felony convictions, primarily because the authorities are more likely to pursue difficult cases with weak evidence of guilt if one or more people have been killed (23). However, there are no data that confirm or refute this hypothesis.

We do know that the rate of error among death sentences is far greater than Justice Scalia's reassuring 0.027% (6). That much is apparent directly from the number of death row exonerations that have already occurred. Our research adds the disturbing news that most innocent defendants who have been sentenced to death have not been exonerated, and many including the great majority of those who have been resented to life in prison probably never will be.

This is only part of a disturbing picture. Fewer than half of all defendants who are convicted of capital murder are ever sentenced to death in the first place (e.g., 49.1% in Missouri as in ref. 24, 29% in Philadelphia as in ref. 25, and 31% in New Jersey as in ref. 26). Sentencing juries, like other participants in the process, worry about the execution of innocent defendants. Interviews with jurors who participated in capital sentencing procedures indicate that lingering doubts about the defendant's guilt is the strongest available predictor of a sentence of life imprisonment rather than death (27). It follows that the rate of innocence must be higher for convicted capital defendants who are not sentenced to death than for those who are. The net result is that the great majority of innocent defendants who are convicted of capital murder in the United States are neither executed nor exonerated. They are sentenced, or resented to prison for life, and then forgotten.

ACKNOWLEDGMENTS. We thank the following for their assistance and advice: Dr. Roderick J. A. Little (Richard D. Remington Collegiate Professor of Biostatistics and Professor, Department of Statistics, University of Michigan), Dr. Richard Gonzalez (Professor, Department of Psychology and Department of Statistics and Business School, University of Michigan), Dr. John DiNardo (Professor, Department of Economics and School of Public Policy, University of Michigan), and Dr. J. J. Prescott (Professor, Law School, University of Michigan).