Effects of Ignition Interlock Devices on DUI Recidivism: Findings From a Longitudinal Study in Hamilton County, Ohio

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As demands for more effective legal remedies for drunk driving escalate, a number of states have authorized judges to use breath analyzer ignition interlock devices as an optional sanction in drunk driving cases. This research presents initial findings from a quasi-experimental study designed to evaluate the effectiveness of interlock devices as a deterrent to a repeated drunk driving arrest in a sample of persons convicted of DUI. Survival rates across a 30-month risk period, during which interlock installation, license suspension, and probation sanctions were in effect, indicate that interlock devices significantly reduced the likelihood of a repeated DUI arrest as compared to license suspension.

Although both alcohol consumption and automobile driving play important roles in American society, the drunk driver has increasingly become an intolerable part of our culture. Strategies aimed at discouraging drinking and driving in society at large have attempted to alter social, psychological, and moral norms through public policy efforts, community awareness campaigns, and educational programs. Unfortunately, these efforts are, to date, largely symbolic and difficult to evaluate. Without reasonable and effective informal social sanctions in place, efforts to control drunk driving have

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focused on the formal social sanctions and legal consequences of impaired driving; that is, deterring drunk driving behavior by increasing both the probability of apprehension as well as the likelihood and severity of conviction. This strategy, however, has placed a particularly heavy burden on our legislative system, which holds the primary responsibility for employing legal threats and sanctions designed to deter both the general driving population as well as the convicted drunk driving offender.

As demands for more effective legal remedies for drunk driving escalate, a number of states have recently authorized judges or state agencies to use breath analyzer ignition interlock devices as an optional sanction in drunk driving cases.[1] In most cases, interlocks are ordered in addition to the fines, license suspension, jail sentences, probation and treatment programs that have been used in the past. However, although an increasing number of the judiciary are turning to this device, there is little sound empirical evidence to date that it is, in fact, an effective deterrent to drunk driving. In this article we present initial findings from a longitudinal, quasi-experimental study designed to evaluate the effectiveness of ignition interlock devices as a deterrent to a repeated drunk driving arrest in a sample of persons convicted of DUI (Driving Under the Influence). These findings, based on data collected over the first 30 months of the Hamilton County Drinking and Driving Study (HCDDS), provide insight into the relative impact of the interlock device on DUI recidivism as compared to that produced by license suspension.

GENERAL ISSUES IN DUI DETERRENCE LITERATURE

Although a broad review of the principles of deterrence theory as it relates to the social control of drunk driving is beyond the scope of this article (see Jacobs 1989; Laurence, Snortum, and Zimring 1988; or Homel 1988 for comprehensive reviews of issues surrounding drunk driving and its control), several general observations about this body of research are worth noting. First, it is important to distinguish between *general deterrence*, or evaluations of deterrence efforts directed at the general driving public, and *specific deterrence*, or evaluations of deterrence measures directed at those persons convicted of a drunk driving offense. This distinction is often blurred in DUI program evaluations. Nichols and Ross's (1990) recent review of the evaluation literature on the impact of deterrence-based policies for reducing alcohol-impaired driving as well as Homel's (1988) review of the general and specific deterrence effects of DUI sanctions are exceptions.

A second, related issue concerns the delineation of offender types; that is, when evaluating the deterrent effect of sanction alternatives on convicted DUI offenders, it is necessary to keep in mind offender characteristics or subtypes, particularly the distinction between first-time and repeat offenders. While offender type may be difficult to unravel both definitionally (e.g., first offenders may, in reality, be "problem drinkers," have a history of non-alcohol-related criminal behavior, etc.) and methodologically (e.g., difficulties in study design), many authors have, nonetheless, noted that DUI offenders are not a homogeneous group (Donovan 1989; Selzer, Vinokur, and Wilson 1977; Snowden, Nelson, and Campbell 1986; Wells-Parker, Cosby, and Landrum 1986; Steer, Fine, and Scoles 1979; Donovan and Marlatt 1982; Holden 1983; Argeriou, McCarty, and Blacker 1985; Morse and Elliott 1990; Nichols and Ross 1990; Homel 1988; Jacobs 1989; Zimring and Hawkins 1973; Laurence et al. 1988). This offender diversity suggests that there may be an interaction effect between offender characteristics and the type of sanction employed, contributing to a differential sanction efficacy.

Third, it is necessary to clarify both the strengths and weaknesses of the study design as well as the particular outcome measure(s) to be evaluated. A number of studies have evaluated the specific deterrent effect of legal penalties on DUI recidivism. The bulk of this research involves quasi-experimental designs and deals with marginal rather than absolute effects; that is, comparisons are made between different types or degrees of sanctions rather than with a total absence of sanctions (see Nichols and Ross 1990; Homel 1988). Although studies of this nature can provide important insights into the efficacy of different legal sanctions on DUI recidivism, they can often be complex and difficult to interpret.

Finally, research may differentially assess the impact of a particular legal action on: (a) total subsequent alcohol/nonalcohol-related auto accidents and convictions (i.e., overall traffic safety impact), (b) alcohol-related accident involvement only, (c) fatal/nonfatal crash involvement, or (d) rearrest or conviction for drunk driving. "Success" (or failure) of a sanction may vary drastically, depending on the particular outcome measure used.

DETERRING DUI RECIDIVISM: THE EFFECT OF LEGAL SANCTIONS

Typically, the legal sanctions available to the courts for preventing recidivism by individuals convicted of DUI have been limited to fines and jail

terms, license suspensions or revocations, and court-ordered alcohol treatment or educational programs. Although public response to the problem has been to pressure lawmakers into exacting stringent offender penalties, research on the actual effectiveness of this "get tough" approach on reducing DUI recidivism is not particularly encouraging.

Mandatory Jail

In general, DUI recidivism studies on the specific deterrent effect of incarceration suggest little difference between jail sentences and other legal sanctions (Wheeler and Hissong 1988; Blumenthal and Ross 1973; Nichols and Ross 1990; Voas 1986; Salzberg and Paulsrude 1983; Siegal 1985). In a sample of randomly selected drunk driving offenders in Harris County, Texas, Wheeler and Hissong (1988) evaluated the marginal specific deterrent effects of probation, fines and jail sentences on DUI recidivism convictions across a 3-year period. Using both parametric and nonparametric statistics, their findings revealed that imposition of mandatory jail terms was no more effective in reducing recidivism among either first-time offenders or repeat offenders than were sentences involving probation or fines. After examining outcomes for repeat offenders, Wheeler and Hissong (1988, p. 38) found that "those incarcerated less than two days (probationers) had a 15% higher success rate than their jailed counterparts confined for nearly two weeks." However, it is unclear how individual differences among the offender groups were controlled, that is, how potential selection biases associated with assignment to probation, fine, or jail were addressed. Similarly, Salzberg and Paulsrude (1983) reported a higher drunk driving recidivism rate for repeat offenders convicted under Washington State's mandatory jailing law than for those convicted under the previous law. Finally, Siegal (1985), in a controlled quasi-experimental evaluation of three legal sentencing alternatives, found that jailed multiple offenders had significantly higher recidivism rates than those offenders sentenced to a residential confinement intervention (with referral to treatment), or those who received a suspended sentence. In addition to lower recidivism, the confined-with-treatment group had significantly longer survival times before recidivating than did the other two groups.

Importantly, other studies reveal that in those states where legislation has been passed providing for mandatory jail sentences, sanctions are often circumvented due to the high cost and increased burden on the courts, judges and prosecutors, as well as real problems with jail overcrowding. Thus, although some studies may show increases in incarceration rates for convicted

drunk drivers in states after introduction of a mandatory confinement policy (National Institute of Justice 1984; Jacobs 1989), there is also evidence of significant *decreases* in DUI conviction rates as well as increased access to bail and overall sentence reduction following mandatory jail legislation (Grube and Kearny 1983; Wheeler and Hissong 1988; Ross 1984; Gropper, Mantorama, Mock, O'Connor, and Travers 1983; Ross and Foley 1987).

Court-Ordered Treatment

Likewise, evaluations of court-ordered rehabilitation measures, aimed at changing the behavior of the convicted drinking driver, present little evidence to support the efficacy of this type of sanction as a deterrent to drunk driving recidivism (Holden 1983; Nichols, Weinstein, Ellingstad, and Struckman-Johnson 1978; Mann, Vingilis, and DeGenova 1983; Ross and Blumenthal 1974; Hagen 1985; Ross 1985). In an experiment designed to evaluate rehabilitative sanctions for drunk driving in Memphis, Holden (1983) examined recidivism among first-time DUI offenders randomly assigned to control, education and/or therapy, probation supervision, or probation supervision plus education/therapy groups. Offenders were classified at intake as either a "social drinker" or a "problem drinker." Holden concluded that none of the three rehabilitation programs were effective in reducing rearrests for DUI over a 2-year follow-up period for either the social or problem drinkers. Similar results were obtained in evaluations of the effectiveness of Alcohol Safety Action Project's (ASAP) education and therapy programs for drunk drivers, many of which have been criticized for their methodological shortcomings (Nichols et al. 1978; National Highway Traffic Safety Administration 1979). Overall results show that, compared to no treatment, ASAP education and treatment programs had at best some small specific deterrent effect on DUI recidivism among first offenders or social drinkers; however, there was little evidence indicating impact on subsequent DUI arrests among repeat offenders or problem drinkers. Further, there appeared to be a possible interaction effect between the severity of alcohol problems and type of rehabilitation program (Donovan 1989; Hagen 1985; Peck, Sadler, and Perrine 1985).

One experimental study that was able to find some positive effect of DUI education and rehabilitation sanctions on recidivism was conducted in California with a sample of volunteer participants (Reis 1982, 1983). Results indicated that repeat offenders randomly assigned to attend education, counseling and/or treatment programs had significant reductions in DUI recidi-

vism as compared to offenders who received no treatment. Given the potential selection bias associated with a volunteer sample, the generalizability of this finding is questionable.

Licensing Actions

Despite self-reports that indicate that up to 75% of those with suspended licenses drive illegally (Waller 1985; Hagen, McConnell, and Williams 1980; Sadler and Perrine 1984; Peck et al. 1985; Ross and Gonzales 1988), there is some evidence that license revocation may be an effective sanction for reducing DUI recidivism (Nichols and Ross 1990; Hagen 1977, 1985; Hagen, Williams, McConnell, and Fleming 1978; Donovan 1989; Peck et al. 1985; Homel 1988; Preusser, Blomberg, and Ulmer 1988). In a well-known California study of multiple DUI offenders, matched by county, sex, and prior DUI convictions and followed for 6 years post conviction, Hagen (1977) found that those offenders who received mandatory license suspensions had lower DUI reconviction rates over a 3.5 year period than offenders whose licenses were not suspended due to technical dismissals of prior DUI convictions. No group differences were observed beyond 3.5 years. It is important to note that the effect of license suspension on subsequent DUI convictions lasted somewhat beyond the maximum 3-year suspension period, but the effect was apparent only for offenders over age 30. In addition, because dismissal of prior offenses on technical grounds is typically associated with having both good legal counsel and socioeconomic status (SES), the limited matching procedures may have overlooked a potential selection bias between the two offender groups. That the specific deterrent effect of license suspension was observed only for offenders over age 30 is consistent with the potential SES bias in this study.

Findings from research on the marginal specific deterrent effects of license suspensions compared to treatment programs among repeat offenders are mixed. Studies conducted in California indicate that although a period of license suspension appeared to have a greater positive impact on subsequent overall traffic safety (nonalcohol violations, accidents and convictions) than did treatment alone, possibly due to reduced driving exposure and/or more careful driving, there was no differential effect in reducing subsequent rearrests for DUI (Hagen et al. 1978; Sadler and Perrine 1984; Homel 1988; Nichols and Ross 1990). Similar traffic safety effects were also reported by Tashima and Peck (1986) in a study comparing repeat offenders receiving license suspensions with offenders referred to a combination of education or treatment with restricted licenses. However, although there is some indication that group differences were not adequately controlled for (e.g., compared

to the treatment/restriction groups, the license suspension group generally included offenders with worse prior DUI records), they did find a lower rate of subsequent major convictions, including DUI, among offenders in the combined treatment/restriction group.

IGNITION INTERLOCK DEVICES AS DETERRENTS TO DUI

An ignition interlock device is a system that connects a breath analyzer to an automobile's ignition. To start the engine of an interlock-equipped vehicle, the driver must blow into the analyzer that measures blood alcohol levels. If the breath test shows the driver's blood alcohol content meets or exceeds the calibrated setting on the device, the car will not start.[2]

The potential of the interlock device for reducing recidivism is obvious—persons who are alcohol impaired cannot start and thus cannot drive an interlock-equipped vehicle, greatly reducing the likelihood of a repeated DUI. Of course, this potential can be realized only if circumvention and tampering efforts prove to be minimal. While research to date indicates that the interlock device can be successfully bypassed, this failure rate is small in comparison with those associated with other DUI sanctions available to the court, for example, license suspension, alcohol treatment and rehabilitation programs (Morse and Elliott 1990; EMT Group, Inc. 1990). Further, data from interlock devices with electronic monitoring logs indicate that the device is successful at preventing drinking and driving incidents; that is, interlock users who failed the breath test as a result of unacceptable blood alcohol content (BAC) levels were unable to start their vehicles (EMT Group, Inc. 1990). Given the findings noted earlier that a majority of those with suspended licenses continue to drive illegally, interlock usage would appear to provide a viable option for deterring persons convicted of DUI from repeated instances of drinking and driving (Jacobs 1989; Nichols and Ross 1990; Homel 1988; Morse and Elliott 1990).

THE HAMILTON COUNTY STUDY

Research Design

The Hamilton County Drinking and Driving Study (HCDDS) is an ongoing research project that involves a quasi-experimental study design with matched license suspension and license suspension-plus-interlock compari-

son groups. The study sample was drawn from an eligible pool of persons convicted of DUI in Hamilton County between July 1, 1987 and February 28, 1989.[3] In addition to conviction of DUI, eligibility was limited to: (a) all first time offenders with a BAC of .20 or higher at arrest, (b) repeat offenders convicted of DUI two or more times within the last 10 years, and (c) offenders who refused a BAC test at the time of their arrest. On conviction, judges had the option of offering the interlock device with driving privileges (i.e., a suspended license with driving restricted to an interlock-equipped vehicle) to persons included in the eligible pool.[4] Offenders who were offered the interlock device had the choice to accept participation in the interlock program or refuse participation and serve their original court-ordered license suspension and probation period. Those persons who accepted participation in the interlock program were issued a court-ordered "letter to drive," and assigned to the license suspension-plus-interlock pool of subjects. Those offenders who refused to participate in the interlock program as well as offenders not offered the interlock option received court-ordered license suspension sanctions and probation terms and were assigned to the license suspension pool of subjects.[5] Entry into the two subject pools thus involved two initial stages: a judge-selection stage (i.e., offered or not offered the interlock) and a self-selection stage (i.e., accepted or refused the interlock).

Measures

The official measure of recidivism was rearrest for DUI in Hamilton County, although record searches included arrests for driving under suspension (DUS), no driver's license (NDL), and other alcohol- and drug-related offenses.[6] Official background data included: (a) demographic identifiers (e.g., birthdate, education, employment, income), (b) court administrative information concerning the presenting DUI offense (e.g., arrest and conviction date, BAC, accident/injury report, probation, jail, license suspension date and term, treatment evaluation, diagnosis, and recommendation), and (c) prior involvement with the judicial system (e.g., prior DUI and non-DUI convictions and arrests, prior court sentencing terms, prior alcohol- or drug-related treatment). In addition, for the interlock subjects, administrative aspects of interlock installation were recorded, such as installation date, calibration and length of term, limitations on driving terms, odometer readings, and evidence of insurance.

Self-reported interview and questionnaire data included a wide range of measures: (a) demographic and social status identifiers, (b) alcohol-related behavioral patterns (e.g., drinking and driving behavior, personal, friend's or family's use of alcohol and drugs), (c) alcohol-related attitudinal assessments

(e.g., importance and consequences of alcohol use and drinking and driving behavior), and (d) reports of any prior DUI arrests and court-ordered sanctions.[7] In addition, self-reported items assessed both interlock subjects' experience with the device (operational characteristics, personal impressions and circumvention attempts), as well as license suspension subjects' knowledge and perceptions of the interlock device and frequency of license suspension circumvention.[8]

Testing for Selection Bias

As with most quasi-experimental studies, the major threat to the internal validity of the Hamilton County study is the possibility of selection bias. As noted above, upon conviction all eligible DUI offenders were assigned to a license suspension only pool of subjects or a suspension-plus-interlock pool. To determine if study findings could be generalized to the population sampled, that is, to those in the entire eligible pool, a series of analyses was undertaken on the subjects to determine if there were judicial or self-selection biases at either of the two selection stages.[9]

Judge Selection

What were the official and demographic characteristics of the offenders to whom Hamilton County judges typically offered the interlock device? An examination of judge-selected group differences allows for the possibility of detecting selectivity on the part of judges as to who was and who was not offered the interlock option. Table 1 reveals few demographic differences between offenders offered the interlock and those not offered the interlock option. The majority of eligible DUI offenders coming through the court were single, White, working-class males, with an average age of 36. As both the interlock offered and not offered groups generally reflect this same demographic composition, there appears to be little judicial selection bias relative to these characteristics. Although there is a significant social class difference between the two groups, with those offered the interlock slightly less likely to be from *either* the middle or lower classes than those not offered, the majority of offenders in both groups were from the working class and reported approximately the same annual income.[10]

Significant differences between the two judge-selected groups are more apparent after examining the official data. Compared to those not offered the interlock option, persons offered the device may be somewhat more likely to be habitual offenders. For example, interlock offered offenders were more

(text continues on page 144)

TABLE 1: Demographic and Official Characteristics of Hamilton County Total Eligible Cases, Judge- and Self-Selected Cases

		Judge Selection		*Self Selection*	
	Total Eligible Cases N = *674*	*Offered Interlock* N = *455*	*Not Offered Interlock* N = *219*	*Offered-Accepted Interlock* N = *273*	*Offered-Rejected Interlock* N = *182*
Demographics					
Sex (in %)					
Male	86.9	88.1	84.5	87.9	88.5
Female	13.1	11.9	15.5	12.1	11.5
Race (in %)					
White	80.8	81.6	79.2	87.3	72.8**
Non-White	19.2	18.4	20.8	12.7	27.2
Social class (in %)					
Middle	6.2	5.7	7.3*	7.7	2.7*
Working	58.3	62.2	50.2	64.5	58.8
Lower	35.5	32.1	42.5	27.8	38.5
Age $\bar{X}$	36.2	36.7	34.9	37.2	35.8
Annual income $\bar{X}$	$16,195	$16,540	$15,508	$18,658	$13,145**
Marital status (in %)					
Single	31.2	31.4	30.6	33.6	28.2
Married	68.8	68.6	69.4	66.4	71.8

Current DUI					
BAC level (in %)					
≤ .15	13.4	15.6	8.7**	15.0	16.5
.16–.20	28.8	29.7	26.9	31.1	27.5
.21–.25	25.5	21.1	34.7	21.2	20.9
> .25	9.2	8.1	11.4	8.4	7.7
Refused/unknown	23.1	25.5	9.1	24.3	27.4
Accident involved (in %)					
No	73.2	74.8	70.0	77.2	71.1
Yes	26.8	25.0	30.0	22.4	28.9
Injury (in %)					
No	93.3	93.2	93.5	94.7	91.0
Yes	6.7	6.8	6.5	5.3	9.0
License suspension (in %)					
6-18 months	53.6	41.1	78.5**	38.8	44.5
24 months	22.4	27.3	12.3	27.1	27.5
26-48 months	11.9	15.2	5.0	17.6	11.5
≥ 60 months	12.2	16.3	3.7	16.1	16.5
Jail term (in %)					
0	31.0	25.9	41.6**	24.9	27.5
1-14 days	43.8	40.9	49.8	40.7	41.2
15-60 days	14.2	17.6	7.3	17.9	17.0
> 60 days	11.0	15.6	1.4	16.5	14.3

(continued)

TABLE 1 Continued

		Judge Selection		Self Selection	
	Total Eligible Cases N = *674*	*Offered Interlock* N = *455*	*Not Offered Interlock* N = *219*	*Offered-Accepted Interlock* N = *273*	*Offered-Rejected Interlock* N = *182*
Prior history					
DUI arrests					
0	40.7	31.2	60.3**	26.0	39.0*
1	33.4	36.5	26.9	37.0	35.7
2-3	22.7	26.8	11.0	30.8	20.9
≥ 4	17.1	5.5	1.9	6.3	4.3
Nontraffic arrests (non-DUI)					
0	49.2	46.6	54.8	49.6	42.0
1	20.1	21.2	17.8	22.4	19.3
2-3	13.7	14.1	12.7	12.1	17.2
≥ 4	17.1	17.6	14.8	15.8	21.5
Alcohol/drug-related arrests (non-DUI)					
0	46.7	46.0	48.9	47.8	43.3
1	21.1	21.9	19.6	22.8	20.6
2-3	20.2	21.3	18.2	19.9	23.4
≥ 4	12.0	10.7	13.2	9.6	13.0
Probation outcome (last prior)					
Terminated	88.7	88.0	90.5	86.5	90.4
Still serving term	11.3	12.1	9.3	13.5	9.6

DUI treatment program (last prior)					
No	3.9	3.0	6.2	3.9	1.7
Yes	96.1	96.9	93.8	96.2	98.3
Illicit drug use[a]					
No	62.0	63.4	59.5	66.5	58.7
Yes	38.0	36.6	40.5	33.5	41.3
Problem alcohol use scale $\overline{X}$[a]					
	2.3	2.4	2.2	2.4	2.3
Miles drive per week[a]					
≤ 50	21.1	19.1	25.0*	11.9	30.1**
51-100	22.9	22.1	24.5	23.0	20.8
101-150	12.9	11.8	15.3	13.4	9.2
151-200	10.0	10.1	9.7	10.0	10.4
> 200	33.1	36.9	25.5	41.8	29.5

a. Items reflect offender's self-reported behavior during the year *prior* to presenting DUI conviction.
*Chi-square and/or *t*-test differences significant at $p \leq .05$.
**Chi-square and/or *t*-test differences significant at $p \leq .01$.

likely to have refused the BAC test, and far more likely to have had prior DUI arrests than those not offered. Similarly, offenders referred to the interlock program also had more multiple arrests for nontraffic (non-DUI) and alcohol/drug-related arrests (non-DUI) than those not referred, although the group differences are not so dramatic. It also appears that judges offered the interlock to persons with longer license suspension periods and longer jail terms than those not offered this option; again, group differences are not significant.

Overall, there appears to have been a tendency for Hamilton County judges to have selected the more serious, habitual offenders, or those they perceived to be at greater risk for a repeated DUI, for the interlock option.

Self-Selection

Among the DUI offenders offered the interlock option, what were the characteristics of those who accepted interlock installation as compared to those who rejected it? Table 1 also presents self-selected group differences in interlock program participation, a number of which are statistically significant. Compared to those who rejected the option, those who accepted were more often White, working-class males with substantially higher incomes. While the demographic distribution of both groups roughly reflects the total pool of eligibles, there does appear to be a racial and economic bias (which may be correlated) in that offenders who accepted the interlock option were more likely to be White and from more advantaged backgrounds.

Again, evidence of selection bias among persons offered the interlock option is apparent after examining the official data. Although those who rejected the offer had a slightly greater tendency for multiple prior nontraffic (non-DUI) and alcohol/drug-related (non-DUI) arrests than both the eligible pool of offenders and those who accepted the interlock offer, those who accepted interlock installation were significantly more likely to have had a history of multiple prior DUI arrests than either the eligible pool of offenders or those who rejected the interlock.

Discussion

In sum, there is evidence of bias in both the judicial and self-selection stages of interlock program participation. Although the judicial decision to offer the interlock option appears to be related to a more serious prior official record (both DUI and non-DUI), it also appears to have been an option more readily accepted by those offenders with a more serious history of drinking and driving. However, although those persons accepting the interlock were

at higher risk for a subsequent DUI, they also tended to have more resources and may have been a more motivated group than those individuals rejecting the interlock.

The presence of judicial and self-selection biases limits the external validity of the study; that is, findings cannot readily be generalized to the eligible pool of convicted DUI offenders in Hamilton County. However, although there are some significant differences between the two judge-selected groups, those offered the interlock option more closely resemble the total eligible DUI offender population than those not offered this option; for example, although 60% of the eligible offenders had multiple prior DUIs (27% with two or more), 69% of those offered the interlock had prior DUIs (32% with two or more) compared to 40% of those not offered the interlock (13% with two or more). This suggests that the findings would be more appropriately generalized to a more serious population of DUI offenders than appeared in the eligible pool of Hamilton County offenders.

Due to the matching procedure, described below, which controlled for group differences on several DUI risk factors, judicial and self-selection biases are not likely to present a problem for the internal validity of the study. Again, those persons offered the interlock by Hamilton County judges were, in general, more likely to be habitual offenders than those not offered the option. Those who rejected the interlock offer were slightly more likely than those who accepted to have had prior nontraffic (non-DUI) arrests, but they were *less* likely to have had a history of multiple prior DUI arrests. It is important to note that with respect to risk factors, persons who refused the offer to install an interlock were more like those who accepted than persons who were not offered the interlock device.

MATCHING EXPERIMENTAL AND CONTROL GROUPS

In order to protect against potential selection biases and insure baseline equivalence between offender groups, subjects from the license suspension pool were precision-matched to suspension-plus-interlock subjects on three factors statistically shown to put persons at risk for repeated DUI arrest. In order of their predictive ability, these factors were: (a) problem drinker classification (self-reported), (b) number of prior alcohol/drug-related arrests (non-DUI), and (c) number of prior DUI arrests. The matching criteria were determined using predictive analyses.[11]

Subjects were initially assigned to license suspension and interlock groups using a cluster analysis, a procedure that clusters persons on the basis of the

similarity of their profiles on a set of specified variables; in this case, problem drinker classification, prior alcohol/drug-related arrests (non-DUI), and prior DUI arrests (Everitt 1974; Milligan and Cooper 1987; SPSS Inc. 1988). This procedure yielded clusters from which 273 individually matched pairs were selected.[12]

In order to test the accuracy of the matching procedures, differences between the license suspension and interlock groups on the matching variables as well as on the full set of demographic and official record variables were examined.[13] As indicated in Table 2, the two groups are well matched on both problem drinker classification (i.e., problem use scale) and number of prior alcohol/drug-related arrests. However, there is a significant difference between the two groups on the third risk variable – number of prior DUI arrests. Thus the license suspension and the interlock groups are alike in terms of two of the significant predictors of DUI recidivism, but interlock group members appear to have had more prior DUI arrests than license suspension members putting them at a slightly greater risk for a repeated DUI.

Table 2 also reveals several other significant differences between the matched license suspension and interlock groups; however, as noted previously, none of these variables proved to be predictive of DUI rearrest. Compared to license suspension group members, interlock subjects were more likely to be White males with a higher annual income. Although BACs did not differ significantly, there was a tendency for an accident to be associated with the license suspension group members presenting DUI offense. Interlock members also reported driving a significantly greater number of miles per week during the year prior to the presenting DUI conviction.

Overall, the differences between the matched license suspension and interlock groups are minimal. Of the significant differences that do exist, only one was found to be a predictor of DUI recidivism. The fact that the interlock group, with a greater number of prior DUI arrests, may be slightly more vulnerable to DUI recidivism indicates that any comparison on DUI recidivism would be a conservative test, that is, the higher risk of the interlock group renders it less likely that they would experience lower recidivism rates than the license suspension group and, if anything, would produce underestimates of the magnitude of any true deterrent effect of the interlock device.

TIME-TO-FAILURE ANALYSIS

Although the study design will eventually allow for the calculation of short-term survival estimates for subjects with a minimum risk period of 36

TABLE 2: Demographic and Official Characteristics of Hamilton County Precision-Matched License Suspension-Plus-Interlock and License Suspension Cases

	Total N = *546*	*Interlock* N = *273*	*License Suspension* N = *273*
Demographics			
Sex (in %)			
Male	87.9	87.9	87.9
Female	12.1	12.1	12.1
Race (in %)			
White	80.5	87.3	73.7**
Non-White	19.5	12.7	26.3
Social class (in %)			
Middle	6.6	7.7	5.5
Working	61.2	64.5	57.9
Lower	32.2	27.8	36.6
Age $\bar{X}$	36.4	37.2	35.6
Annual income $\bar{X}$	$16,880	$18,658	$15,240**
Marital status			
Single	66.4	66.4	66.3
Married	33.6	33.6	33.7
Current DUI			
BAC level			
≤ .15	14.3	15.0	13.6
.16–.20	29.7	31.1	28.2
.21–.25	23.3	21.2	25.3
> .25	8.6	8.4	8.8
Refused/unknown	24.2	24.2	24.2
Accident involved			
No	72.2	77.2	67.2*
Yes	27.6	22.4	32.8
Injury			
No	92.3	94.7	89.9
Yes	7.7	5.3	10.1
Prior history			
DUI arrests			
0	32.6	26.0	39.2**
1	38.8	37.0	40.7
2-3	24.5	30.8	18.3
≥ 4	4.0	6.2	1.8

(continued)

TABLE 2 Continued

	Total N = *546*	*Interlock* N = *273*	*License Suspension* N = *273*
Nontraffic arrests (non-DUI, in %)			
0	48.6	49.5	47.8
1	20.2	22.3	18.0
2-3	13.9	12.1	15.8
≥ 4	17.2	16.1	18.4
Alcohol/drug-related arrests (non-DUI, in %)			
0	47.4	47.6	47.3
1	20.1	22.7	17.6
2-3	21.4	19.8	23.1
≥ 4	11.0	9.9	12.1
Probation outcome (last prior, in %)			
Terminated	88.3	86.5	90.5
Still serving term	11.7	13.5	9.5
DUI treatment program (last prior, in %)			
No	3.1	3.7	2.6
Yes	96.9	96.3	97.4
Illicit drug use (in %)[a]			
No	62.3	66.5	58.3
Yes	37.7	33.5	41.7
Problem alcohol use scale $\bar{X}$[a]	2.4	2.4	2.3
Miles drive per week[a]			
≤ 50	20.3	11.9	28.5**
51-100	22.5	23.0	22.1
101-150	12.5	13.4	11.6
151-200	10.0	10.0	10.1
> 200	41.8	41.8	27.7

NOTE: Interlock and license suspension group members were matched for baseline equivalence on three DUI risk factors: (a) problem drinker classification, (b) number of prior alcohol- or drug-related arrests (non-DUI), and (c) number of prior DUI arrests.
a. Items reflect offender's self-reported behavior during the year *prior* to presenting DUI conviction.
*Chi-square and/or *t*-test differences significant at $p \leq .05$.
**Chi-square and/or *t*-test differences significant at $p \leq .01$.

months and a maximum of 60 months (depending on time of study entry), the short-term risk period for subjects to date ranges between 12 and 30 months. "Short-term" effects refer to the probability of rearrest for DUI (and DUS or NDL) during the court-ordered period the interlock is operational in

the vehicles of those in the interlock group, driver's licenses are suspended for those in the license suspension group, and members of both groups are on probation.

The analytical approach used to estimate time-to-failure for DUI, DUS and NDL involved a nonparametric life-table and survival analysis procedure (Barton and Turnbull 1979; Tuma and Hannan 1984; Kalbfleisch and Prentice 1980; SPSS Inc. 1988). As implemented, the procedure calculates the number of days to failure for arrest using the date of interlock installation (for interlock subjects) or the date of license suspension (for license suspension subjects) as the start point, and the date of the first DUI (DUS or NDL) rearrest as the point of failure. Survival scores (Lee and Desu 1972) are used in comparisons to determine whether the license suspension and interlock groups differ significantly in terms of their survival curves across time (see Figures 1 and 2).

DUI Short-Term Survival Rates

The short-term survival rates presented in Table 3 represent the proportion of persons in each group who have *not* been arrested for a repeated DUI offense in Hamilton County during the "treatment" or time-at-risk period. As noted above, the risk period to date for those still under court-ordered interlock installation or license suspension ranges from 12 to 30 months. The failure rate (or cumulative prevalence) is the complement of the survival rate and provides an estimate of recidivism.

The survival score differences between the two groups are statistically significant ($p = .004$). The DUI rearrest rate for the license suspension group is approximately three times as great as that of the interlock group across all time-at-risk periods. Although the survival rates for DUI appear to be rather high compared to those reported in other studies (e.g., National Highway Traffic Safety Administration 1979), it should be remembered that these rates involve a period during which both the license suspension and interlock group members were on probation and the court-ordered sanctions (i.e., interlock installation or license suspension) were in effect. The high rates presented here are thus likely to reflect a general suppression effect for that period during which these sanctions were in place.

DUS or NDL Short-Term Survival Rates

As a means of estimating circumvention of the court-ordered sanction for DUI, an examination of survival rates for DUS or NDL is useful.

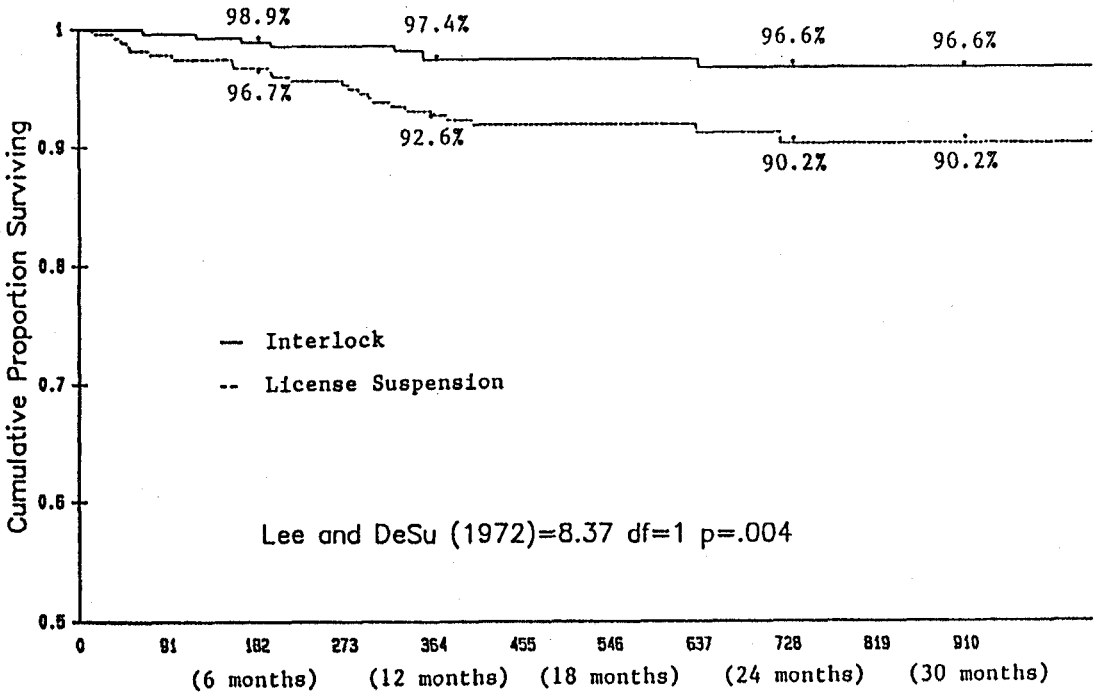

Figure 1: Survival Function for DUI Rearrest by Interlock and License Suspension Groups

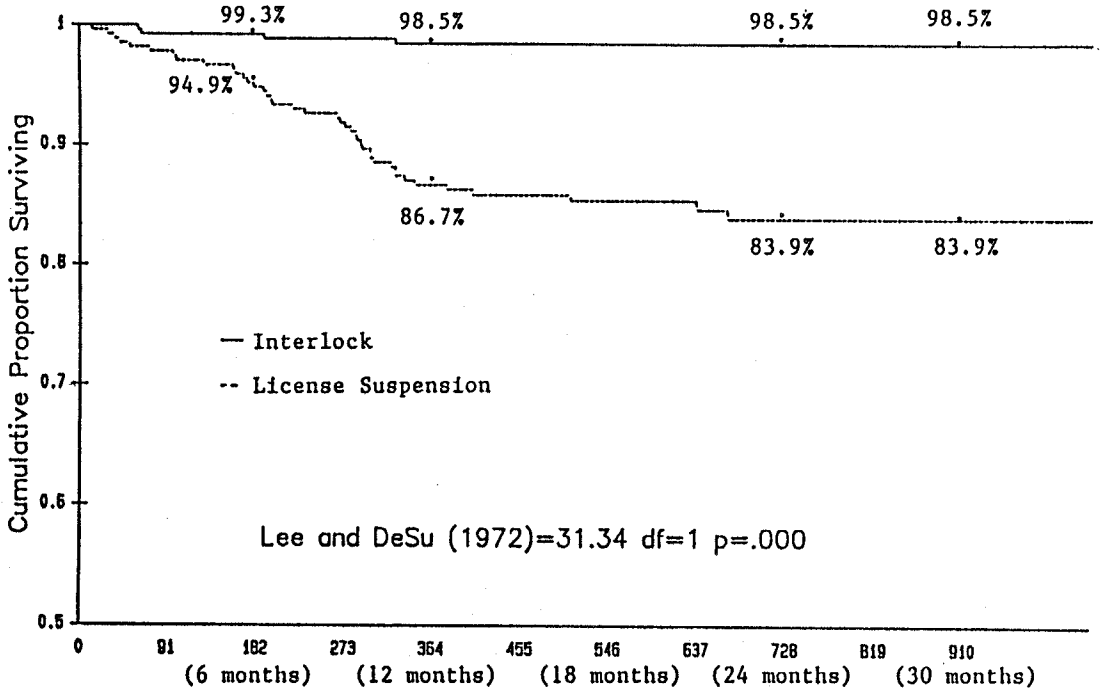

Figure 2: Survival Function for DUS and NDL Rearrest by Interlock and License Suspension Groups

TABLE 3: Survival and Failure Rates for a Repeated DUI by Comparison Group

	Interlock Rates		*License Suspension Rates*	
Time at Risk	*Survival*	*(Failure)*	*Survival*	*(Failure)*
6 months	98.9%	(1.1%)	96.7%	(3.3%)
12 months	97.4%	(2.6%)	92.6%	(7.4%)
24 months	96.6%	(3.4%)	90.2%	(9.8%)
30 months	96.6%	(3.4%)	90.2%	(9.8%)[a]

a. After 30 months, a total of eight interlock group members were rearrested for DUI compared to 24 license suspension group members.

TABLE 4: Survival and Failure Rates for Driving Without a License (NDL) or With a Suspended License (DUS)

	Interlock Rates		*License Suspension Rates*	
Time at Risk	*Survival*	*(Failure)*	*Survival*	*(Failure)*
6 months	99.3%	(0.7%)	94.9%	(5.1%)
12 months	98.5%	(1.5%)	86.7%	(13.3%)
24 months	98.5%	(1.5%)	83.9%	(16.1%)
30 months	98.5%	(1.5%)	83.9%	(16.1%)[a]

a. After 30 months, a total of four interlock group members were arrested for DUS or NDL (i.e., driving a noninterlock vehicle) compared to 41 license suspension group members (i.e., driving any vehicle). As with DUI, only the first failure of either DUS or NDL was calculated in the survival analysis. As DUI and DUS/NDL survival analyses were performed separately, the two failure rates are not independent. That is, subjects who were rearrested for both DUI and DUS or NDL were counted as failures in each analysis.

The survival score differences between the two groups, shown in Table 4, are statistically significant (p =.001). The DUS/NDL rearrest rate for the license suspension group at 6 months is about seven times as great as that for the interlock group; at 12 months, the rearrest differential is nearly nine to one; and at 24 and 30 months, the DUS/NDL recidivism rate for license suspension subjects is over ten times that of interlock group members.[14]

SUMMARY AND IMPLICATIONS

Keeping in mind the caveats appropriate for a quasi-experimental research design, the results of the Hamilton County Drinking and Driving study to date support the view that ignition interlock devices installed in the vehicles of DUI offenders in Hamilton County substantially reduce the incidence of

a repeated DUI arrest as compared to license suspension. Compared to a 30-month failure rate of 9.8% for the license suspension group, the 3.4% failure rate in the interlock group represents a 65% decrease in the likelihood of a repeated DUI. Further, evidence of sanction circumvention is substantially lower in the interlock group, as reflected not only by DUI rearrests, but by the significantly lower rearrest rates for DUS or NDL. Compared to the 30-month failure rate for license suspension subjects (16.1%), the interlock failure rate (1.5%) represents a 91% decrease in the likelihood of DUS or NDL arrests.

Although the generalizability of these findings is limited, the direction and magnitude of observed differences clearly support a continuing interest in the interlock device with a "letter to drive" as a court-ordered alternative to license suspension alone, or as an option to be used in conjunction with (most likely following) license suspension. Further, these results seem sufficiently positive to provide justification for investing the necessary funds and obtaining the legal clearances for a large-scale study of the effectiveness of interlock devices employing a true experimental design.

NOTES

1. California was the first state to pass specific legislation authorizing judicial use of interlock devices (the Farr-Davis Driver Safety Act of 1986). To date, approximately 16 states have passed similar legislation.

2. For a more extensive review of the technical aspects of ignition devices, see Frank (1987) and the National Highway Traffic Safety Administration (1986, 1988).

3. The largest city in Hamilton County, Ohio, is Cincinnati. The 1980 Census estimate of the population living in the county was 1,405,121 with 86.6% White, 12.4% Black, and 1.0% in other ethnic categories.

4. Not all eligible persons were offered the interlock for two reasons. First, not all of the Hamilton County Court judges participated in the study, and eligible cases processed while a nonparticipating judge was on the bench (each judge rotates through arraignment court on a 2-week cycle) were not offered the option. Second, participating judges were not required to offer all eligible cases the interlock option, leaving each judge free to offer or not offer this option to any eligible offender.

5. All eligible offenders received license suspension sanctions. However, offenders who agreed to participate in the interlock program, after installation of the device, received a "letter to drive", which enabled them to drive the interlock-equipped vehicle only. See Morse and Elliott (1990) for a more detailed description of post eligibility group assignment rules.

6. An official records search for the tri-state area (Ohio, Kentucky, and Indiana) is planned for the final stages of the study.

7. Personal alcohol use, beyond general frequencies, was determined using several scales. The primary source for these scales was Cahalan (1976), the Monitoring the Future Study (Bachman, Johnston, and O'Malley 1980), and the National Youth Survey (Elliott and Huizinga

1983; Huizinga and Elliott 1986). Initial reliability estimates yielded alpha coefficients of .68 or greater.

8. See Morse and Elliott (1990) for a more detailed account of data collection procedures, questionnaire administration, and self-reported interview schedules across the study period.

9. Differences between the groups were examined by two methods. Chi-square tests were used to determine group differences for nominal or categorical variables; *t* tests were used to examine differences between group means on continuous variables.

10. The social class measure is the Hollingshead two-factor index (Hollingshead and Redlich 1958). These descriptive class labels generally reflect the occupational and educational differences in the class distribution, but it is acknowledged that the categories are quite broad and exact boundaries between them somewhat arbitrary.

11. Using all instances of DUI recidivism during the study to date as the criterion ($N = 48$), a number of variables previously identified as having a potential impact on DUI were tested as to their predictive power for this outcome. For example, in addition to the three matching variables, analyses included such variables as race, BAC, marital status, SES, age, prior treatment, prior alcohol- and nonalcohol-related arrests, drug use, and so on. Following initial *t* tests, multiple regression analyses showed that the inclusion of race, BAC, marital status, SES, and age increased the explained variance by less than .5% over that accounted for by the three matching variables. Similarly, discriminant analyses confirmed the predictive power of the three matching variables; addition of the above demographic variables added little to overall classification accuracy (DUIs and non-DUIs) and actually somewhat reduced the accuracy of identification of known DUI recidivists.

12. The matched sample license suspension group consists of an approximately equal number of persons who were offered the interlock option and refused ($n = 135$), and persons who were not offered the interlock option ($n = 138$).

13. Categorial and mean item differences between the two groups were examined with Chi-square and *t* tests of significance (see Table 2).

14. As noted previously, the license suspension sample consists of a nearly equal number of persons who were offered the interlock and refused, and persons who were not offered the interlock option. Although the matching procedure controlled for group differences in DUI risk factors, questions concerning license suspension group bias may remain; for example, were those persons who refused the interlock offer a select group of individuals who *intended* to drive following their conviction? Reanalyses of survival rates for DUI, DUS and NDL showed little evidence of this type of bias; that is, (a) the failure rate on these offenses for offered/refused subjects was not significantly different than that of not offered subjects, and (b) eliminating offered/refused subjects from the analyses did not change the direction of the results, although it lowered the significance of the differences in DUI survival rates between the interlock group and the not offered subject group. In addition, there was little evidence from the self-reported data that offered/refused subjects rejected the interlock offer because they intended to drink and drive.

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