ON THE LEGAL DETERRENCE OF PEDESTRIAN HIT-AND-RUN COLLISIONS

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ABSTRACT
Hit-and-run collisions—those in which a driver involved in the collision leaves the scene before the arrival of law enforcement officials—are a unique type of traffic violation because the driver's decision is a question of damage control rather than damage prevention. To reduce hit-and-run violations, individual state laws impose legal sanctions to deter drivers from leaving the collision scene prematurely. Deterrence Theory dictates that compliance with laws is associated with the certainty, severity, and swiftness of punishment. The purpose of this study is to explore the deterrent effect of legal sanctions on the rate of hit-and-run collisions. Legal sanctions for hit-and-run violations across the United States were compared with the prevalence of pedestrian hit-and-run collisions in those states. Specifically, the severity of punishment, the certainty of punishment, and the excess legal sanctions of hit-and-run were compared with the rates of hit-and-run. The results of these analyses suggest that legal sanctions do not have a significant deterrent effect on hit-and-run collisions. Uncertainty regarding the likelihood of being caught or the severity of punishment may impair the effects of legal sanctions to reduce hit-and-run incidents. However, the data indicate that social sanctions may deter drivers from hit-and-run violations. Further study is necessary to determine which deterrence mechanism would be the most effective for reducing hit-and-run violations.

INTRODUCTION

Hit-and-run collisions—in which a driver involved in the collision leaves the scene before the arrival of law enforcement officials—are a result of a unique type of traffic violation. While many traffic violations, such as red-light-running or speeding, increase the risk for—or the damage from—a collision, hit-and-run is a post-collision violation. Put another way, the driver's decision is a question of damage control rather than damage prevention. To reduce hit-and-run violations, state laws impose legal sanctions to deter drivers from leaving the scene prematurely. In light of this, the purpose of this study is to evaluate the deterrent effect of legal sanctions on the likelihood of hit-and-run collisions.

Approximately 20% of drivers involved in pedestrian crashes leave the scene of the collision, resulting in 4,600 to 4,900 pedestrian fatalities and 30,000 to 40,000 pedestrian injuries annually on U.S. roadways (*1*). Hit-and-run collisions are more prevalent in urban areas, at nighttime, and on weekends (*2,3*). They are also more frequent on high-speed roads or at non-intersections (non-signalized) in urban areas. Drivers involved in hit-and-runs are more likely to be under the age of 25 and male. Drivers are more likely to flee the scene of a collision if they believe that fault can be more clearly attributed to them (for example, when they are intoxicated) (*4,1*).

In general, one of the goals of legal sanctions is to complement the natural deterrent derived from the driver's motivation to avoid harmful events (*5*). Deterrence Theory dictates that compliance with laws is associated with the certainty, severity, and swiftness of punishment, where certainty represents the likelihood that a violator will be punished, severity represents the extent of the punishment, and swiftness represents the time between the violation and the punishment (*6,7*). Perceptions of certainty, severity, and swiftness of punishment for particular violations are derived from personal experience (specific deterrence) or from vicarious experience (general deterrence), with some research showing that the certainty of punishment has a largest effect (*6,8*).

Drivers commonly establish a perception of the associated legal sanctions for many traffic violations (e.g., drunk driving, talking on a handheld cellular phone). These perceptions based both on punishment and punishment avoidance experience, since it is possible to commit violations without suffering any consequences. However, that is not necessarily the case for hit-and-run violations. Most drivers possess very little, if any, specific or general experience with hit-and-run violations and therefore their perception of the certainty, severity, and swiftness of the legal sanctions associated with fleeing the scene of a crash are limited.

It is important to emphasize that legal sanctions are only one of several factors that influence the driver's decision. Previous studies have shown that factors such as nighttime, male drivers and drunken driving involvement are associated with hit-and-run violations (*2*,*3*,*4*). Factors affecting hit-and-run violations can be divided to four categories: (i) incentive to run; (ii) opportunity to run; (iii) ability to run; and (iv) personality factors (*4*). Factors related to the incentive to run are associated with legal sanctions and are the focus of this analysis.

To accomplish this, legal sanctions for hit-and-run across various states were compared with the prevalence of hit-and-run in those states. To reduce the confounding effects of other factor categories, pedestrian-involved collisions were selected as the study population. Drivers hitting a pedestrian are faced with a higher opportunity to run, and represent a more coherent population, since the damage to the vehicle involved is usually minimal. This may explain why hit-and-run collisions disproportionately affect pedestrians, as they are the largest category of hit-and-run victims accounting for approximately 60% (*9*).

As opposed to other factors affecting hit-and-run violations, the impact of legal sanctions has not been sufficiently studied. Since hit-and-run violations are synonymous with hit-and-run collisions, increasing enforcement would not be effective and legal sanctions are the major policy effort to reduce hit-and-run collisions. It is therefore essential to: (i) evaluate the deterrent effect of legal sanctions; and (ii) determine which components of these sanctions are effective. Based on these findings, future research can inform efforts to improve the effectiveness of legal sanctions on reducing hit-and-run collisions.

This manuscript is organized as follows. In the subsequent section the methodology used to analyze deterrence is presented along with the necessary assumptions. The data collections efforts for the legal sanctions and for the frequency of hit-and-run crashes are described next. The third section presents the results and their interpretation. Finally, the insights of this analysis are discussed along with future research ideas.

METHODS

The variation in legal consequences for hit-and-run across the United States, provides a basis for studying the association with the percentage of hit-and-run violations. It allows us to explore the association between different severities of legal sanction and the percentage of hit-and-run as the outcome variable. Pedestrian collisions were selected as the study population for this review. This is justified by the fact that pedestrian hit-and-run collisions represent the largest category of hit-and-run, accounting for about 60% of such crashes. As mentioned in the introduction, the certainty, severity, and swiftness of punishment are all associated with compliance with the law. However, swiftness is unlikely to play a role for this type of violations since drivers are almost always arrested immediately when apprehended for a hit-and-run. Therefore, this study focuses on the impact of the severity and the certainty of the punishment.

The Severity of Punishment

The severity of the punishment was estimated using the maximum prison sentences for drivers guilty of hit-and-run who had no prior violations. A comparison of the hit-and-run rates with both the maximum length of prison sentence would reveal whether an association exists between the severity of the legal sanctions and hit-and-run rates. Hit-and-run is a post-crash response in which the driver must decide between suffering the consequences of staying, and risking the consequences of fleeing. Therefore, it would also be beneficial to evaluate the association between the additional consequence caused by fleeing, approximated here by the difference between being guilty of a fatal crash, and being guilty of a hit-and-run.

Since there are differences in the punishment level for hit-and-run by level of injury severity, an additional method to evaluate the impact of the severity of punishment on hit-and-run is to examine whether the level of injury to the victim is a factor in the driver's decision to flee.

The Certainty of Punishment

An approximation of the certainty of punishment across the different states was obtained from the percentage of drivers who were identified. The assumption is that percentage identified is associated with apprehension rates and can therefore be used to approximate certainty of punishment. A comparison of the hit-and-run rates with the percentage of drivers identified would reveal whether an association exists between the certainty of legal sanctions and hit-and-run rates.

Legal Sanctions for Other Traffic Violations

Legal sanctions can also have an indirect impact on hit-and-run rates. Legal consequences such as imprisonment and license suspension remove violation-prone drivers from the road. Since violation-prone drivers are more likely to be involved in hit-and-run collisions, removing these drivers from the road may reduce the hit-and-run rate. To evaluate this theory, data regarding the maximum prison sentence for speeding and reckless driving across all states were collected.

Data Collection

A ten-year period was selected as the study interval. Data regarding fatal pedestrian collisions between 1998 and 2007 were downloaded from the nationwide Fatality Analysis Reporting System (FARS). The percentage of fatal pedestrian hit-and-run crashes out of all fatal pedestrian crashes was calculated for each state, and presented in column 3 of Table 1. Out of 47,465 fatal pedestrian collisions that occurred during the study period, a total of 8,428 were hit-and-run collisions, resulting in an average hit-and-run rate of 18.2%. As expected, hit-and-run rates vary significantly across all states from 6.6% in Mississippi to 28.6% in DC.

Data for legal sanctions were collected by a review of hit-and-run laws for each individual state. The data was accessed through a website summarizing hit-and-run laws by state (*10*). Each state has a slightly different mechanism to categorize violations and corresponding punishment. For example, some states do not distinguish between fatal and severe collisions when assessing the penalty, other states do not determine punishment based on whether the driver was at fault. Therefore, to conduct a consistent analysis, data was collected for the maximum prison sentence for drivers guilty of fatal hit-and-run collisions.

Table 1 shows the maximum prison sentences for 50 states and the District of Columbia. The data reveals a wide range of values for sentence levels (between 0.5 and 30 years) and an average maximum sentence of 8.6 years. The percentage of hit-and-run drivers identified is also shown in Figure 1 and reveals a wide range of values with an average value of 42.9%.

TABLE 1. Severity of Legal Sanctions for Hit-and-Run Violations and Hit-and-Run Rate by State

State	Pedestrian Collisions	HR Collisions	HR as % of Total	Maximum Sentence for drivers guilty of fatal HR	% of HR Drivers Identified
Alabama	699	122	17.6	10	37.6
Alaska	97	19	18.6	10	64.3
Arizona	1,449	283	19.9	10	7.3
Arkansas	379	50	12.7	6	40.4
California	6,780	1,460	22.3	11	76.2
Colorado	625	127	20.6	6	66.7
Connecticut	385	60	15.1	10	44.9
Delaware	167	23	13.2	5.5	71.4
DC	140	37	28.6	0.5	44.6
Florida	5,038	781	17.1	30	30.6
Georgia	1,518	234	16.1	5	41.0
Hawaii	278	35	12.2	10	43.5
Idaho	116	12	10.3	5	85.7
Illinois	1,706	450	26.9	14	58.7
Indiana	619	101	15.7	8	45.8
Iowa	216	44	19.4	2	60.0
Kansas	247	45	17.0	0.58	48.8
Kentucky	522	65	10.5	1	50.0
Louisiana	1,004	176	19.5	10	43.1
Maine	114	9	7.0	5	78.6
Maryland	1,020	152	16.9	10	50.8
Massachusetts	739	128	16.6	10	38.1
Michigan	1,533	298	19.8	15	59.3
Minnesota	436	56	12.6	10	100.0
Mississippi	559	41	6.6	5	39.8
Missouri	813	151	18.5	4	54.6
Montana	109	21	20.2	1	70.0
Nebraska	124	12	10.5	1	70.9
Nevada	525	98	19.4	15	72.7
New Hampshire	93	7	8.6	7	42.9
New Jersey	1,493	233	16.9	0.5	37.6
New Mexico	571	98	17.0	6	64.3
New York	3,271	549	17.0	7	7.3
North Carolina	1,634	271	16.4	0.67	40.4
North Dakota	47	7	12.8	10	76.2
Ohio	1,013	172	16.5	5	66.7
Oklahoma	478	72	15.3	10	44.9
Oregon	495	60	12.1	10	71.4
Pennsylvania	1,629	250	15.3	7	44.6
Rhode Island	111	18	17.1	15	30.6
South Carolina	990	153	15.5	25	41.0
South Dakota	98	14	15.3	2	43.5
Tennessee	789	126	17.5	6	85.7
Texas	4,064	904	22.6	10	58.7
Utah	300	27	7.7	6	45.8
Vermont	50	6	10.0	15	60.0
Virginia	880	123	13.4	10	48.8
Washington	667	97	13.3	10	50.0
West Virginia	260	30	13.1	3	43.1
Wisconsin	516	110	21.1	25	78.6
Wyoming	59	11	13.6	1	50.8
All States	**47,465**	**8,428**	**18.2%**	**8.6**	**42.9%**

Note: Hit-and-run excludes Hit Motor Vehicle in Transport; Hit Parked Vehicle or Object; Driver Leaves Scene After Non-Collision Event; and Other Involved Person, Not a Driver, Left Scene. *Data source:* NHTSA/FARS 1998-2007

Unidentified were defined as drivers for which age and gender were unknown. *Data source:* NHTSA/FARS 1998-2007

Maximum prison sentence for drivers guilty of a hit-and-run collision with no prior violations

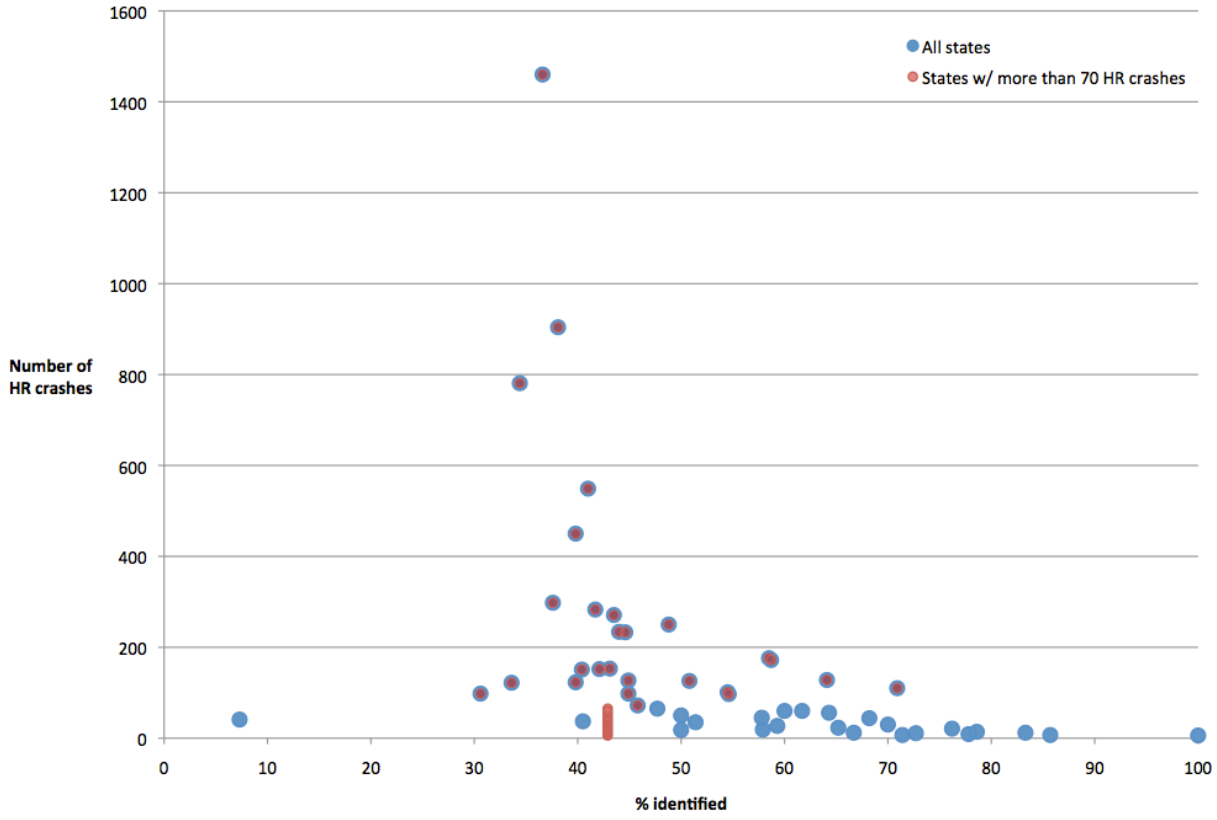


FIGURE 1. Number of Hit-and-Run Crashes Versus Percentage of HR Drivers Identified

An additional source of data was used for the purpose of this analysis. Seven counties were selected based on criteria that include (i) a high absolute number of fatal pedestrian-involved hit-and-run crashes, (ii) a high or low ratio of pedestrian-involved hit-and-run collisions to total pedestrian-involved collisions, (iii) a high or low rate of pedestrian-involved hit-and-run collisions per capita, (iv) a high rate of pedestrian-involved hit-and-run collisions as a percentage of total collisions, (v) representation of counties from multiple states in diverse regions, and (vi) and strong data availability. As Table 2 shows, their populations range from a low of 1.45 million in Philadelphia, PA to a high of 9.88 million in Los Angeles County, CA. Philadelphia, PA is the densest with just over 10,000 people per square mile, while Maricopa County, Arizona is the least dense with 421 people per square mile. Maricopa County is also the richest with a median household income of over $54,000, while Philadelphia has the lowest median income at $35,365.

Two data sources were used for developing an integrated local database: (i) the State Data System (SDS), compiled by NHTSA; (ii) data obtained directly from the selected counties. Since neither source covers all potential counties across the study period, the two data sources were integrated.

TABLE 2. Demographic Characteristics of Seven Counties

County	Population	Land Area (sq. mi.)	Population Density (pop/sq. mi.)	Median Household Income ($)	Major Cities
Broward, FL	1,759,591	1,320	1,333	52,670	Fort Lauderdale
Cook, IL	5,285,107	1,635	3,232	52,564	Chicago
Los Angeles, CA	9,878,554	4,752	2,079	53,573	Los Angeles
Maricopa, AZ	3,880,181	9,224	421	54,730	Phoenix
Orange, FL	1,066,113	907	1,175	51,101	Orlando
Philadelphia, PA	1,449,634	143	10,163	35,365	Philadelphia
Wayne, MI	1,985,101	672	2,953	42,470	Detroit

Source: U.S. Census Bureau American Community Survey 2007 estimates and County and City Data Book: 2007 (land area only)

Six of the select counties participate in the State Data System (SDS), compiled by NHTSA, and provide complete collision databases for some or all of the study. Arizona does not participate in the system, so local data were used for Maricopa County. The variables of interest are coded in ways unique to each state. For example, the hit-and-run coding for Florida lumps hit-and-run vehicles with parked cars and other cars with unidentified drivers.

RESULTS

The Severity of Punishment

Figure 2 plots the data from Table 1. The horizontal axis represents the maximum prison term in years, while the vertical axis represents the percentage of hit-and-run collisions. The blue circles correspond to pairs of data for individual states. This graph illustrates that the percentage of hit-and-run collisions remains stable, between 15% and 20%, as the maximum punishment increases.

To further analyze the data, the individual states were grouped in intervals of five years. The average maximum prison term for each of the groups is shown by the red squares in Figure 2 and is summarized in Table 3. Based on this analysis, there again does not appear to be an association between legal sanctions and hit-and-run rates. On average hit-and-run rates peak in the middle range of prison sentence length, and are lowest for states with the shortest and longest sentences. States with the longest maximum sentences are focused on general deterrence, where those caught are given an onerously long sentence as an example to others who might flee.

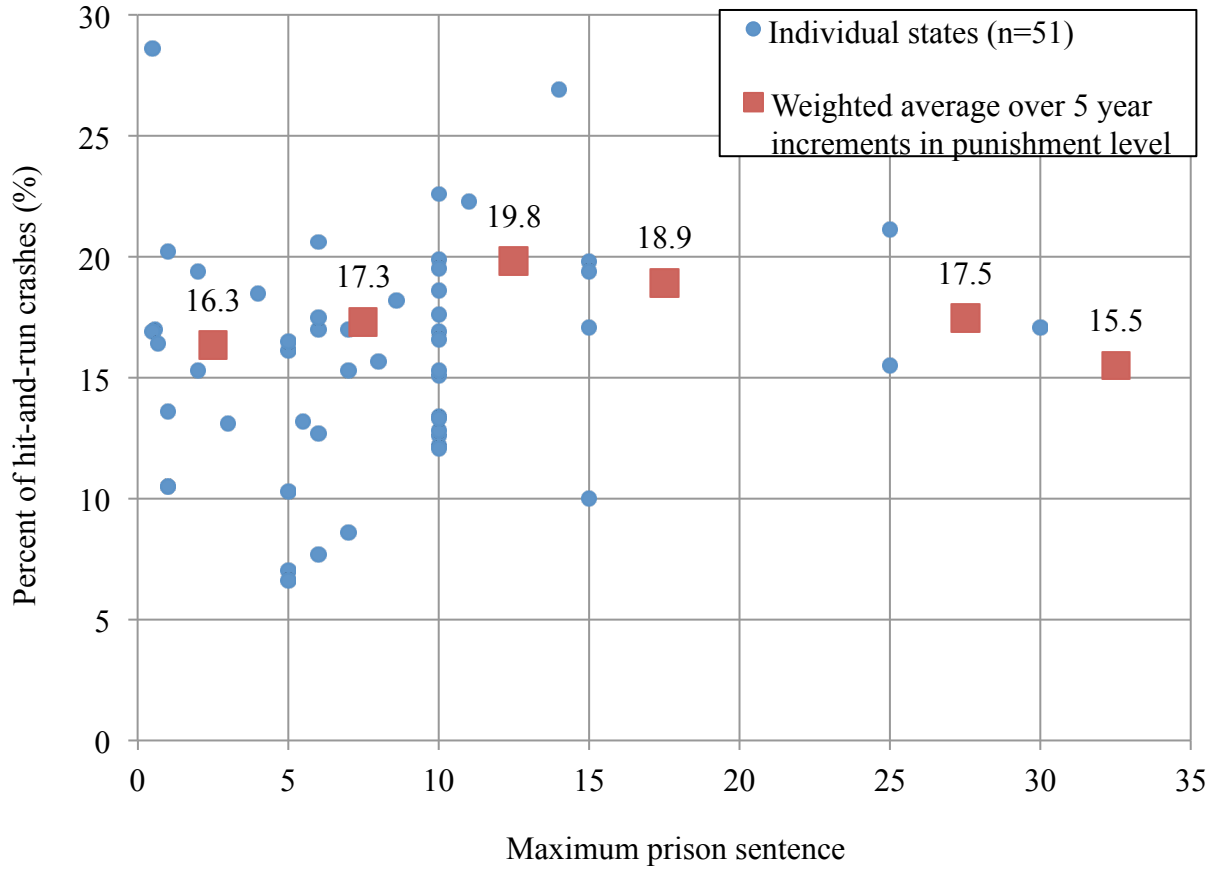


FIGURE 2. Maximum Prison Sentence for Hit-and-Run and Hit-and-Run Rate

TABLE 3. Severity of Legal Sanctions for Hit-and-Run Violations and Hit-and-Run Rate by State

Maximum prison term for fatal HR (years)	Non-Hit-and-Run		Hit-and-Run (HR)		Total		HR as % of Row Total
	Number	% of all non-HR	Number	% of all HR	Number	% of all Crashes	
0-4	3,782	10.1	730	8.8	4,512	9.9	16.2
5-9	14,722	39.4	3,250	39.1	17,972	39.3	18.1
10-14	11,653	31.2	2,791	33.5	14,444	31.6	19.3
15-19	1,790	4.8	429	5.2	2,219	4.9	19.3
20-24	-	0.0	-	0.0	-	0.0	-
25-29	1,244	3.3	262	3.1	1,506	3.3	17.4
30-34	4,179	11.2	859	10.3	5,038	11.0	17.1
Total	**37,370**	**100**	**8,321**	**100**	**45,691**	**100**	**18.2**

Data source: NHTSA/FARS 1998–2007

Table 4 shows the maximum prison term for both fatal hit-and-run collisions and fatal non-hit-and-run collisions for the seven select counties. Broward County, Florida has the lowest odds of hit-and-run and the longest prison term, while Wayne County, Michigan has the highest odds of hit-and-run and the second longer prison term. In Wayne County and Philadelphia there is no difference between the penalty for hit-and-run and non-hit-and-run fatal collisions. This factor may reduce the potential deterrent effect of the law. Additionally, if a driver is drunk at the time of the collision, there may be a clear benefit to them in fleeing, even if they are caught later on.

TABLE 4. Legal Sanctions and Percentage of Fatal Hit-and-Run Collisions for Select Counties

County, State	Violation Type	Fatalities		Odds for HR
		Maximum Prison Term (years)	% of HR	
Maricopa, AZ	Hit-and-run	10	21.9	0.28
	No hit-and-run	3	78.1	
Los Angeles, CA	Hit-and-Run	11	23.7	0.31
	No hit-and-run	6	76.3	
Broward, FL	Hit-and-Run	30	18.1	0.22
	No hit-and-run	15	81.9	
Orange, FL	Hit-and-Run	30	22.5	0.29
	No hit-and-run	15	77.5	
Cook, IL	Hit-and-Run	14	31.0	0.45
	No hit-and-run	5	69.0	
Wayne, MI	Hit-and-Run	15	36.5	0.57
	No hit-and-run	15	63.5	
Philadelphia, PA	Hit-and-Run	7	23.9	0.31
	No hit-and-run	7	76.1	

Data source: Integrated database

Figure 3 displays the odds of hit-and-run versus the additional years of punishment due to fleeing the scene of a fatal collision. This figure shows that the odds of hit-and-run do not

exhibit any pattern as the prison term incrementally increases. This again suggests that legal sanctions do not have a significant deterrent effect on fatal hit-and-run incidents.

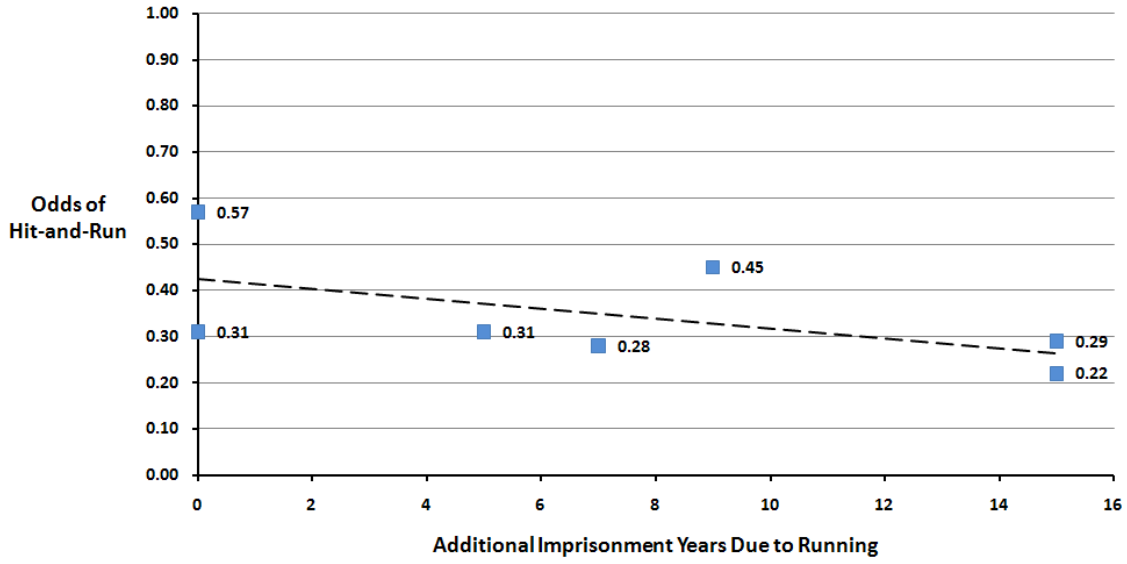


FIGURE 3. Probability of Hit-and-Run in Fatal Collision Compared With Additional Prison Term for Running

Table 5 shows that across levels of injury severity there are comparable percentages of hit-and-run violations. This finding indicates that the level of victim severity may not be a factor in a driver's decision to flee. However, additional analysis is necessary to determine whether drivers are unable to evaluate the level of injury, or rather fail to distinguish between the risk of fleeing the scene of injury collision or a fatal collision.

TABLE 5. Local Pedestrian Collisions by Injury Severity

Injury Severity	Non-Hit-and-Run (non-HR)		Hit-and-Run (HR)		Total		HR as % of Row Total
	Number	% of all non-HR	Number	% of all HR	Number	% of all Crashes	
Fatal injury	1,350	3.6	4,086	3.8	5,436	3.7	24.8
Injury	34,115	92.1	99,313	92.0	133,428	92.0	25.6
No injury	518	1.4	1,294	1.2	1,812	1.2	28.6
Unknown	1,071	2.9	3,308	3.1	4,379	3.0	24.5
Total	37,054	100	108,001	100	145,055	100	25.5

Data source: Integrated database

The Certainty of Punishment

As mentioned in the introduction the percent of drivers identified is used as an approximation for the certainty of punishment. Figure 4 plots the percentage of hit-and-run crashes as a function of the percentage of hit-and-run drivers identified, based on the data shown in Table 1. The blue circles correspond to pairs of data for individual states (n=51). The data does not present any association between the two plotted variables (r= -0.05). To control for any bias due to different sizes of states, the data was further clustered into fixed intervals across the scale of drivers identified. The weighted average of the percent of hit-and-run crashes was calculated for each of the intervals, and is shown by the red squares in Figure 4. Again, no association was found between the percentage of hit-and-run and the percent of hit-and-run drivers identified.

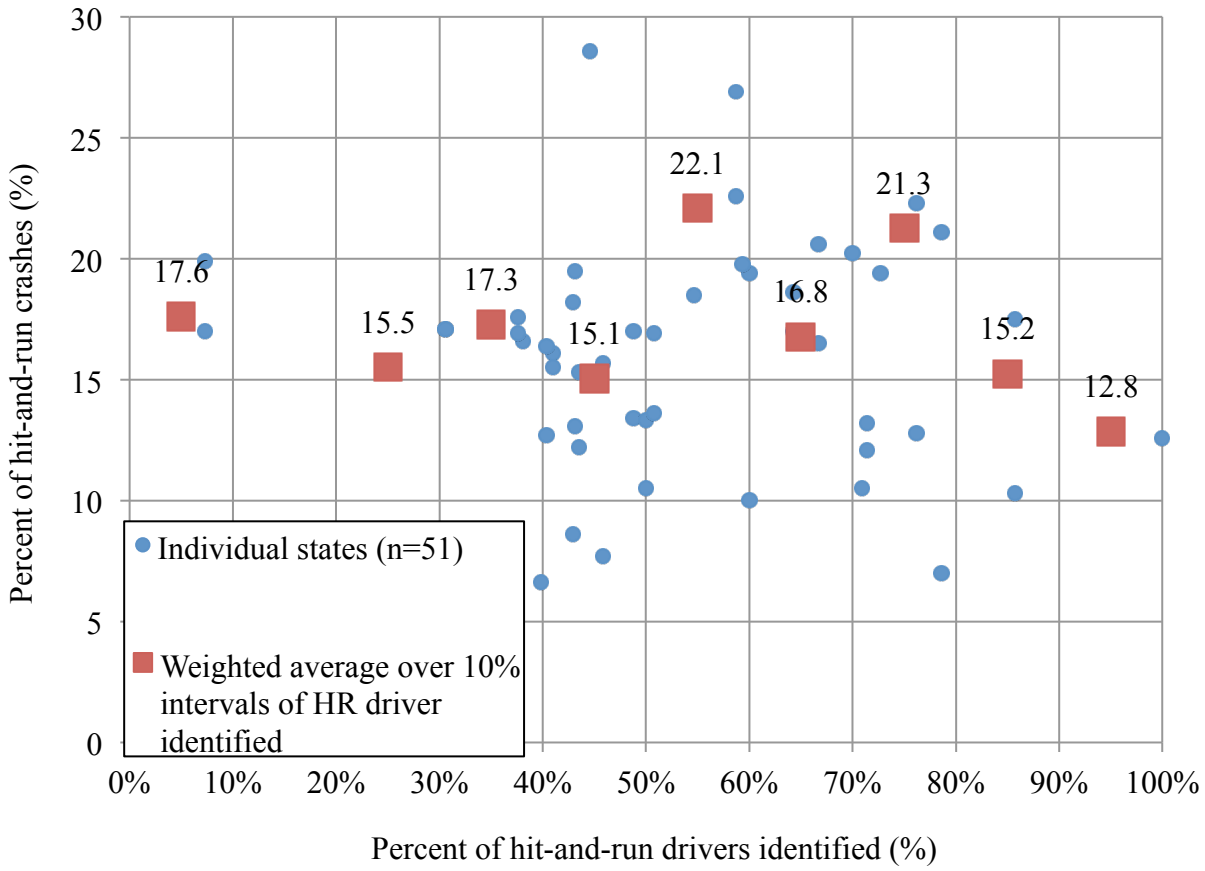


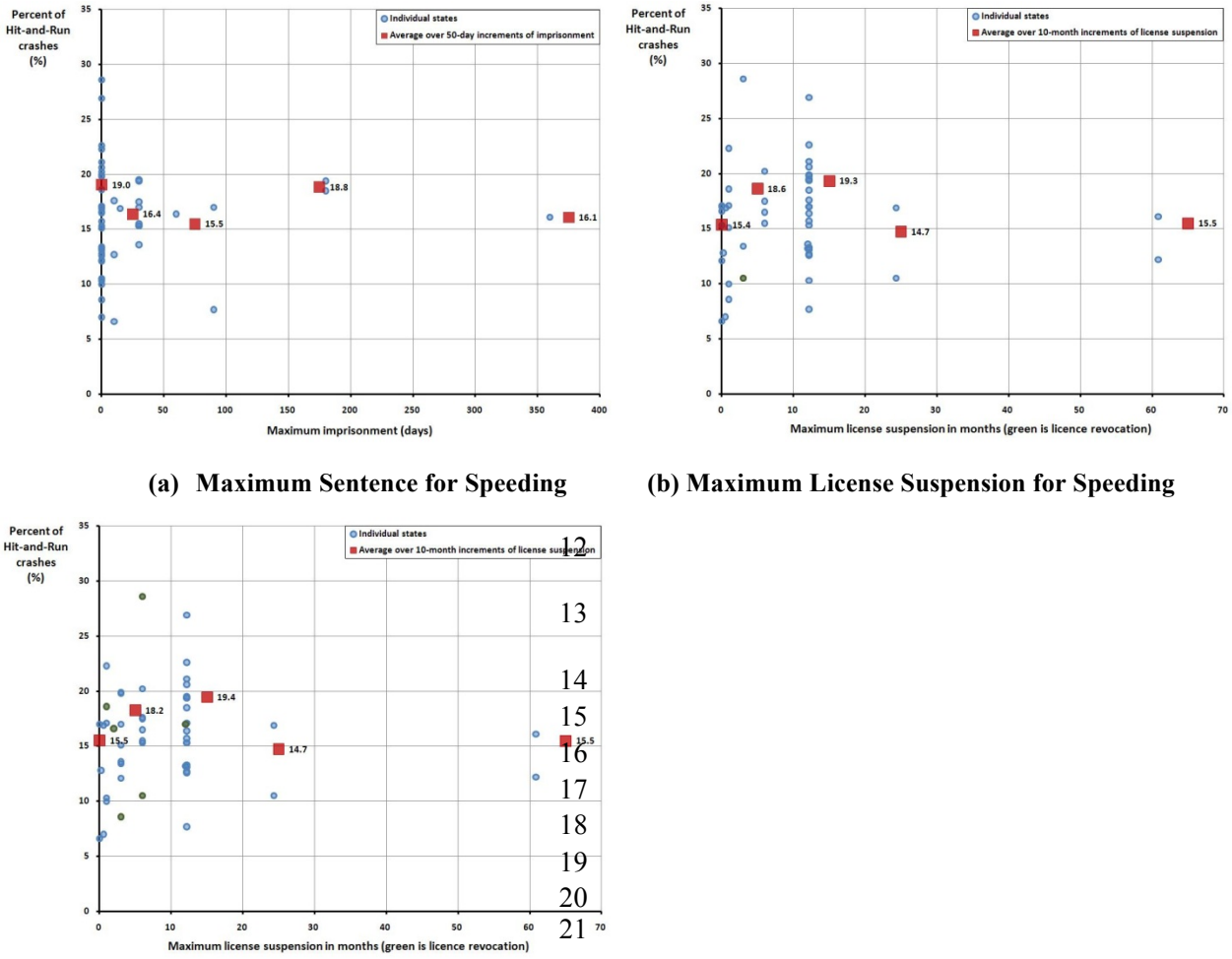
FIGURE 4. Percentage of Hit-and-Run Drivers Identified and Hit-and-Run Rate

These two results indicate that there is no association between the certainty of punishment and the percent of hit-and-run crashes, suggesting that a driver's decision to run after hitting a pedestrian is not affected by the likelihood of being apprehended. This may mean that the drivers are either unaware of the apprehension likelihood or they are aware but it does not affect their decision. Since deterrence theory is established it is more likely that they are unaware of the likelihood. It may seem at the onset of such an incident that the driver is under a lot of stress and cannot make a conscious decision. Maybe there is a shortage of information that needs to go along with the sanctions.

Legal Sanctions for Other Traffic Violations

This analysis also includes an assessment of license suspension and fines for speeding violations, and for reckless driving violations (*11*). These sanctions may reduce the number of violation-prone drivers on the road, which may in turn reduce hit-and-run crashes.

Figure 5 demonstrates the relationship between the sentence for speeding and the percentage of hit-and run crashes within individual states, with sentence averages shown in 50-day increments. The observations are widely spread, without a consistent pattern. For example, for a maximum sentence of more than 350 days, the percentage of hit-and-run is below the national average, while the range for no imprisonment varies from approximately 6% to 27%.



(a) Maximum Sentence for Speeding **(b) Maximum License Suspension for Speeding**

(c) Maximum License Suspension for reckless driving

FIGURE 5. Percentage of hit-and-run crashes for different legal sanctions of non-hit-and-run violations

Figure 5 also shows the relationship between maximum license suspension and hit-and-run rates within the individual states. The data do not show a strong relationship; however, the initial trend where hit-and-run rates increase with longer maximum sentences is counterintuitive and warrants further investigation.

DISCUSSION

An analysis of pedestrian hit-and-run crashes suggests that legal sanctions do not have a significant deterrent effect on these collisions. It is likely that most people are unaware of the penalties involved with fleeing the scene of a collision. For other location-specific traffic violations, like carpool lane violations, the fines are often posted at the locations where the violation occurs. Alternatively, for important safety violations, like lack of seat belt use and drunk driving, authorities have used public education campaigns and checkpoints to make drivers aware of the penalties and importance of compliance with the law. Hit-and-run education campaigns are much less common. A campaign in Florida called "Hit and Run – Bad to Worse" describes the punishment for fleeing the scene of collisions of various severities, but it does not mention the likelihood of being caught (*12*).

Hit-and-run crashes make common news stories all over the U.S., and the newspaper articles and television news stories help publicize details of the event in hopes of catching the driver who fled. The stories are also often updated when a driver is identified and charged. These stories rarely mention the penalty the driver faces for fleeing the scene.

When the penalties are not well-known, there is little opportunity for general deterrence to be effective. Angry citizens may demand heavier penalties to prevent drivers from fleeing, but they will have little effect if the driver is unaware of the penalty. At the same time, if the punishment is going to be publicized, it may still be ineffective if it is less than the penalty for an alcohol-involved collision. A drunk driver involved in a crash must quickly perform a cost-benefit analysis on fleeing in an impaired state.

CONCLUSION

An analysis of pedestrian hit-and-run crash and state hit-and-run penalties suggests that legal sanctions do not have a significant deterrent effect on these collisions. The unique nature of hit-and-run violations may impair the effect of legal sanctions to reduce hit-and-run, since the driver's decision whether or not to run is based on damage control instead of damage prevention. Uncertainty regarding the likelihood of being caught or the severity of punishment may impair the effects of legal sanctions to reduce hit-and-run incidents. Similarly, legal sanctions for other traffic violations do not have a significant deterrent effect on hit-and-run collisions. However, there are emerging evidence that social sanctions (such as the presence of additional passengers in the vehicle) may deter drivers from hit-and-run violations.

Further study is necessary to determine the most effective deterrence mechanism for reducing hit-and-run violations, but there is evidence to suggest that education is an important element of deterrence.

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