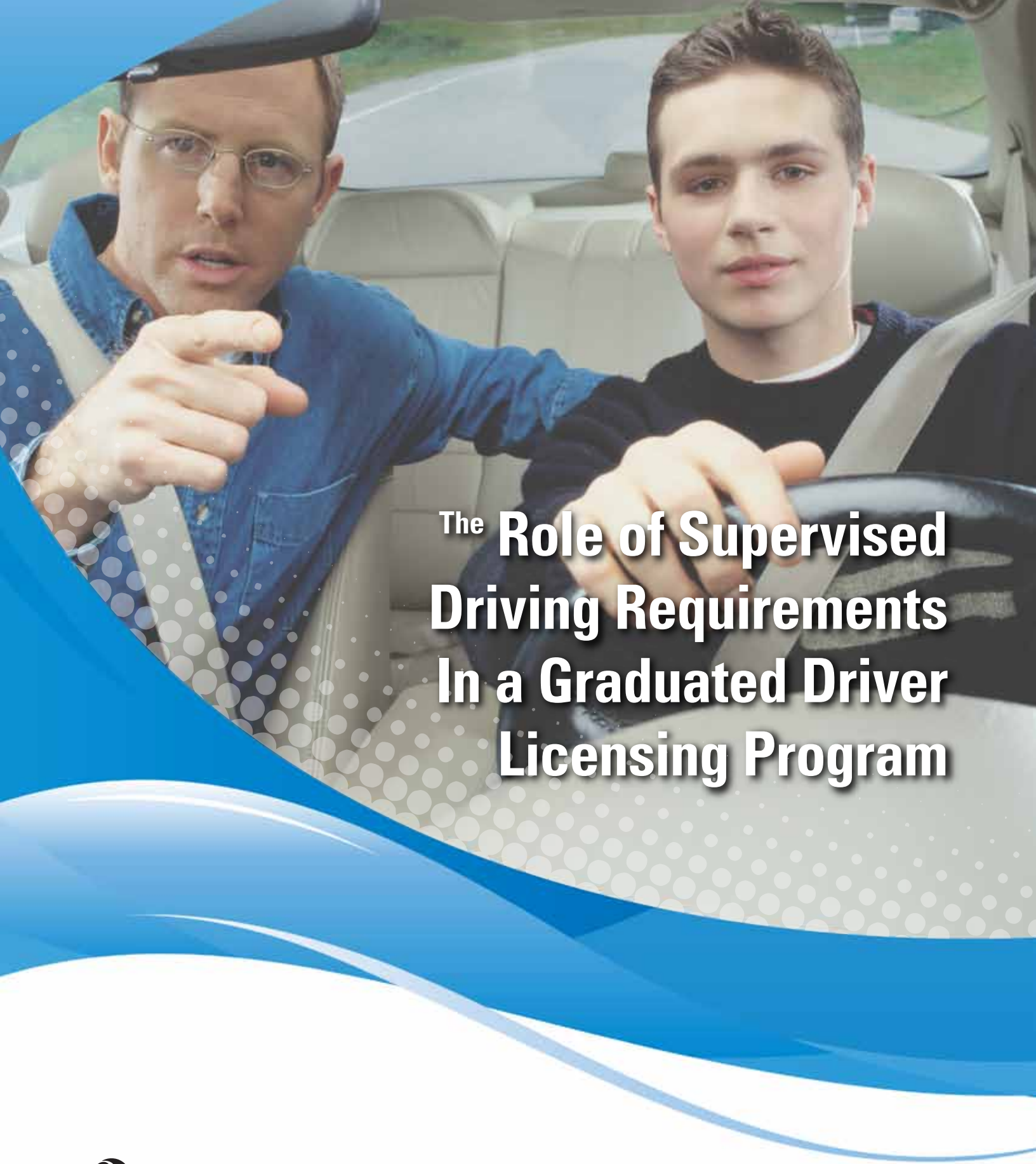


The Role of Supervised Driving Requirements In a Graduated Driver Licensing Program

U.S. Department of Transportation
National Highway Traffic Safel Administration

NHTSA
www.nhtsa.gov

Suggested APA Format for This Document Reference:

Foss, R. D., Masten, S. V., Goodwin, A. H., & O'Brien, N. P. (2012, March). *The role of supervised driving requirements in graduated driver licensing programs.* (Report No. DOT HS 811 550.) Washington, DC: National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No. DOT HS 811 550	2. Government Accession No.	3. Recipients' Catalog No.	
4. Title and Subtitle **The Role of Supervised Driving Requirements in Graduated Driver Licensing Programs**		5. Report Date March 2012 6. Performing Organization Code NTI-132	
7. Authors: Robert D. Foss, Scott V. Masten, Arthur H. Goodwin, Natalie P. O'Brien		8. Performing Organization Report No.	
9. Performing Organization Name and Address Highway Safety Research Center University of North Carolina 730 Martin Luther King, Jr., Blvd., Suite 300 Chapel Hill, NC 27599-3430 TransAnalytics, LLC 336 West Broad Street Quakertown, PA 18951		10. Work Unit No. (TRAIS)n code 11. Contract of Grant No. DTNH22-05-D-05043, Task Order 09	
12. Sponsoring Agency Name and Address National Highway Traffic Safety Administration U.S. Department of Transportation Office of Behavioral Safety Research, NTI-130 1200 New Jersey Avenue SE. Washington, DC 20590		13. Type of Report and Period Covered NHTSA Technical Report 14. Sponsoring Agency Code	
15.Supplementary Notes			

16. Abstract

Many States require parents to certify that their teens have completed a certain amount of supervised driving practice, usually 40 to 50 hours, before they are permitted to obtain an intermediate license. Although strongly supported by numerous groups and organizations, the effectiveness of supervised practice requirements is unknown. NHTSA conducted a cross-sectional comparison of fatal crash rates throughout the United States, and examined State crash data using interrupted time-series analysis in a small number of States that had increased their required number of supervised driving hours. To supplement and provide insight into these findings, the University of North Carolina-Highway Safety Research Center conducted telephone interviews, funded by State Farm Insurance, with parents of newly licensed teenage drivers in 5 States (Maryland, Minnesota, Ohio, South Carolina, and Washington) with varying supervised driving requirements. Employees of licensing bureaus in these States were also contacted by telephone to determine how they conveyed the requirements to parents and teenagers.

Analyses of the Fatality Analysis Reporting System (FARS) showed that fatal-crash rates of 16- and 17- year-olds did not differ across States with varying supervised driving requirements. Crash analyses in Minnesota, the only State to change the number of required practice hours without changing other Graduated Driver Licensing (GDL) components, did not find any difference in 16- and 17-year-old-driver fatal or serious injury crash rates following the change in the requirement. Interviews with parents and licensing officials showed that awareness of the supervised driving requirements was weak in all 5 States. Only 32% of parents overall (range 15% to 55%) could correctly identify the number of hours required by their State. Almost all parents in Maryland (91%) reported using a log provided by the licensing agency to keep track of their teens' driving and about half of Maryland parents correctly reported the number of required supervised hours. With low parental awareness and little or no licensing agency verification, it is difficult to determine whether teenagers drove the minimum number of supervised hours required by their States. These findings suggest that improvements in communications with parents and novice drivers about supervised driving requirements, guidance to parents about the best techniques to provide supervision, and tracking actual hours and conditions of supervised driving would be beneficial.

17. Key Words	18. Distribution Statement		
Teen Drivers, Graduated Driver Licensing, Parental Involvement, Supervised Driving, Teen Crash Rates	Document is available to the public from the National Technical Information Service www.ntis.gov		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No of Pages 92	22. Price

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

Tables

Figures

All States in the United States have adopted graduated driver licensing (GDL) systems in an effort to reduce crashes and fatalities among young drivers. Traditional GDL systems include three licensing stages: initial learner stage, the intermediate or provisional stage, and full licensure. An important component of GDL is the extended learner stage for beginning drivers. This stage is designed to ensure that a novice driver gains valuable driving experience under the supervision of an experienced adult driver. Despite their inexperience, novice drivers rarely crash while they are being supervised by adults (Mayhew, Simpson, & Pak, 2003; Williams et al., 1997).

Many States require parents to certify that learner drivers complete a certain amount of supervised driving practice, usually 40 to 50 hours, before they are permitted to obtain an intermediate license. Some States stipulate that a certain number of these hours should be accumulated during nighttime driving. The expectation is that such requirements will ensure that parents provide their teens with at least the specified number of hours of practice driving and that this practice will result in more proficient, safer drivers.

Minimum Required Hours of Supervised Driving for Young Beginning Drivers in the United States, April 2011

Hours Required	Number of States
100	1
60	2
50	25
45	1
40	10
35	1
30	4
20	2
None	5

Source: Insurance Institute for Highway Safety

Although this requirement is strongly supported by parents and safety organizations, the effectiveness of prescribing specific amounts of supervised driving is presently unknown. The overall aim of the project was to determine whether the number of supervised driving hours required by a State influences 16- and 17-year-old drivers' involvement in fatal and nonfatal

crashes. An additional goal was to assess teen driver's parents and licensing bureau employees' knowledge, awareness, and compliance with the requirements.

First, FARS data were used to conduct a cross-sectional comparison of 16- and 17-year-old driver fatal crash involvement rates throughout the United States to examine whether they were related to State's supervised practice requirements. Second, State fatal and nonfatal crash data were examined in a small number of States that had increased their required number of hours of supervised driving. Third, telephone interviews with parents of newly licensed teenage drivers in 5 States examined their awareness, approval, and behaviors in response to these supervised driving requirements. Finally, calls to licensing agencies in these 5 States examined how licensing officials conveyed the requirements to parents and teenagers. The telephone interviews with parents were funded by State Farm Insurance.

Teenage Driver Fatal Crash Involvement – All U.S. Jurisdictions

Fatal crash involvements for drivers of passenger vehicles were obtained from the Fatality Analysis Reporting System (FARS) for 1986 through 2007 (22 years) for all 50 States and the District of Columbia. These were aggregated by jurisdiction, age group, and quarter (January-March, April-June, July-September, and October-December for each year). Each State-quarter was then coded for the presence of eight possible GDL components, including required hours of supervised driving (none, ≤ 20 hours, 25 to 35 hours, 40 hours, and 50 to 60 hours). The State-quarters were also coded for other traffic safety laws introduced during the study period, such as per se blood alcohol concentration (BAC) limits and safety belt laws that could potentially affect fatal crash involvement rates. Per capita crash involvement rates per State-age group-quarters for 16- and 17-year-olds were estimated using pooled cross-sectional time series analysis through negative binomial regression modeling. The objective was to establish whether requiring a certain number of supervised driving hours was independently associated with a lower fatal crash involvement rate.

Overall, the analyses found no relationship between the number of required supervised driving hours and fatal crash involvement among young drivers. For 16-year-old drivers, requiring any particular number of supervised driving hours was not associated with changes in fatal crash involvement rates. However, when 17-year-old driver fatal crash rates were examined, requiring some minimum amount of supervised driving hours first appeared to be associated with higher 17-year-old crash rates (ranging from 2% to 13%). However, only a few of these estimates

reached conventional levels of statistical reliability ($p < .05$) and none of the effect estimates remained statistically significant after adjusting for crash rates among older age groups as a control for other factors that influence fatality rates, such as safer vehicles. Overall, the analyses found no relationship between the number of required supervised driving hours and fatal crash involvement among young drivers.

Effect of Changed Supervised Driving Requirements in Individual States

Additional analyses examined whether requiring specific amounts of supervision might affect 16- and 17-year-old involvement in nonfatal crashes using data obtained from the State Data System (SDS) maintained by NHTSA. The original intent was to identify States that made changes only to the number of hours of required supervised driving practice without making changes to other GDL components. Crash data, however, were either unavailable or incomplete in the SDS for most of the States that made changes to their supervised driving hours requirement without making other GDL changes. Only Minnesota had adequate data available for analysis with for sufficient pre- and post-change periods during which no other changes to GDL had been made.

In an effort to work around the limited availability of data for States that changed only the required hours of supervision, States were divided into two types: those that changed both the required number of supervised driving hours and the minimum learner permit periods during the same year and those that only increased the learner period. This procedure yielded four more States for analysis and allowed comparison of the impact of changing the supervised driving requirement. The following table summarizes information for the States in this analysis.

State	Change (Mo./Yr. effective)	Years in SDS
States that simultaneously increased supervised driving hours and mandatory holding period		
Illinois	0-3 months, 0-25 hours (1/98)	1991-2005
Pennsylvania	0-1 months (9/95), 0-50 hours (1/00)	1991-2001, 2003-2005
States that increased the mandatory holding period only		
South Carolina	0-3 months (7/98)	1997-2004
Virginia	0-6 months (7/96)	1991-2004

To estimate the effects of changes made to supervised driving hours requirements, the fatal and serious injury (F/I) crash involvement rates per 10,000 population for 16- and 17-year-olds were analyzed using Auto-Regressive Integrated Moving Average (ARIMA) interrupted time series analysis. In January 1999, Minnesota added the requirement that beginning drivers obtain 30 hours of supervised driving practice in the learner phase and 10 additional hours in the intermediate phase (for 40 total hours of required supervised driving practice). The ARIMA results found that this requirement was not associated with a change in either 16- or 17-year-old fatal and serious-injury crash rates. Similar analyses in Illinois, Pennsylvania, South Carolina, and Virginia revealed no significant changes in F/I crash rates that could be attributed to an increase in the number of required hours of supervised driving.

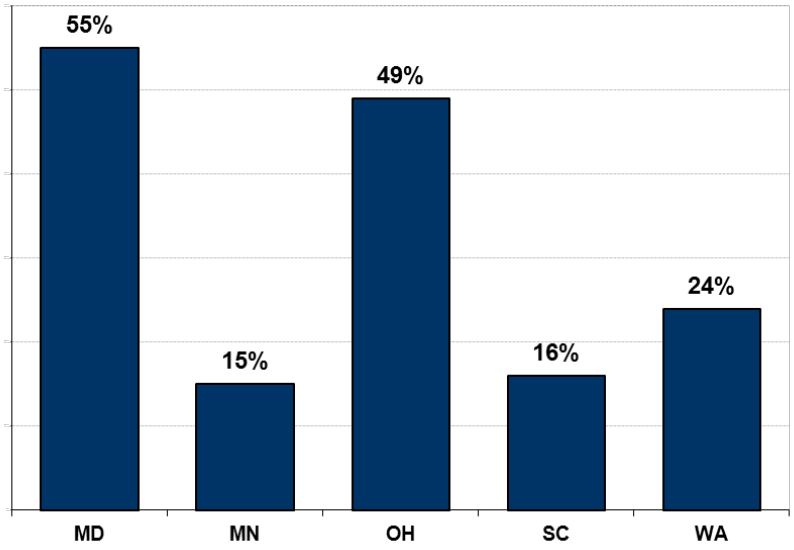
Parent Interviews

State Farm Insurance provided funding for HSRC to conduct interviews with parents of recently licensed teenage drivers to obtain information that might help explain findings of the crash analyses. A total of 510 parents in 5 States with varying supervised driving requirements were interviewed. These States included Maryland (60 hrs), Minnesota (30 hrs), Ohio (50 hrs), South Carolina (40 hrs), and Washington (50 hrs). At least 100 phone interviews were conducted in each State. The key issues explored in these interviews included:

- Awareness of supervised driving requirements;
- Approval/disapproval of supervised driving requirements;
- The degree to which parents consider these requirements sufficient;
- How and when parents kept track of their teens' driving practice;
- How much practice teens received during the permit stage;
- Perceptions about license agency enforcement of supervised driving requirements.

Overall, 77% of parents believed there was an hours-of-supervision requirement, although this varied widely across States. Knowledge of the number of hours required was substantially lower than awareness that there was some requirement (see figure below). Only one-third (32%) of parents knew the correct number of supervised driving hours their teen was required to obtain. Knowledge of night driving requirements was even lower. Only 13% of parents knew the number of hours that their teens were required to drive at night.

Percent of Parents who Know Number of Required Hours for Supervised Driving for Novice Teen Drivers by State



The substantially greater knowledge of the supervised driving requirement among parents in Maryland and Ohio strongly suggests that there are systems, procedures, or programs in place in these two States that do a better job of alerting parents to this particular requirement. Nonetheless, it is noteworthy that even in Maryland and Ohio, only about half of all parents could accurately report the number of hours required.

Most parents (73%) reported that they tried to keep track of the number of hours their teenager spent driving during the learner period. Half (52%) said they kept written records or logs. Ninety-one percent of parents in Maryland reported using logs to keep track of their teens' driving – a substantially higher percentage than what was reported in the other 4 States. Maryland provides parents with a log when teens obtain a permit, and the log must be turned in to the DMV when the teen applies for a license. Although each of the other States requires parents or guardians to certify the teenagers have obtained the required amount of practice, only 59% of parents said they were required to sign such a form. Parents in Maryland and Ohio were the most likely to say they were required to sign forms.

Almost all (96%) of parents reported that they approve of requiring teens to drive a certain number of hours while supervised before they can obtain licenses that allow independent driving. Approval of the requirement was high in all 5 States. A series of questions asked how

many hours of supervised driving parents thought were sufficient to result in teens being ready to drive unsupervised. Across all States, the mean number of hours that parents considered to be adequate was 56 (median = 50), but this varied by State.

Unstructured Interviews

To gain insight into parents' interpretation of supervision requirements, and to learn how they dealt with the varying requirements and supporting guidance provided by the States, unstructured interviews were conducted with a sub-sample of 56 parents who had completed the structured interview (including at least 10 parents from each State). Interviews were conducted with some parents who reported they were aware of their States' supervised driving requirement and with others who were not. These interviews were funded separately by State Farm Insurance.

Among parents who knew about the requirement, the vast majority, across all States, said it was not difficult to complete the required amount of supervised driving. Parents commonly reported fitting driving practice into their normal daily routine. A few parents who lived in small towns said it was hard to complete the number of required hours because the places they usually drive involve only short trips. These parents reported taking special trips or letting their teens drive during family vacations in order to meet supervision requirements.

In several of the States, parents reported they did not keep track of the number of practice hours their teens completed. This was particularly true in States where the practice requirements were not well known (South Carolina, Minnesota). However, among parents who used logs to keep track of their teen's driving hours, the vast majority reported that it was not difficult. Many kept the logs in the vehicles and filled them out immediately after each trip. Others reported that they filled out the logs on a weekly basis. A few parents reported that it was difficult to record the hours because the teen drove with different parents in different vehicles or that they kept the logs at home and often forget to fill them out.

Licensing Bureau Contacts

To assess how supervised driving requirements are administered and enforced by licensing agencies, licensing agency representatives in each of the 5 States were interviewed. Callers posing as either parents or a teenagers asked about licensing requirements for beginning teenage drivers. With the exception of Maryland, none of the license agency officials mentioned

that a particular amount of supervised driving was a requirement during the permit phase of the GDL. When specifically asked about a supervision requirement, licensing officials did not seem to know the required number of hours without checking.

Discussion and Conclusions

This is the first study to investigate the independent effect of mandating a specific number of hours of supervised driving during the learner stage of GDL. Overall, the analyses failed to find evidence in the fatal and serious injury crash databases indicating that requiring 30 to 60 hours supervised driving practice results in lower crash rates for teenagers once they begin driving without supervision. This conclusion is supported by an analysis of fatal crash involvement by 16- and 17-year-old drivers from all 50 States and an interrupted time-series analysis of fatal and serious injury teen driver crashes in Minnesota following a new requirement for minimum hours of supervised driving. Interviews with driver licensing bureau employees and parents suggest that the requirement may not be communicated well from the driver licensing bureau to the parents, as most of the parents were not aware of the requirement and few could correctly identify their State's requirement. Without accurate records it is difficult to determine how many hours of supervised driving teen drivers actually received in each of the States, regardless of the State's requirements.

It appears that getting the word clearly and effectively to parents about supervised hours requirements is far more challenging than many States have realized. Few, if any, States other than Maryland require a log to be kept and submitted to the licensing agency. Even in Maryland, barely half of parents knew the actual number of hours required. Parents were in favor of beginning teenage drivers obtaining extensive amounts of supervised driving experience and of requirements to encourage this. They strongly endorsed their States' requirement – regardless of how much or how little it involved. They expressed little concern about being required to provide supervision and said they found the time to do the required supervision. They generally thought that more hours than mandated were needed and they believed States should be more proactive in efforts to ensure that parents provide the amount of supervision their teenagers need and gather documentation such as a driving log.

BACKGROUND

Nearly all States in the United States have implemented GDL systems in an effort to reduce crashes and fatalities among young drivers (IIHS, 2009). Traditional graduated driver licensing systems include three licensing stages: initial learner, intermediate or restricted, and full-privilege stages. An important component of GDL is the extended learner stage for beginning drivers. The learner stage provides an opportunity for novices to accumulate valuable driving experience in relatively safe but realistic conditions. Research shows that novice drivers rarely crash while they are being supervised by adult drivers (Mayhew, Simpson, & Pak, 2003; Williams et al., 1997).

Prior to the mid-1990s, many States required beginning teen drivers to hold learner permits for up to 30 days, while in other States permits were optional. Following the nationwide effort to enact GDL programs, 37 States and the District of Columbia now require adult supervision of beginning drivers for 6 months, 3 require 9 months, and 7 States require beginning drivers to be supervised for a full year (IIHS, 2009). Many States also require parents to certify that their teens have completed a certain amount of supervised driving practice, usually 40 to 50 hours, before they are permitted to obtain intermediate licenses (IIHS, 2009; see Table 1). In some States, a certain number of these hours must be accumulated in specific situations, such as at night or in inclement weather. The expectation is that such requirements will ensure that parents provide their teens with at least the specified number of hours of practice driving, and that this will translate into more proficient – and safer – drivers.

Table 1

Minimum Required Hours of Supervised Driving for Young Beginning Drivers, April 2011

Hours required	Number of States (including DC)
100	1
60	2
50	25
45	1
40	10
35	1
30	4
20	2
None	5

Source: Insurance Institute for Highway Safety
Note: Alabama (30 hours), Alaska (30), Nebraska (50), and West Virginia (50) waive the supervised driving requirement if teens complete driver education. Oregon (100 hours) reduces the requirement to 50 hours for teens who complete driver education.

A few studies suggest that teens often meet or exceed the minimum requirement for supervised driving hours. Parents in Michigan reported supervising their teens for an average of 75 hours during the learner stage, even though only 50 hours of supervised practice is required in that State (Waller, Olk, & Shope, 2000). California also requires 50 hours of supervised practice. In a survey of California parents, 81% reported their teens had met or exceeded this requirement (Williams, Nelson, & Leaf, 2002).

Support for supervised practice requirements appears to be strong among both parents and teens. In a California survey, 94% of parents and 88% of teens said they favored the requirement of 50 hours supervised practice (Williams et al., 2002). In Michigan, most parents (74%) reported that 50 hours was the appropriate number of hours to require during the learner stage (Waller et al., 2000).

Although strongly supported by numerous groups and organizations, the effectiveness of supervised practice requirements is presently unknown. Baker, Chen, and Li (2006) examined whether the various elements of GDL programs were associated with reductions in fatal crashes among 16-year-old drivers. They found that the combination of a holding period of several months and at least a 30 hour supervised driving requirement reduced fatal crashes by 18%

(Baker et al., 2006). However, the independent effect of the supervised driving requirement was not reported.

It is also not known how much supervised driving experience is sufficient to achieve the goal of developing safe drivers. The few studies conducted to date are inconclusive on whether increased practice reduces crash rates among newly licensed teen drivers. McCartt, Shabanova, and Leaf (2003) examined crash-involvements among 900 licensed teens who reported they had driven an average of about 350 miles with supervision. A detailed analysis found no association between the reported amount of practice during the learner stage and the likelihood of experiencing a crash post-licensure. Although such self reports – especially from inexperienced drivers – must be taken with caution, studies in France and Norway have also shown no safety effects following extensive (e.g., 5,000 kilometers) supervised practice (cited in Simons-Morton & Ouimet, 2007). In contrast, one Swedish study reported a decrease in cashes following increased driving practice. In 1993, the minimum age for obtaining a learner's permit in Sweden was lowered from 17½ to 16, while the licensing age remained 18. Teens who took advantage of the extended learner stage obtained an average of 117 hours of supervised practice, and had a 40% lower crash rate once licensed compared to teens who did not obtain their permits early (Gregersen et al., 2000). A similar finding has been reported in Austria (cf., Twisk & Stacey, 2007). Although encouraging, these studies were not randomized trials and self-selection might explain some or all of the differences between the groups.

Besides the lack of supporting evidence, occasional concerns have been raised about requirements for supervised hours. Anecdotal evidence suggests that parents may not keep close track of how much driving practice their teens obtain during the learner stage. Consequently, there is some question whether these requirements may simply encourage parental "fudging" when certifying their teens' driving experience. In addition, some research suggests that it may be unnecessary to establish supervised hours requirements to ensure that teens gain substantial amounts of driving experience. For example, North Carolina has no requirement for a particular amount of practice during its 12-month learner stage. Nonetheless, one study estimated that teens drove approximately 50 hours during just the first 4 months of the learner stage (Goodwin, Waller, Foss, & Margolis, 2006). This suggests that lengthy learner stages of a year or more may be just as effective – if not more so – than mandating a minimum amount of supervised driving. Finally, a supervised driving requirement that applies to all teens within a State fails to take into account important individual differences. Some teens may need

greater amounts of practice before they are ready to drive unsupervised. If a State's requirements are viewed by parents as sufficient – rather than a minimum – then some teens may receive less practice than is needed to become safe drivers (Goodwin, Foss, Sohn, & Mayhew, 2007).

In summary, a number of organizations recommend GDL systems include 30 to 50 hours of supervised driving for novice drivers, some of which should occur during nighttime hours (Advocates for Highway and Auto Safety, 2009; American Academy of Pediatrics, 2006; IIHS, 2009; NHTSA, 2008b). Although this seems a sensible recommendation, there is no empirical evidence, as of yet, to support such requirements. Presently, it is not known whether supervised practice requirements affect the amount of practice teens obtain during the learner stage, or whether they help to reduce teenage driver crashes. Beyond the possible effect of a policy mandating a certain amount of driving practice, there are also no data to indicate that 30 hours – or even 60 hours – of supervised driving practice during the learner's phase produces any safety benefit.

The aim of the present study was to determine whether requirements for supervised practice influence parental or teenage driver behavior during the learner stage of GDL and whether they reduce crashes among teen drivers after they are licensed. FARS data were used to conduct a cross-sectional comparison of fatal crash rates throughout the United States to examine whether crash rates were related to State's supervised practice requirements. State-specific crash data were examined in a small number of States that had increased their required number of hours of supervised driving. Telephone interviews with parents of newly licensed teenage drivers in 5 States examined their awareness, approval, and behaviors in response to these supervised driving requirements. These interviews were funded by State Farm Insurance. Licensing bureaus in these 5 States were contacted to determine how they conveyed the requirements to parents and teenagers.

CRASH ANALYSES

Teenage Driver Fatal Crash Involvement – All U.S. Jurisdictions

Data

Driver fatal crash involvements for cars, pickup trucks, vans/minivans, and SUVs were obtained from the FARS for 1986 to 2007 for all 50 States and the District of Columbia. Driver crash involvements were aggregated by jurisdiction, age group (age 16, 17, 20 to 24, 25 to 39, 40 to 59, and 60+), and quarter (January-March, April-June, July-September, and October-December for each year). Hence the unit of analysis was a State-age group-quarter. For each age group, in each jurisdiction, there were 88 quarters (22 years x 4 quarters), which amounted to 528 quarters for each jurisdiction (88 quarters x 6 age groups), and a grand total of 26,928 State-age group-quarters (528 age-group quarters x 51 jurisdictions).

To estimate age-group-specific crash involvement rates per 10,000 population for analysis, State single-year-of-age population estimates were obtained from the U.S. Census Bureau for the years 1985 to 2007; population projections were used for 2008. Quarterly estimates were interpolated between the annual July estimates.

Coding State GDL Components and Other Pertinent Traffic Laws

Required hours of supervision for novice teen drivers are but a single element of many requirements and laws that may affect crash rates. In an effort to statistically isolate the effects of supervision requirements, we coded the presence of these potentially influential factors along with the number of hours that novice teens were required to obtain.

Several current and historical summaries of State laws and GDL systems have been compiled by organizations and researchers. State statutes are complex and are interpreted differently, and occasionally incorrectly, by various sources. Rather than attempting to create yet another compendium of codes, or relying on only one of the existing systems, we tried to maximize accuracy by consulting numerous sources, comparing the codes they used then resolving inconsistencies ourselves. These sources and the process used are described more fully in Appendix A.

Each State quarter was coded for the eight different GDL components shown in Table 2. The number of quarters per age group and the number of unique jurisdictions contributing at least one State-quarter to each category are also shown in the table. A GDL component was considered to be in effect during an entire quarter if it was in effect for at least 2 of the 3 months in the quarter (+/- up to 5 days).

The GDL elements for each jurisdiction were coded based on a hypothetical teenager who applied as early as possible and completed every requirement necessary to avoid additional restrictions and obtain a full, unrestricted license at the earliest possible age. Often this included the assumption that the teen completed driver education and driver training courses, to avoid additional required hours of practice, qualify for an independent license earlier, or avoid license restrictions. The exception to this rule concerned “hardship” licenses (e.g., a license allowing young teens to drive to and from school only), which were not considered to be a viable option for most teens and were therefore not considered to be part of the normal pathway to licensure. Nighttime and passenger restrictions were only coded as in effect during a quarter if they specifically applied to 16- or 17-year-old drivers. These restrictions sometimes differed in application to 16- and 17-year-olds within a State (i.e., in some cases the restriction applied to 16-year-olds but not 17-year-olds). Furthermore, the restrictions sometimes had multiple stages (e.g., no passengers for the first 6 months, and no more than one passenger for the second 6 months). To make the coding of restrictions consistent across both age groups in such cases, the first-occurring phases of multi-stage restrictions as they applied to 16-year-olds were coded for the analyses.

Table 2

GDL Components Coded, Number of Quarters for Each Age Group in Each Category, And Number of Unique Jurisdictions Contributing to Each Category

GDL component categories	Quarters per age group		Unique jurisdictions	
	N	%	*N*	%
Supervised driving hours (total)				
None required	3,472	77.4	51	100.0
≤ 20 hours	137	3.0	6	11.8
25 to 35 hours	192	4.3	6	11.8
40 hours	186	4.1	11	21.6
50 to 60 hours	501	11.2	21	41.2
Nighttime supervised driving hours				
None required	3,731	83.1	51	100.0
Some required (from 4 to 10 hours)	757	16.9	32	62.7
Learner permit age (minimum)				
<15 years old	747	16.6	9	17.6
15 to 15, 5 months	2,050	45.7	28	54.9
15, 6 months to 15, 11 months	854	19.0	14	27.4
16 years old	837	18.6	14	27.4
Learner permit length (minimum)				
None	2,330	51.9	44	86.3
< 3 months	466	10.4	10	19.6
3 to 4 months	442	9.8	13	25.4
5 to 6 months	1,069	23.8	42	82.3
9 to 12 months	181	4.0	6	11.8
Intermediate license age (minimum)				
No intermediate license stage	2,658	59.2	42	82.3
< 16 years old	389	8.7	8	15.7
16 to 16, 5 months	1,204	26.8	36	70.6
16, 6 months to 17 years old	237	5.3	8	15.7
Nighttime driving restriction				
No nighttime restriction	2,952	65.8	45	88.2
≤ 10 p.m.	239	5.3	6	11.8
11 p.m.	212	4.7	10	19.6
12 a.m.	856	19.1	24	47.1
1 a.m.	229	5.1	8	15.7
Passenger restriction				
No passenger restriction	3,681	82.0	51	100.0
0 passengers, < 6 months	91	2.0	5	9.8
0 passengers, ≥ 6 months	289	6.4	13	25.5
1 passenger, ≥ 6 months	279	6.2	19	37.2
2 to 3 passengers, ≥ 6 months	148	3.3	7	13.7
Unrestricted license age (minimum)				
15 to 15, 11 months	252	5.6	5	9.8
16 to 16, 5 months	2,599	57.9	43	84.3
16, 6 months to 16, 11 months	304	6.8	13	25.5
17 to 17, 5 months	842	18.8	22	43.1
17, 6 months to 18 years old	491	10.9	15	29.4

Note. Each age group had 4,488 quarters across all jurisdictions and years. Quarter percentages do not add to 100% due to rounding. Jurisdiction counts add to greater than 51 because some jurisdictions changed categories over time. Jurisdiction percentages indicate the percentage of the 51 jurisdictions contributing at least one quarter to each category across the full 22-year period examined. Nighttime and passenger restrictions were only included

if they specifically applied to 16- or 17-year-old drivers. Because some restrictions have multiple stages (e.g., 1st 6-months vs. 2nd 6 months) the first occurring restriction phase alone was coded. Further, because the application of restrictions is sometimes different for 16- and 17-year-olds, the quarters were coded based on restrictions as they applied to 16-year-olds. Categories were constrained to include at least 5 unique contributing jurisdictions to reduce confounding by State-specific effects.

Coding for Other Traffic Safety Laws

During the time period examined, the jurisdictions also changed or implemented several laws in addition to GDL (e.g., per se BAC limits, maximum speed limits, and safety belt laws) that could also affect fatal crash involvement rates over time. The influence of these changes could confound the effect estimates for the GDL components and overall teen licensing systems if they were not taken into account in the analyses and adjusted for statistically. Therefore, the State-quarters were also coded for the other traffic safety laws shown in Table 3. The sources for this information about jurisdictions are provided in appendix SVM.

Table 3

Other Traffic Safety Laws Coded, Number of Quarters for Each Age Group in Each Category, And Number of Unique Jurisdictions Contributing to Each Category

Traffic safety law categories	Quarters per age group		Unique jurisdictions	
	N	%	*N*	%
Maximum speed limit				
55 mph	726	16.2	51	100.0
65 mph	2,411	53.7	49	96.1
70 mph	792	17.6	23	45.1
75+ mph	559	12.5	13	25.5
Mandatory safety belt use				
None	624	13.9	39	76.5
Secondary enforcement	2,664	59.4	42	82.3
Primary enforcement	1,200	26.7	27	52.9
Minimum legal drinking age of 21				
No	210	4.7	29	56.9
Yes	4,278	95.3	51	100.0
Zero-tolerance for all ages < 21				
No	1,930	43.0	51	100.0
Yes	2,558	57.0	51	100.0
BAC per se alcohol limit				
≥ .10 g/dL or no limit	243	5.4	8	15.7
.10	2,555	56.9	48	94.1
.08	1,690	37.7	51	100.0
Administrative per se for all ages				
No	1,558	34.7	33	64.7
Yes	2,930	65.3	41	80.4

Note. Each age group had 4,488 quarters across all States and years. Quarter percentages do not add to 100% due to rounding. Jurisdiction counts add to greater than 51 because some jurisdictions changed categories over time. Jurisdiction percentages indicate the percentage of the 51 jurisdictions contributing at least one quarter to each category across all time. BAC = blood alcohol concentration. Administrative *per se* = administrative license suspension/revocation for BAC ≥ the per se limit, regardless of age or prior offense history.

Analysis Method

The State-age group-quarters for 16- and 17-year-olds were analyzed with pooled cross-sectional time series analysis through negative binomial regression modeling using the SAS GENMOD procedure. The natural log of the interpolated quarterly population for each age group divided by 10,000 was used as an offset term, resulting in analyses of driver fatal crash involvement rates per 10,000 population. Because there was correlation among the quarters, due to both clustering by jurisdiction and repeated measurements of the age groups over time, generalized estimating equations (GEEs) were used to fit the final models and obtain robust variance estimates adjusted for these statistical dependencies.. The working correlation structure for the GEE analyses was approximated by a first-order autoregressive structure, meaning that State-age group-quarters closer to one another in time were assumed to be more similar than those separated by greater time periods. The unit of clustering (i.e., a "subject") was an age group within a State.

To adjust for possible confounding by long-term secular trends, a linear parameter representing continuous time (quarter-years) was included in all models. In addition, a series of three indicator-coded variables representing quarter (January-March, etc.) was used in all models, to remove variation in crash rates due to seasonal cycles. Interactions of these trend and seasonal parameters with jurisdiction, age group, and jurisdiction by age group were included, to allow trend and seasonality to differ for each age group within each State. The choice to allow the various effects to vary by age group and jurisdiction resulted in very large models, but provided the best control for a priori differences among the States that might confound effect estimates.

Indicator variables representing individual year of age (16, 17) were used in the analyses to adjust for differences in fatal crash involvement rates associated with driver age group. To account for the fact that *a priori* differences exist in fatal crash rates between jurisdictions due to different roadway environments, enforcement, weather, demographic, socioeconomic characteristics and other unmeasured State-specific factors, 50 (k – 1) indicator variables representing jurisdiction were also included in all analyses. An age group by jurisdiction

interaction was included, to allow for the possibility that State to State differences in fatal crash involvement rates differ across age groups.

To adjust for historical artifacts affecting fatal crash involvements associated with macroeconomic factors, quarterly unemployment data from the Bureau of Labor Statistics was included as a linear term in all analyses. Unemployment interactions with jurisdiction, age group, and jurisdiction x age group were included to allow for the relations between macroeconomic factors and fatal crash rates to vary for each driver age group within each State.

The various laws and GDL elements were represented in the models using k - 1 indicator variables. To allow for the likelihood that the effects of the various laws differed according driver age, age group by law interaction terms were used in all models involving two or more age groups. An important implication of this modeling strategy is that it results in effect estimates that are relative to drivers of the same age (i.e., the referent group is drivers of the same age). Overall tests of effects parameterized by multiple indicator variables were evaluated using custom Wald tests based on the robust variance estimates in the GEE models.

Several analyses were conducted involving 16- and 17-year-olds to see how the effect estimates varied as a function of two different factors. The first factor was whether, and if so which, adult age groups were included in the analyses as covariate series, in an attempt to remove additional variation in the teen crash rates that could be accounted for by their shared relation with adult crash rates. That is, two different combinations of crash rates for adult age groups in each jurisdiction were used to further control for residual State-specific variability that might be due to unmeasured factors such as differences in enforcement, weather and roadway conditions, gasoline prices, and changes in other laws that were not coded for this study. Specifically, the teen crash rates were first analyzed without using adult crash rates as covariates. Next, the teen crash rates were analyzed with those for adult drivers 40 to 59 included in the model. Interactions of adult crash rates with age group were included, which allowed for the relation between adult crash rates and those of each teen age group to vary.[1]

[1] The 40- to 59-year-old adult age group was chosen as the initial covariate series because it was the youngest of the adult age groups that would not overlap with 16- and 17-year-old drivers during the study time period of 22 years. That is, a 17-year-old in 1986 would be 38 in 2007, so to avoid having overlap among drivers between the teen and adult crash rate series, the 40- to 59-year-old group was the youngest that could be used.

The constraint of having no overlap between the teen and adult covariate series may limit the ability to control for unmeasured factors in this case, given the long period of time included and the fact that crash rates tend to be more similar between age groups that are closer together. Including the crash rates of other, younger adult age groups as covariates, even though some portion of them consists of persons who were licensed through the teen licensing system being evaluated, might do a better job of removing variability in the teen crash rates resulting from State-specific unmeasured variables. Therefore, one additional analysis was conducted. This included the crash rates for all adult age groups (20 to 24, 25 to 39, 40 to 59, and 60+), with age group interactions to allow for each adult covariate series to have a different relation with each of the two teen age groups (16, 17).

The second factor that was varied between analytic models was whether the quarters were weighted by the proportion of teenagers in each age group that contributed to each State-quarter. The three analyses just described were repeated with weighting to determine whether the effect estimates changed meaningfully and, if so, how. In the unweighted analyses, each quarter counted equally towards the effect estimates, whether it represented a relatively small number of teen drivers (e.g., Wyoming or Delaware) or a large number (e.g., California or New York). To account for the fact that crash rates based on larger numbers of teens provide more reliable parameter estimates, each quarter was weighted by the normalized age-group population.[2] Normalizing the weights to the total number of State-age group-quarters avoids biasing the variances downward by ensuring they are based on the actual number of quarters observed for an age group rather than the total age-group population across all quarters and States.

Results

Table 4 presents the adjusted crash incidence rate ratios, per 10,000 population, for 16- and 17-year-olds associated with various supervised driving requirements. To conserve space, only the models that included covariates for all adult drivers 20 and older (in several ranges separately, rather than simply the total) are presented. The findings were highly similar when using only 40- to 59-year-old adults. Estimates for trend, seasonality, unemployment, jurisdiction, age group, the adult crash covariates, other laws and GDL components, and their various interactions are

[2] The normalized weight for a quarter was the State-specific age group population estimate for the quarter x the quotient resulting from the total number of quarters for the age group across all States (4,488) divided by the sum of population in that age group across all States [w_n = $\text{Population}_{\text{Age Group State Quarter}}$ x (4488 / $\text{Population}_{\text{Age Group All Quarters}}$)].

also not shown, as these were not the goal of the analysis, merely representing factors that needed to be controlled in order to establish whether requiring a certain number of supervised driving hours was independently associated with a lower fatal crash involvement rate.

Table 4

Adjusted Incidence Rate Ratios for Driver Fatal Crash Involvements per 10,000 Population Associated With Supervised Driving Requirements for 16- and 17-Year-Olds, United States, 1986-2007

Requirement	Unweighted estimates (95% CI)	Weighted estimates (95% CI)
	16-year-olds	
Supervised driving hours (total)		
None required	–	–
≤ 20 hours	1.00 (0.84,1.19)	0.99 (0.84,1.15)
25 to 35 hours	0.91 (0.78,1.07)	0.90 (0.77,1.06)
40 hours	1.07 (0.90,1.28)	1.05 (0.87,1.25)
50 to 60 hours	0.95 (0.82,1.09)	0.93 (0.80,1.08)
Nighttime supervised driving hours		
None required	–	–
Some required	1.08 (0.93,1.26)	1.05 (0.88,1.26)
	17-year-olds	
Supervised driving hours (total)		
None required	–	–
≤ 20 hours	1.05 (0.93,1.19)	1.05 (0.93,1.19)
25 to 35 hours	1.06 (0.89,1.26)	1.02 (0.89,1.18)
40 hours	1.13 (0.99,1.29)	1.12 (0.98,1.27)
50 to 60 hours	1.05 (0.87,1.26)	1.03 (0.87,1.22)
Nighttime supervised driving hours		
None required	–	–
Some required	0.99 (0.84,1.18)	1.03 (0.87,1.21)

Note. All analyses shown included adult crash rates for several age groupings as covariates and are adjusted for linear trend, seasonality, unemployment, jurisdiction, age group, interactions of trend, seasonality, and unemployment by age group and jurisdiction, age x jurisdiction interactions, as well as all the GDL components and laws coded in Tables 2 and 3. Models are adjusted for the crash rates of each included adult age group separately for each teen age group in each State (i.e., all covariate x age group x jurisdiction interactions). Results for the weighted analysis reflect the proportional State representation of each teen age group nationwide. The 95% CI = 95% confidence interval for the adjusted rate ratios.

16-Year-Old Nationwide Supervised Driving Requirement Results. Requiring any particular number of supervised driving hours was not associated with changes in fatal crash involvement rates of 16-year-olds. The estimates across the different numbers of hours required and the varying analytic models oscillate around 1.00, but none are reliably different from 1.00 (which represents no effect). Requiring that at least some of the supervised driving hours be completed during nighttime hours (or during darkness) appeared to be associated with somewhat higher

16-year-old crash rates, but again these estimates were not statistically significant. Overall these analyses provide no indication that specific amounts of supervised driving practice, or requiring that some portion be completed during nighttime hours, are associated with changes in the fatal crash involvement rates of 16-year-old drivers.

17-Year-Old Nationwide Supervised Driving Requirement Results. Compared to having no required supervised driving hours, requiring some minimum amount of supervised driving hours for beginning drivers initially appeared to be associated with higher 17-year-old-driver crash rates (ranging from 2% to 13%). However, only a few of these estimates (not shown) reached conventional levels of statistical reliability ($p < .05$) and none of the effect estimates remained statistically significant when the models adjusted for crash rates among older age groups. As with 16-year-olds, requiring that some portion of the supervised driving hours be completed during hours of darkness was not consistently or reliably associated with a difference in 17-year-old-driver fatal crash involvement rates. It is important to bear in mind that this analysis examined the effects of State mandates of certain amounts of supervised driving for young beginning drivers – not supervision requirements that pertain specifically to 17-year-old drivers – on 17-year-old-driver fatal crash involvement. The choice of an unweighted or weighted model made little difference in the final parameter estimates. This is somewhat surprising given the very large variations in State populations.

Effect of Changed Supervised Driving Requirements in Individual States

The previous analyses attempted to estimate whether requiring supervised driving practice was associated with changes in teen crash rates by capitalizing on between- and within-State variation in these requirements over time. However, the national analysis could only examine fatal crash data. Although fatal crashes appear to be similarly responsive to the overall effects of graduated licensing systems as less serious crashes, they do represent a very small subset of all young driver crashes. Moreover, although complex statistical models can adjust for confounding factors thought to influence crashes, such adjustments are subject to measurement limitations. Factors that cannot be measured, or which are not thought to influence crashes, cannot be included. Accordingly it is useful to examine instances where a State has changed the variable of interest – required hours of supervised driving practice in the present case – creating a natural experiment whose effects can be measured.

Selection of States

The analyses in the present section examined whether changes in the number of supervised driving hours required in selected States were associated with changes in 16- and 17-year-old-driver crash rates. The original intent was to identify States that made changes to the number of hours of required supervised driving practice without making changes to other GDL components.[3] In such cases inferences regarding the impact of the change in required hours of supervised driving on teen crash rates would be more strongly supported than in situations where multiple GDL components were changed simultaneously. However, it was not possible to fully implement this analytic strategy, for reasons described below.

SDS crash data were either unavailable or incomplete for most of the States that made changes to their supervised driving hours requirement without making changes to other GDL components. Only Minnesota had adequate data readily available for analysis with sufficient pre- and post-change periods during which no other changes had been made (see Table 5).

[3] This set a difficult standard because States have been highly active in addressing young driver licensing during the past decade.

Table 5

States That Increased Their Hours of Supervised Driving Independent of Other GDL Elements Considered for Analysis

State	Change (effective date)	Notes
Arizona	0 – 25 hours (1/00)	Not in SDS
Maine	0 – 35 hours (8/98)	Not in SDS
Minnesota	0 – 30 + 10 intermediate hours (1/99)	In SDS 1994-2002, 2004-2005
Rhode Island	0 – 50 hours (7/17/03)	Not in SDS
Utah	0 – 30 hours (7/99), 30 – 40 (7/04)	May count 5 hours from simulator and 6 from driver education towards requirement (7/03); In SDS 1991-2004

Note. SDS = National Center for Statistical Analysis, State Data System.

In an effort to work around the limited availability of States that met the conditions of changing only the required hours of supervision, we decided to identify States that made changes to supervised driving hours along with changes to minimum learner permit periods, but nothing else, and contrast the effects between States. Table 6 shows the States that were considered for inclusion in these analyses, along with the dates of relevant law changes and availability of data in SDS. States included in the analyses are asterisked in the table.

Table 6

Additional States Considered for Analyses of Changes in Supervised Driving Hours

State	Change (effective date)	Notes
States that simultaneously increased hours of supervised driving and duration of the mandatory holding period independent of other GDL elements (*n* =7)		
Florida	6 – 12 months, 0 – 50 hours (10/00)	In SDS 1991-2005
Idaho	0 – 4 months, 0 – 50 hours (1/01)	Minimum entry age raised to 14, 6 months (1/01); Not in SDS
Illinois*	0 – 3 months, 0 – 25 hours (1/98)	Passenger restriction (6/04); In SDS 1991-2005; Serious data problems
Kansas	0 – 6 months, 0 – 25+25 intermediate hours (7/99)	In SDS 1991-2006
Maryland	0.5 – 4 months, 0 – 40 hours (7/99); 4 – 6, 40 – 60 (10/05)	Passenger restriction (10/05); In SDS 1991-2005
Ohio	0 – 6 months, 0 – 50 hours (1/99)	Minimum entry age lowered to 15, 6 months (7/98); In SDS 1991-2005
Pennsylvania*	0 – 1 months (9/16/95); 1 – 6, 0 – 50 hours (1/00)	In SDS 1991-2001, 2003-2005
States that increased the mandatory holding period independent of other GDL elements (*n* = 12)		
Alaska	0 – 6 months (1/99)	Not in SDS
Arkansas	1 – 6 months (5/99)	In SDS 1998-2005
Connecticut	0 – 6 months (1/97)	Only 4 months required with DE;
Hawaii	0 – 3 months (7/97)	Not in SDS
Indiana	0 – 2 months (1995)	In SDS 1991-2000, 2002-2005
Kentucky	1 – 6 months (10/96)	In SDS 1997-2005
Louisiana	90 days – 6 months (9/04)	Not in SDS
North Dakota	3 – 6 months (8/99)	Not in SDS
South Carolina*	0 – 3 months (7/98)	In SDS 1997-2004
South Dakota	0 – 6 months (1/99)	Only 3 months required with DE; Not in SDS
Tennessee	0 – 3 months (1/96)	Not in SDS
Virginia*	0 – 6 months (7/96)	Learner permit age lowered from 15, 8 months to 15 (7/95); In SDS 1991-2004

Note. SDS = National Center for Statistical Analysis, State Data System. DE = driver education.

Data

Counts of driver crash involvements in serious (A injury) and fatal (K injury) crashes in cars, trucks/pickups, vans/minivans, and SUVS were obtained for Illinois, Minnesota, Pennsylvania, South Carolina, and Virginia for the longest contiguous period possible between 1990 and 2005 for each State, given the limitations of available data from the SDS. Crash counts were obtained for Florida for the years 1990 to 2005, for Illinois from 1994 to 2005, for Minnesota from 1994 to 2002, for Pennsylvania from 1994 to 2002, for South Carolina from 1997 to 2004, and for Virginia from 1994 to 2004. The crash counts were stratified by month and age group (16, 17, & 25 to 39 etc.).

State single-year-of-age population estimates were obtained from the Census Bureau for the years 1989 to 2007. Monthly estimates were interpolated between the annual July estimates using cubic spline curves for each age group in each jurisdiction. As with the previous analyses, the interpolated population estimates allowed the calculation of age-group-specific monthly crash involvement rates per 10,000 population for analysis purposes.

Analysis Method

To estimate the State-specific effects of changes made to supervised driving hours, the fatal/serious injury (F/I) crash rates per 10,000 population for 16- and 17-year-olds were analyzed using ARIMA interrupted time series analysis. This analytic method is the most powerful for identifying changes in the teen crash rates per licensed driver before and after States changed the numbers of required hours of supervised practice. Although ARIMA analyses implicitly control for pre-existing secular trend in crash rates, it is desirable to use the crash rates of another age group as a historical covariate to control for other State-specific factors that affect all drivers (weather, unique enforcement levels and programs, economic conditions, gasoline prices, etc.). The resulting estimates from these analyses are the percentage change in crash rates of teen drivers associated with a specified increase in required hours of supervised practice. Identifying the precise point at which effects of the changed supervised driving requirements could be expected to begin affecting driver crash rates required careful inspection of the details of each State's GDL system, as well as the way in which the legislature implemented it (i.e., did they include a "grandfather" clause that delayed the true effective date beyond the nominal effective date).

The monthly teen crash rates in each State were first statistically adjusted for trends and seasonal variation before the effects of the interventions were evaluated (Lon-Mu Liu, 2006). In each State, the monthly crash rates for drivers 25- to 39 years old[4] were used as covariates to model and remove variability in the teen crash rates due to factors affecting drivers of all ages, such as changes in enforcement, weather, fuel prices, and other unmeasured factors that are specific to each State and which vary over time. The crash rates were log transformed ($\log_e$) prior to analysis to stabilize series variability and simplify interpretation of the sudden impact intervention parameters. Specifically, the coefficient representing the intervention effects (ω) is directly interpretable (using the formula $100 \times [e^{\omega} - 1]$) as the adjusted monthly percentage

[4] Drivers 25 to 54 are often used as control series for analysis of teenage driver crashes. Analyses conducted earlier suggested that a group closer in age to teenagers is a better covariate measure.

change in the post-intervention series relative to the pre-intervention series (McCleary & Hay, 1980; McDowall et al., 1980).

Separate ARIMA analyses were conducted for each of the 5 included States that changed their supervised driving hours requirement. Repeated investigations to identify and reduce the bias caused by extremely deviant monthly estimates (i.e., outliers) were conducted during both the initial modeling and intervention analyses of each series. The final models were deemed to be those that best represented the underlying crash behavior, based on the pre-intervention data points for each State, using auto-correlation and partial-auto-correlation functions of the series residuals (see Brockwell & Davis, 2002, for further information on techniques for model identification).

Results

Minnesota. As noted above, Minnesota is the only State in the SDS that changed the required number of supervised driving hours independent of any other simultaneous or temporally proximate changes. The monthly F/I crash rates per 10,000 population for Minnesota are shown in Figure 1.a. by age group. In February 1997 Minnesota implemented a 6-month learner permit phase (no mandatory learner permit was required prior to this date). In January 1999 the State added the requirement that teens obtain 30 hours of supervised driving practice in the learner phase and 10 additional hours in the intermediate phase (for 40 total hours of supervised driving practice). The ARIMA results summarized in Table 7 indicate no change in 16-year-old-driver F/I crash rates in Minnesota corresponding with the February 1997 introduction of the 6-month learner permit. However, there was a 15% decrease in 17-year-old-driver F/I crash rates ($p <$ .05) following implementation of the mandatory learner permit. The January 1999 addition to require 30 supervised driving hours was not associated with a significant change in the crash rates of either age group. The analysis did not find a statistically reliable association between the required 30 supervised driving hours and a significant change in the crash rates of either age group.

Table 7

Summary of Sudden-Permanent ARIMA Models for Fatal/Serious-Injury Crash Rates per 10,000 Population for 16- and 17-Year-Olds in Minnesota, 1994-2002

Intervention	Model component	Parameter	Lag	Estimate	*t*
16-year-olds					
February 1997	6-month learner permit	ω	0	-0.0023	-0.02
January 1999	30 hours supervised driving	ω	0	0.1093	1.07
	Control series (25-39-yr-olds)	β	0	0.8431	3.50*
	Noise	AR	12	0.3326	3.46*
	Constant			0.5070	4.65*
17-year-olds					
February 1997	6-month learner permit	ω	0	-0.1633	-2.44*
January 1999	30 hours supervised driving	ω	0	0.0763	1.07
	Control series (25-39-yr-olds)	β	0	0.7095	4.39*
	Constant			0.8216	14.30*

*$p < .05$, two-tailed

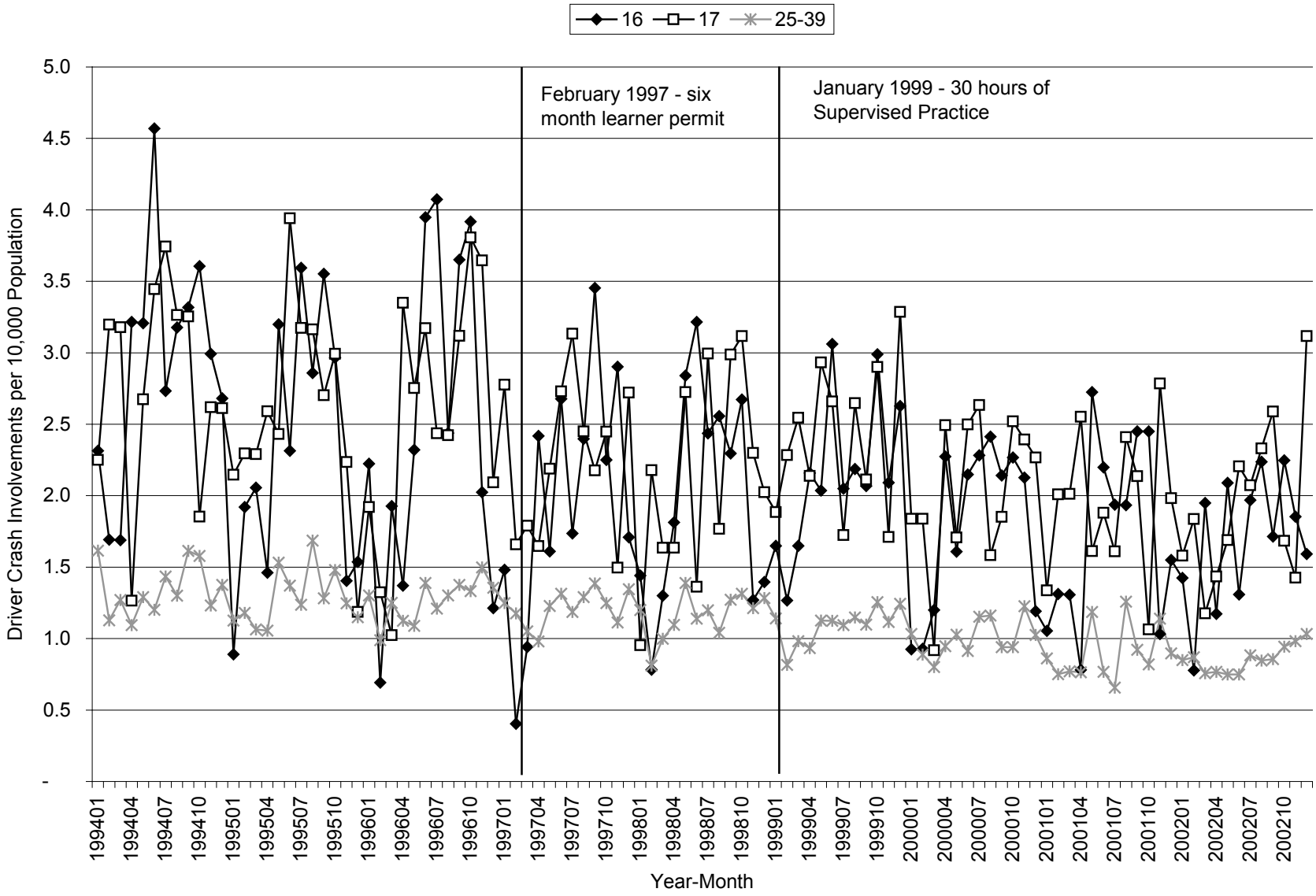


Figure 1.a. *Minnesota Fatal/Serious-Injury Crash Rates per 10,000 Population by Age* Group, 1994-2002.

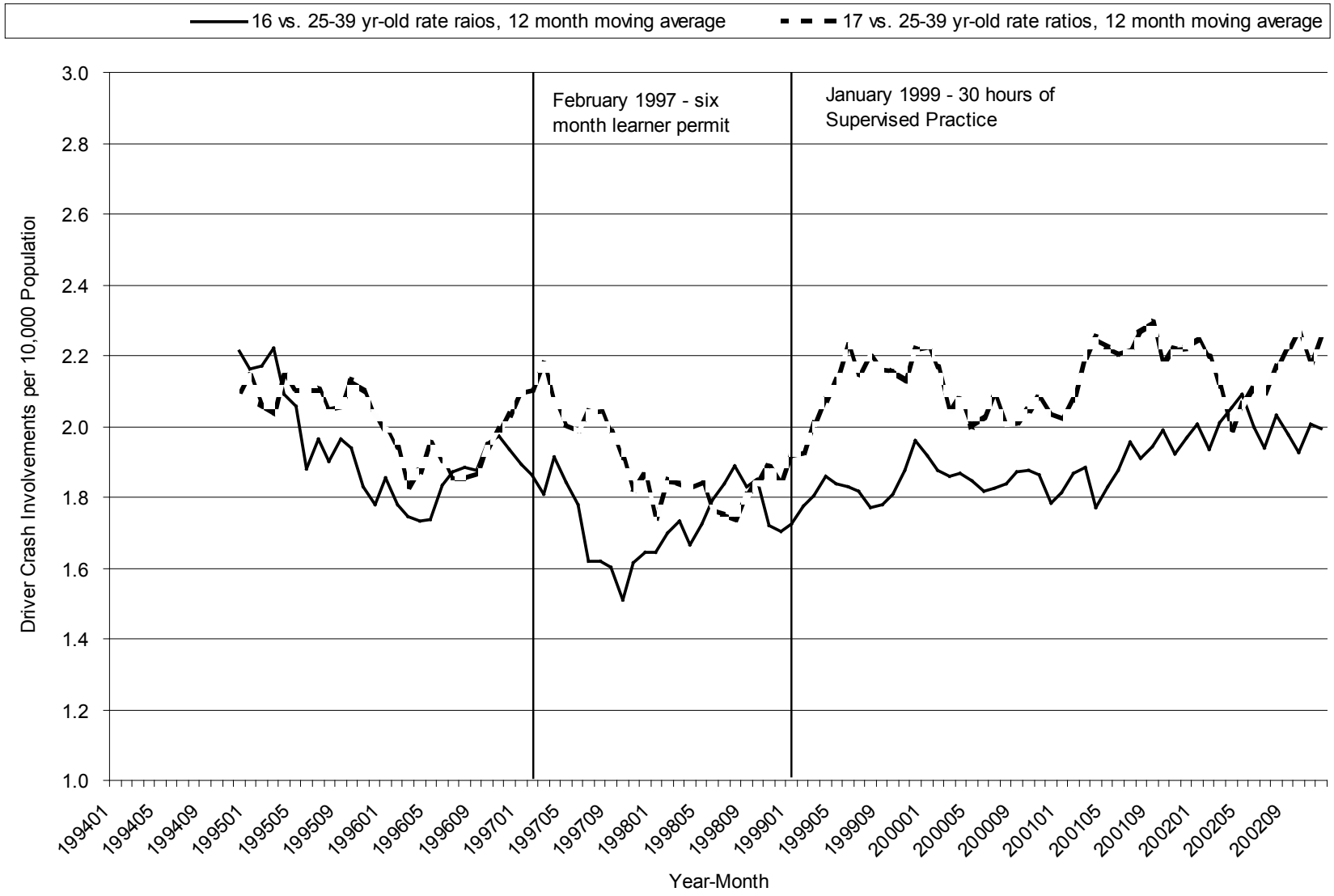


Figure 1.b. *Minnesota Fatal/Serious-Injury Crash Rate Ratios, by Age versus 25-39-Year-olds, 12-Month Moving Average, 1994-2002.*

Figure 1.a. contains substantial detail that can obscure general patterns, but a visual inspection appears to show a decrease in both 16- and 17-year-old-driver crashes following implementation of the 6-month learner permit. However, the analyses control for the trends exhibited by the older driver group, which also declined. For clarity, Figure 1.b. reconfigures the information to show the 12-month moving averages for 16- and 17-year-old-driver monthly crash rate ratios (compared to those for 25- to 39-year-old drivers). Arraying the data this way removes secular trends – as reflected by the adult crash rates – in the crash rate plot and smoothes out the wide month-to-month variations typically found in monthly crash rates. Although Figure 1.b. shows an apparent increase in crash rates relative to more experienced drivers following enactment of the supervised driving requirement, this increase is not statistically significant for either 16- or 17-year-old drivers (t = 1.07 in both cases).

Illinois and South Carolina. As mentioned previously, Minnesota was the only State in the State Data System that changed the required number of supervised driving hours independent of other changes. However, we attempted to obtain some sense of whether adding required hours of supervision may have had an independent effect in other States by pairing States that had added mandatory hours along with a minimum holding period for the learner permit. For example, Illinois added both a 3-month learner period and 25 hours of required supervision (in January 1998). By comparing the effects of that combination with the effects of merely instituting a 3-month learner period in South Carolina at about the same time (July 1998), we hoped to obtain some insight into the possible effects of the hours alone. Although comparing such different States is problematic, we judged that this analysis was worth attempting given the very limited opportunities to examine effects of requiring supervised hours. Unfortunately, the results proved uninformative.

The Illinois crash data available in the SDS were fraught with problems resulting from changes to the crash report form and differential underreporting that varied across time.[5] In an attempt to adjust the analysis for these myriad data problems, temporary step function parameters were entered into the ARIMA analyses to model their effects, but the results were less than satisfactory. The findings suggest a statistically significant 15.9% *increase* in 16-year-old-driver

[5] According to the documentation for the Illinois crash data provided by SDS, the Illinois data reflect the following changes: (a) a new crash report form starting in 1996; (b) underreporting in 1996 (half the normal number of crashes); (c) underreporting of nonfatal crashes in Chicago in 1997; (d) no reporting on nonfatal crashes in Chicago for 1998-1999; and (e) a change in injury reporting in 2004. The documentation recommends that the periods 1989-1992, 1994-1995, 1997-1999, and 2000-present data be viewed as distinct intervals and that 1993 and 1996 be viewed as transition years.

crashes following the introduction of the 3-month learner period and 25 hours of required supervision, but this was clearly an artifact of the data reporting problems immediately prior to this policy change (during 1996). Figure 2 depicts the problematic nature of the crash data in Illinois.

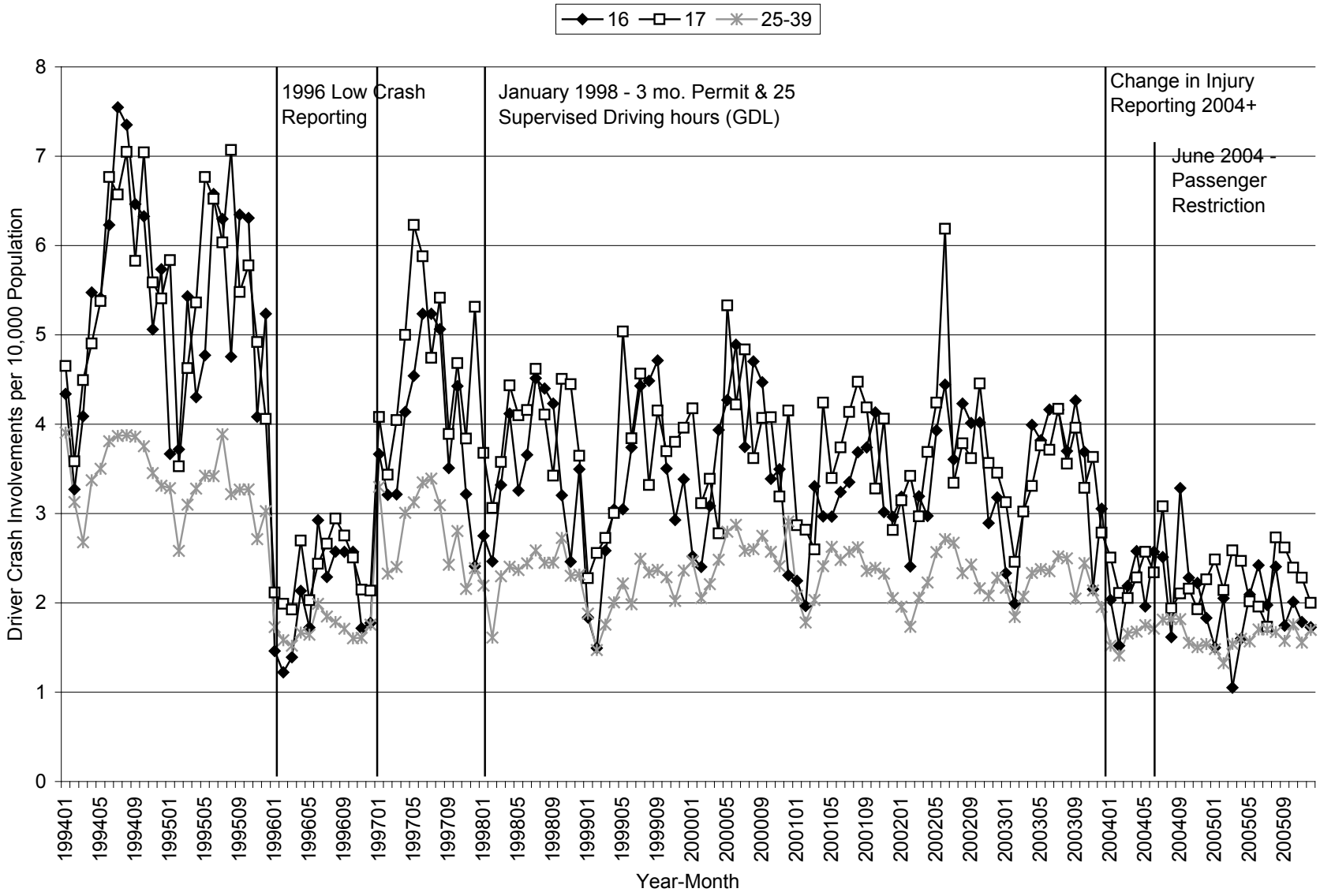


Figure 2. *Illinois Fatal/Serious-Injury Crash Rates per 10,000 Population by Age Group, 1994-2005.*

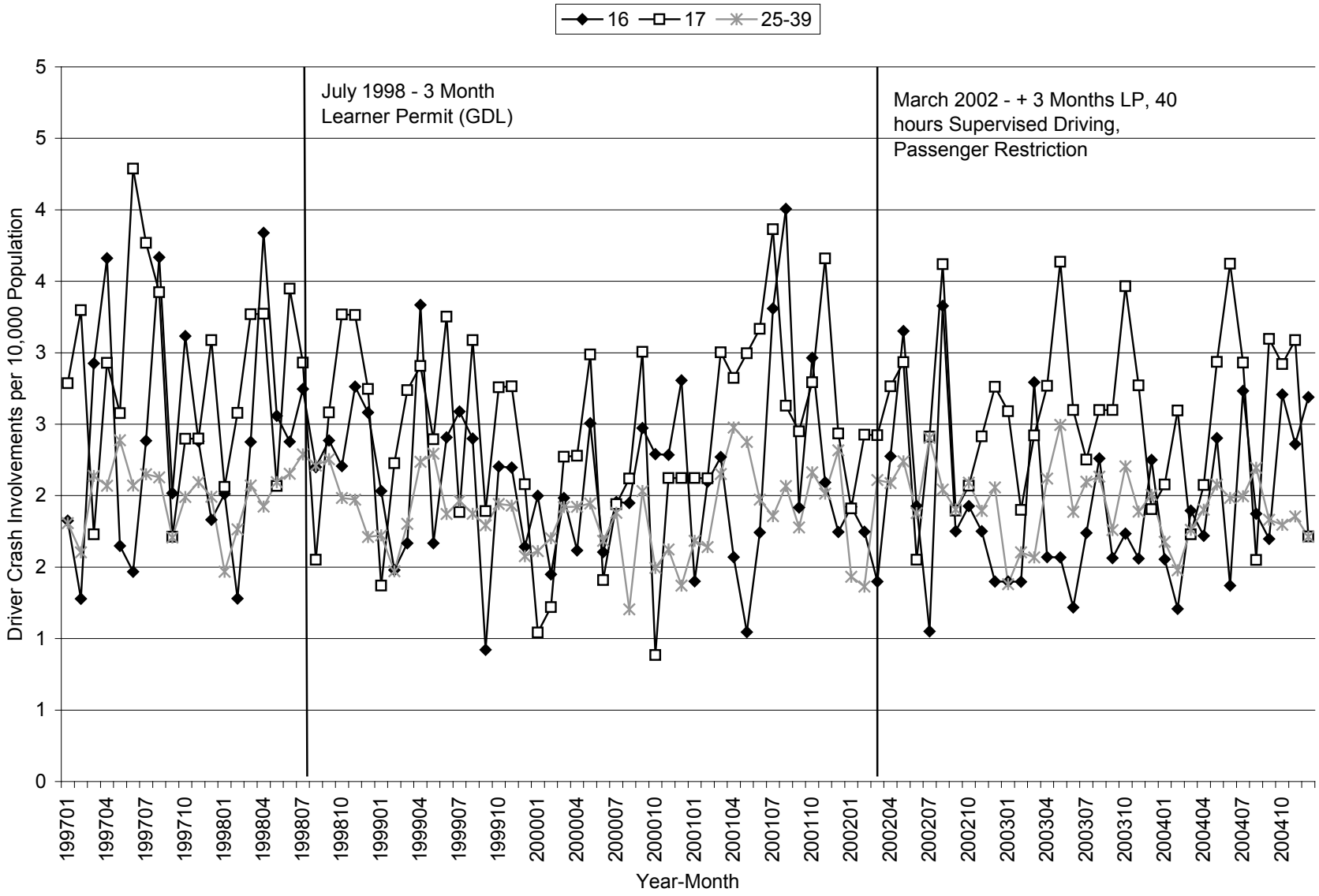


Figure 3. *South Carolina Fatal/Serious-Injury Crash Rates per 10,000 Population by Age Group, 1997-2004*

Introduction of the 3-month learner period alone in South Carolina did not produce any change in crash rates for 16- or 17-year-old drivers (*t*s = -.83, -.65 respectively; see Figure 3). However, comparison with the effect in Illinois cannot be interpreted given the data reporting problems immediately prior to this policy change in Illinois.

Virginia and Pennsylvania. A comparison analysis was also planned for Virginia and Pennsylvania. Whereas Virginia merely instituted a mandatory 6-month learner period (in July 1996), Pennsylvania made a comparable change in the learner period (extending it from 1 to 6 months), but also added a requirement for new teenage drivers to obtain 50 hours of supervised practice. The latter occurred a few years later (January, 2000), rendering the comparison less than ideal. The major problem for the planned analysis, however, was that Virginia made several changes to its teen licensing system over the years. Most problematic for present considerations was that in July 1995 the minimum entry age for a learner permit was lowered from 15, 8 months to age 15. As a result, there was an insufficient sustained period prior to the implementation of the mandatory 6-month learner period to calibrate a statistical model of young driver crashes. In addition, numerous other changes occurred in following years, which prevented a stable calibration of post-1996 crash rates.[6]

Figure 4 shows the crash rates in association with the multiple changes to the Virginia young driver licensing system and Table 8 shows the ARIMA results. Of primary interest is the absence of any effect of adding the 6-month learner requirement on either 16- or 17-year-old-driver crashes. As an aside, it is noteworthy that when Virginia introduced a full-fledged GDL system, in July 2001, 16-year-old-driver crashes dropped notably (following a 6-month period reflecting a grandfathering effect whereby those who had begun driving under the previous licensing system were allowed to continue under those old rules). The ARIMA analysis indicates a statistically significant, 21.9% decrease in 16-year-old-driver crashes after July 2001.

[6] A weak passenger restriction allowing no more than three passengers was added in July 1998. Multiple changes were made in July 2001: the learner permit entry age was raised to 15, 6 months, the mandatory learner permit holding period was increased by 3 months (9 months total), a requirement to obtain 40 hours of supervised driving practice was added, a nighttime restriction disallowing driving from midnight to 4 a.m. was added, and the passenger restriction was strengthened to allow no more than one passenger younger than 18 until age 17 and no more than three thereafter until age 18. Finally, in July 2003 the passenger restriction was further strengthened to allow no more than one teen passenger for the first 12 months and no more than three thereafter until age 18.

Table 8

Summary of Sudden-Permanent ARIMA Models for Fatal/Serious-Injury Crash Rates per 10,000 Population for 16- and 17-Year-Olds in Virginia, 1994-2004

Intervention	Model component	Parameter	Lag	Estimate	*t*
16-year-olds					
July 1995	Reduced learner age	ω	0	-0.1257	-1.23
July 1996	6-month learner permit	ω	0	0.0088	0.09
July 1998	Passenger restriction	ω	0	-0.0186	-0.25
July 2001	Multiple changes	ω	0	-0.2468	-3.30*
July 2003	Changed passenger restric.	ω	0	-0.2463	-2.85*
	Control series	B	0	1.1272	6.37*
	Noise	AR	1	0.4072	4.76*
	Constant			0.4840	1.46
17-year-olds					
July 1995	Reduced learner age	ω	0	-0.0798	-1.81†
July 1996	6-month learner permit	ω	0	0.0039	0.09
July 1998	Passenger restriction	ω	0	0.0177	0.56
July 2001	Multiple changes	ω	0	-0.0172	-0.54
July 2003	Changed passenger restric.	ω	0	-0.0673	-1.80†
	Control series	B	0	1.2084	12.81*
	Constant			0.3623	2.11*

*$p < .05$, two-tailed. †$p < .10$

Table 9 and Figure 5 show the results of the ARIMA analysis for Pennsylvania. The increased learner permit holding period from 1 to 6 months and added requirement to obtain 50 hours of supervised driving practice in January 2000 was associated with a significant 16.6% decrease in 16-year-old-driver F/I crash rates ($p < .05$), but no significant change in 17-year-old-driver F/I crash rates was associated with this date ($p > .05$).

Table 9

Summary of Sudden-Permanent ARIMA Models for Fatal/Serious-Injury Crash Rates per 10,000 Population for 16- and 17-Year-Olds in Pennsylvania, 1994-2002

Intervention	Model component	Parameter	Lag	Estimate	*t*
16-year-olds					
January 2000	6-mo. learner permit, 50 hrs. supervision	ω	0	-0.1816	-1.97*
	Control series	β	0	0.1450	1.74†
	Noise	AR	12	0.3899	4.21*
17-year-olds					
January 2000	6-mo. learner permit, 50 hrs. supervision	ω	0	-0.0129	-0.20
	Control series	β	0	0.6881	4.17*
	Constant			1.5419	12.99*

*$p < .05$, two-tailed. †$p < .10$

Although it is tempting to interpret this significant effect as evidence of the benefits of requiring 50 hours of supervised driving, since Virginia obtained no effect by merely adding a 6-month learner period, it is not appropriate to do so. As noted above, it was not possible to obtain a reliable indication of the effect of the Virginia learner period because of the short pre-intervention period for which data were available. The 8-month reduction in the learner permit age mid-way through this period further undermines the interpretability of the change parameter estimates in the ARIMA analysis. That the Virginia and Pennsylvania interventions occurred 4 years apart raises additional concerns, including the possibility prevailing risk levels may have been different for young teenage drivers during these different time periods.

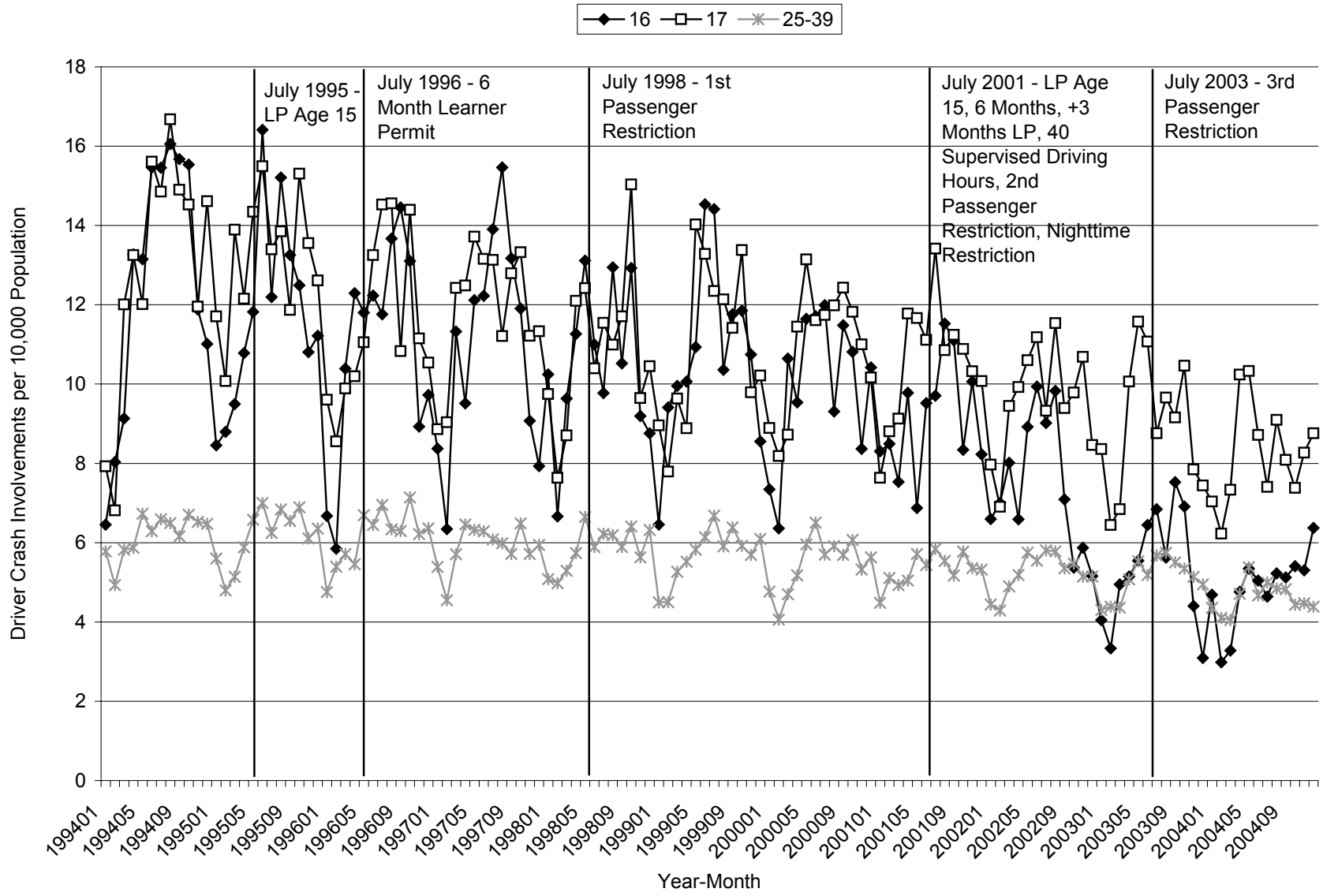


Figure 4. *Virginia Fatal/Serious-Injury Crash Rates per 10,000 Population by Age Group, 1994-2004.*

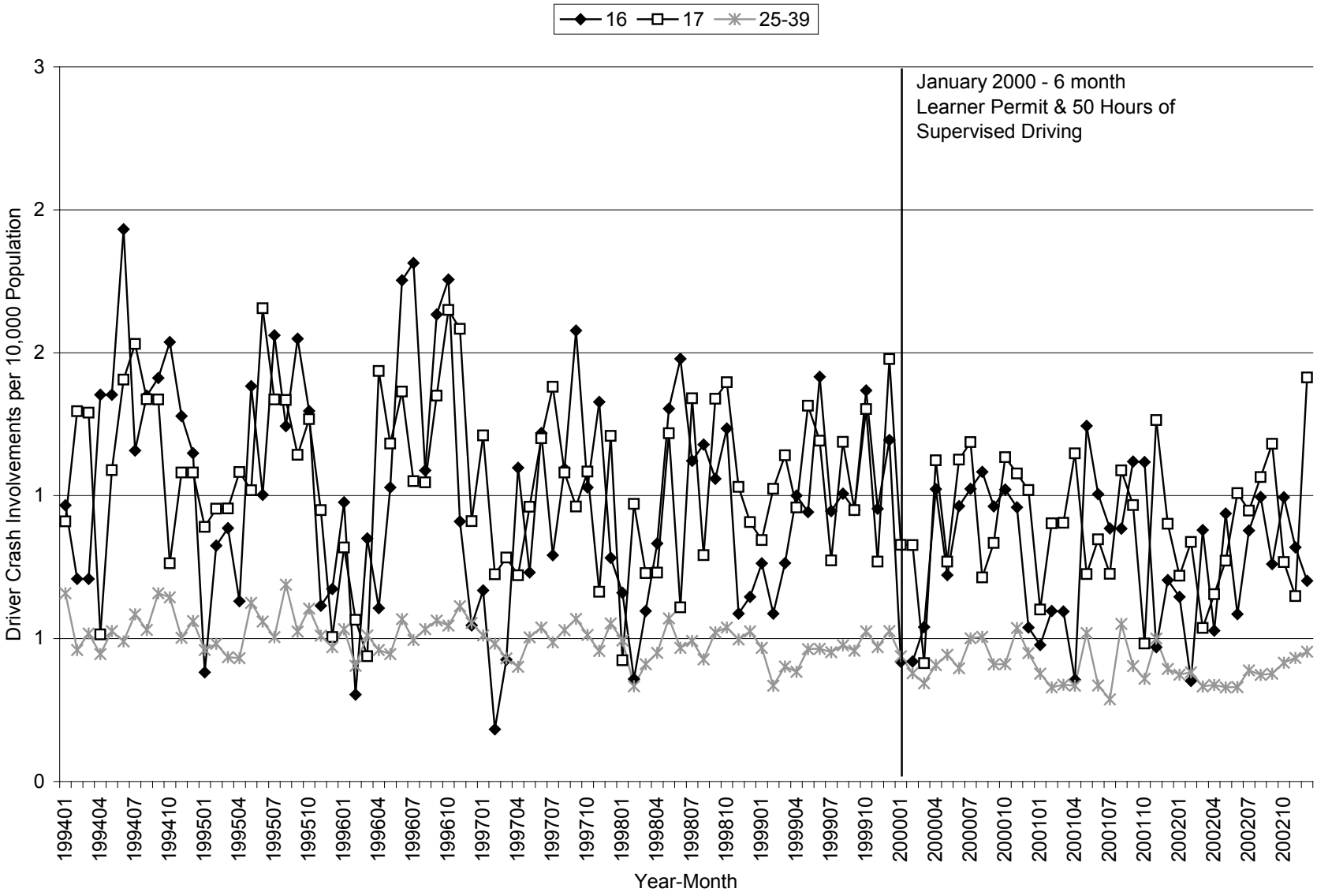


Figure 5. *Pennsylvania Fatal/Serious-Injury Crash Rates per 10,000 Population by Age Group, 1994-2002.*

Summary

In summary, the ARIMA analyses proved to be less enlightening than originally expected. Analyses of Minnesota data did not find a statistically reliable relationship between a requirement of 30 hours of supervised driving and either 16- or 17-year-old-driver crash rates. Efforts to look at the possible effects of requiring larger numbers of supervised driving hours in individual States proved highly problematic. There were several reasons for this, including lack of available data for some States of interest, limitations in data quality in others, and a mismatch of data availability with time periods during which State policy changes of interest were made. In addition, multiple seemingly small – but nonetheless complicating – changes to young driver licensing requirements in close succession in some States rendered ARIMA analyses incapable of identifying changes in crash data patterns subsequent to individual changes.

PARENT INTERVIEWS

Structured Interviews

State Farm Insurance funded UNC/HSRC to conduct interviews with parents of teen drivers and driver licensing employees. A total of 510 parents in 5 States with varying supervised driving requirements were interviewed. These States are Maryland, Minnesota, Ohio, South Carolina, and Washington. Table 10 summarizes the supervised driving requirements in these States.

Table 10

Supervised Driving and Minimum Age Requirements In States Where Parents Were Interviewed

State	Minimum Entry Age	Mandatory Holding Period	Minimum Amount of Supervised Driving	Minimum Age for an Intermediate License	Required Documentation of Hours
Maryland	15, 9 mo.	6 mo.	60 hrs (10 at night)	16, 3 mo.	Log signed by parent/guardian
Minnesota	15	6 mo.	30 hrs (10 at night)	16	Affidavit signed by parent/guardian
Ohio	15, 6 mo.	6 mo.	50 hrs (10 at night)	16	Affidavit signed by parent/guardian
South Carolina	15	6 mo.	40 hrs (10 at night)	15, 6 mo.	Affidavit signed by parent/guardian
Washington	15	6 mo.	50 hrs (10 at night)	16	Affidavit signed by parent/guardian

Source: Insurance Institute for Highway Safety, June 2009

These States were chosen for a combination of reasons. They offer a range in the required number of hours of supervision (30 to 60). In addition, they have a holding period of 6 months for the learner permit and a similar minimum age at which the permit can be obtained. However, they vary in the amount of time between the learner's permit phase and when the intermediate/provisional license is first available. Some States only allow 6 months for new drivers to accumulate the required 6 months and required hours practice, prior to the licensing age. Others allow new drivers 12 months to get the

required 6 months and required hours. This is a significant variation because the latter provides more time to obtain the required hours of supervision.

The following are some of the key issues the interviews covered:

- Awareness of supervised driving requirements, including required number of hours of practice and conditions for those hours (e.g., at night);
- The degree to which parents approve or disapprove of these requirements;
- The degree to which parents consider these requirements to be sufficient (i.e., whether parents believe that more (or less) practice hours are necessary for teens to become safe drivers);
- How and whether parents kept track of their teen's driving practice;
- How much practice teens received during the permit stage; and
- Perceptions among parents about the degree to which supervised driving requirements are enforced by licensing agencies.

A professional survey research organization with extensive experience doing transportation-related surveys conducted telephone interviews. Households were sampled randomly from a list of households in each State projected by Survey Sampling, Inc. to have one or more teenagers 15 to 17 years old. Interviewers first asked to speak with the parent of a teenager. Screening questions ensured that the household included a teenager who: (1) was either 16 or 17 years old (or 15 in South Carolina); (2) had a license to drive unsupervised; and (3) had lived continuously in the State since obtaining his/her learner's permit. If more than one teenager in the household fit these criteria, the interviewer asked the parent to respond to the questions with respect to the youngest of these teens. To ensure that the parent who participated in the interview was familiar with the teen's driving experience during the learner stage, the interviewer asked to speak with the parent who conducted most of the teen's supervision. At the conclusion of the interview the interviewer thanked the respondent and asked permission for a researcher to contact the respondent within the next few weeks for a follow-up interview.

A total of 510 parents were interviewed (at least 100 in each State). The overall response rate among qualifying households was 40%. State-specific response rates were 58% in Minnesota, 48% in Ohio, 46% in Maryland, 39% in Washington, and 27% in South Carolina. The series of questions to identify a qualified household in South

Carolina was particularly complex and may have discouraged more parents from agreeing than in the other States.

Respondent Characteristics

Sixty-three percent of interviews were conducted with mothers. Thirty-six percent were conducted with fathers and 1% with grandparents. Respondents were most likely to describe the area where they lived as a medium size town (40%), followed by a small town (27%), country (18%), or large city (14%). Parents' descriptions of where they lived differed by State. Those in Maryland and Washington were more likely to report living in medium to large cities compared to parents living in Minnesota, Ohio, and South Carolina ($\chi^2 = 35.94$, $df = 12$, $p < .001$).

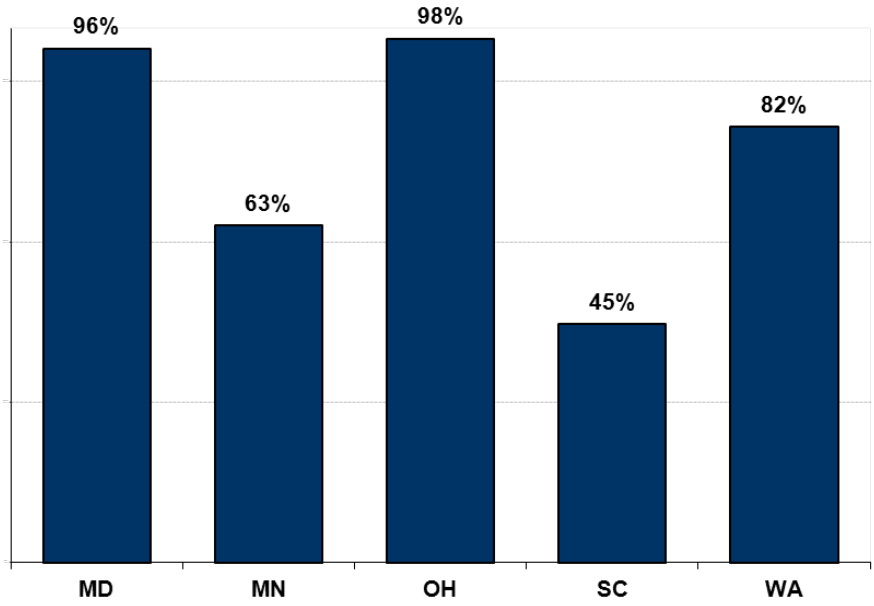
Of the teens who were discussed in the interviews, 54% were male. The sex of teens did not differ significantly across States ($\chi^2 = 7.49$, $df = 1$, $p = .11$). The mean age of teens at the time of the interview was 16.61 years. This differed significantly across States ($F = 10.32$, $df = 1, 4$ $p < .001$). The State with the oldest teens was Maryland, at 16.87 years. South Carolina had the youngest teens, at 16.38 years. This was not unexpected, given that Maryland has the highest minimum age for the restricted license among the 5 States (16 years, 3 months) and South Carolina has the lowest minimum age (15 years, 6 months).

Awareness of Supervised Hours Requirements

Parents were asked several questions about their awareness of their State's supervised hours requirements. Figure 6 shows responses to the question: "Was [he/she] supposed to complete a certain number of hours driving with an adult before [he/she] could get a regular driver's license?"

Figure 6

Percent of Parents who Believe a Certain Number of Hours of Supervised Driving is Required for Novice Drivers by State

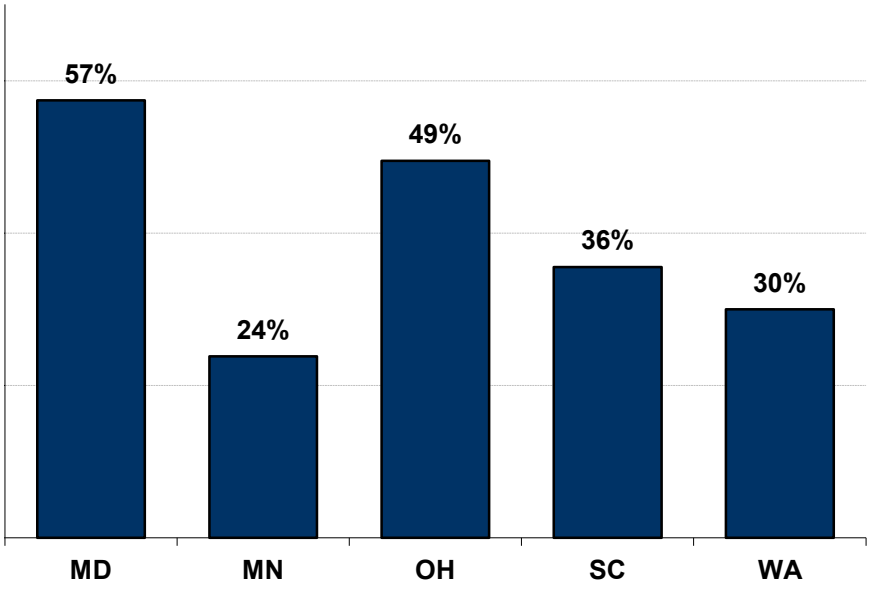


Overall, 77% of parents believed there was an hours-of-supervision requirement. Thirteen percent said there was no requirement, and 10% did not know whether there was a requirement. However, as shown in the figure, parental awareness of the requirement varied widely across States (χ^2 = 124.50, *df* = 4, $p < .001$). In two States – Maryland and Ohio – awareness was nearly universal. By contrast, fewer than half of parents in South Carolina believed there was a requirement.

Parents who were aware of, or thought there was, a requirement for hours of supervised driving were asked how many hours were required. Figure 7 shows the percentage of parents – among those who believed there is an hours-of-supervision requirement – who knew the correct number of hours required by State.

Figure 7

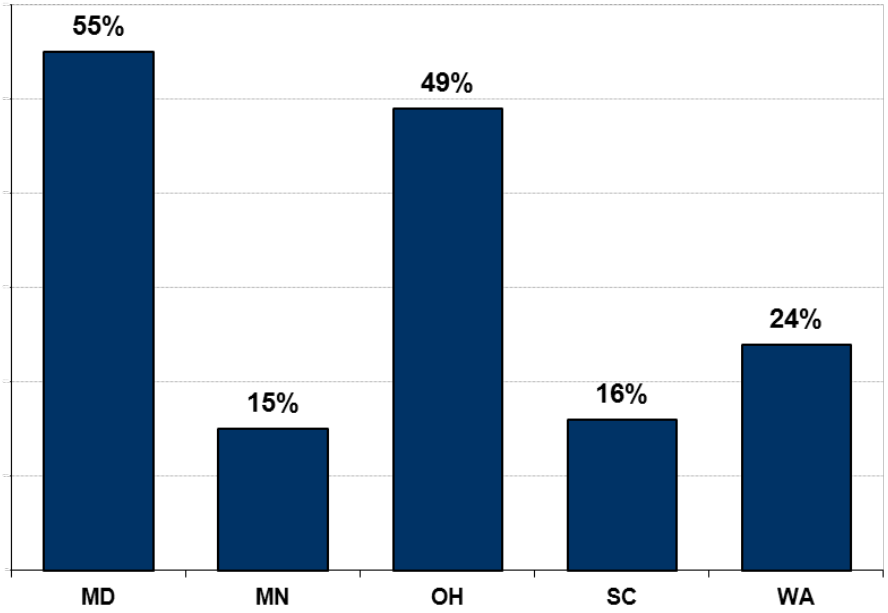
Percent of Parents Who Know Correct Number Among Those Who Believe a Certain Number of Hours of Supervised Driving Is Required



Awareness of the correct number of hours was substantially lower than awareness that there was *some* requirement. Combining those who did not know there was a requirement with those who did not know the correct number, though they believed there was a requirement, indicates that parental awareness of supervised driving requirements is generally quite low (see Figure 8).

Figure 8

Percent of Parents who Know Number of Required Hours for Supervised Driving for Novice Teen Drivers by State

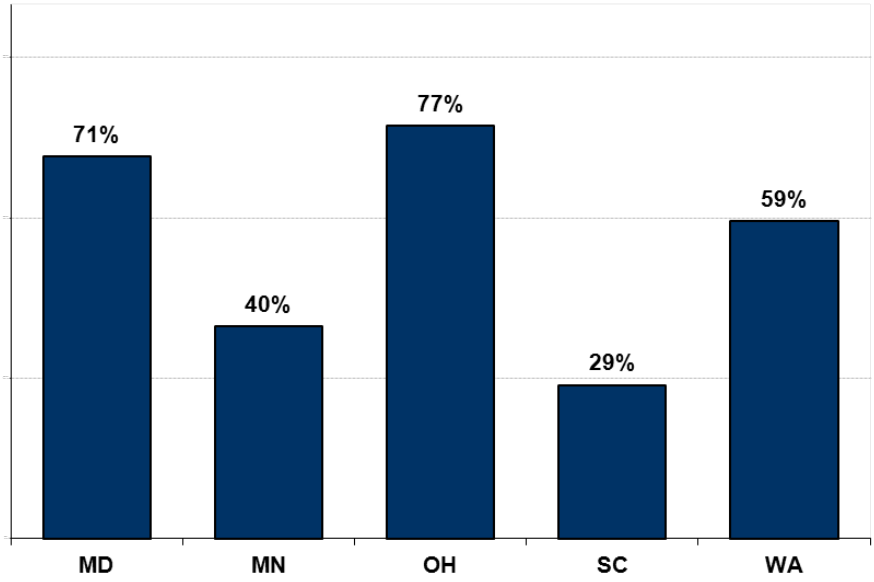


Overall, only 32% of all parents knew the correct number of hours of supervision their teen was required to obtain. In 3 of the 5 States, detailed knowledge was extremely low. Once again, the difference between States was highly significant (χ^2 = 66.99, *df* = 4, *p* < .001). The information shown in Figures 6 to 8 indicates a clear and systematic difference between Maryland and Ohio compared to the other States. Not only do nearly all parents know there is a supervision requirement, among those who believe there is a requirement, parents in Maryland and Ohio are also more likely to know the correct number of hours. This strongly suggests that there are systems, procedures, or programs in place in these two States that do a far better job of alerting parents to this particular requirement. Nonetheless, it is noteworthy that even in Maryland and Ohio, only about half of all parents could accurately report the number of hours required.

Parents were also asked whether their teen was supposed to complete a certain number of hours driving at night. Each of the States requires 10 hours of supervision at night. Figure 9 shows the percentage of parents in each State who believed there was a night-driving requirement.

Figure 9

Percent of Parents who Believe a Certain Number of Hours of Supervised Driving is Required at Night for Novice Drivers by State

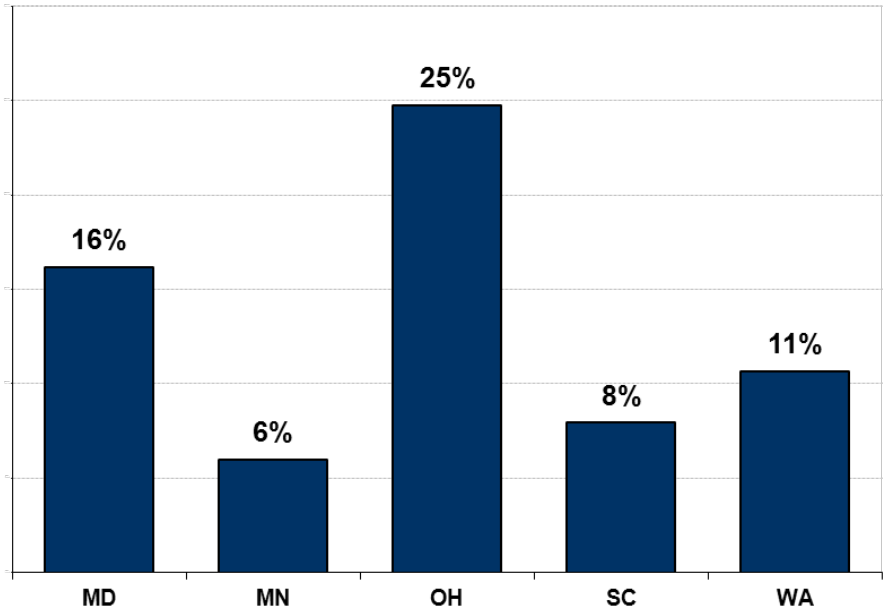


Overall, 55% of parents believed there was a requirement for the teen to drive a certain number of hours at night. Once again, however, awareness of the night requirement differed significantly across States (χ^2 = 69.41, *df* = 4, $p < .001$). More than 70% of parents were aware of the night requirement in Maryland or Ohio, compared to fewer than 30% of parents in South Carolina.

Figure 10 shows the percentage of parents knew the correct number of hours that teens were required to obtain at night.

Figure 10

Percent of Parents who Know Correct Number of Required Hours for Supervised Driving at Night by State



Overall, only 13% of parents knew the correct number of hours that their teens were required to drive at night. Although this differed significantly by State (χ^2 = 20.22, *df* = 4, $p < .001$), no more than 25% of parents in any State knew the correct number of hours that their teens were required to drive at night.

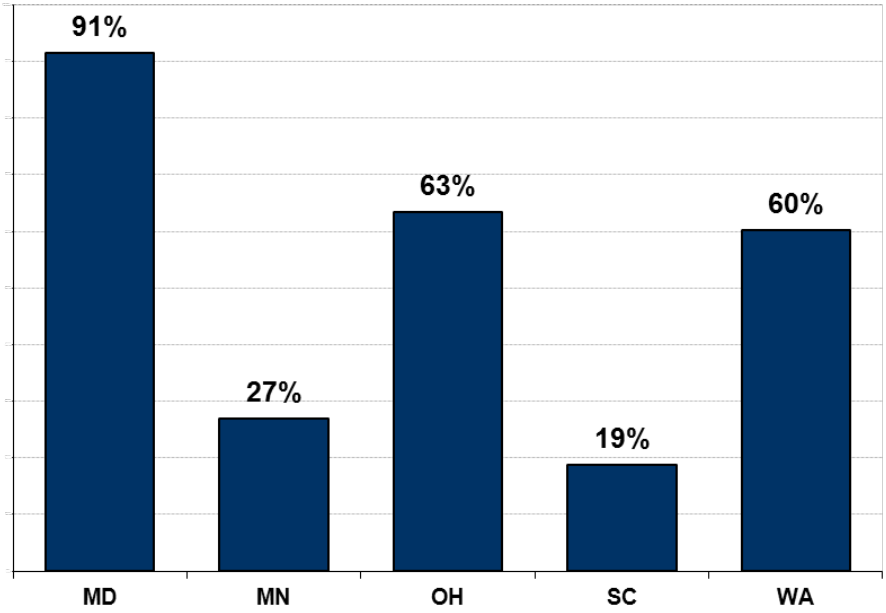
Amount of Supervised Driving Practice Teens Obtain

Several questions during the interview focused on how much supervised driving practice teens accumulated during the learner stage. Unfortunately, this kind of information is difficult to obtain accurately. Individuals are not particularly good at estimating time spent driving over a period of time. Complicating that task in the present case is that interviews were conducted with parents whose teenagers had already held their license for up to 12 months at the time of the interview (or 18 months in South Carolina). Hence, problems with recall, or recall bias, were certainly present.

Overall, 73% of parents said they tried to keep track of the number of hours their teenagers spent driving during the learner period. Half (52%) said they kept written records or logs (see Figure 11).

Figure 11

Percent of Parents who Report Using a Written Record or Log by State



Differences between States were highly significant (χ^2 = 143.10, *df* = 4, *p* < .001). Maryland requires the parents of beginning teenage drivers to keep a log. The log is provided at the time the teen obtains a permit and must be turned in to the MVA when applying for a license. Hence, it comes as little surprise that 91% of parents in Maryland

reported using logs to keep track of their teens' driving. A majority of parents in Ohio (63%) and Washington (60%) also reported keeping logs. In Ohio a log is not required, but the temporary license packet provided to teens and their parents at the licensing office when they apply for their permit includes an affidavit that must be signed by the parent and notarized, certifying that the teen has obtained 50 hours of supervised driving practice. In Washington, a log is provided online along with the parental authorization affidavit.

Even among those who had kept records, when asked how many hours their teenagers drove while supervised 65% reported they did not know. We examined reports of the amount of supervised driving provided by those parents who were willing to offer answers. These estimates ranged widely, from 20 to 500 hours, emphasizing the estimated nature of this information. Additional detailed analyses suggested that these data were not sufficiently reliable to merit reporting.

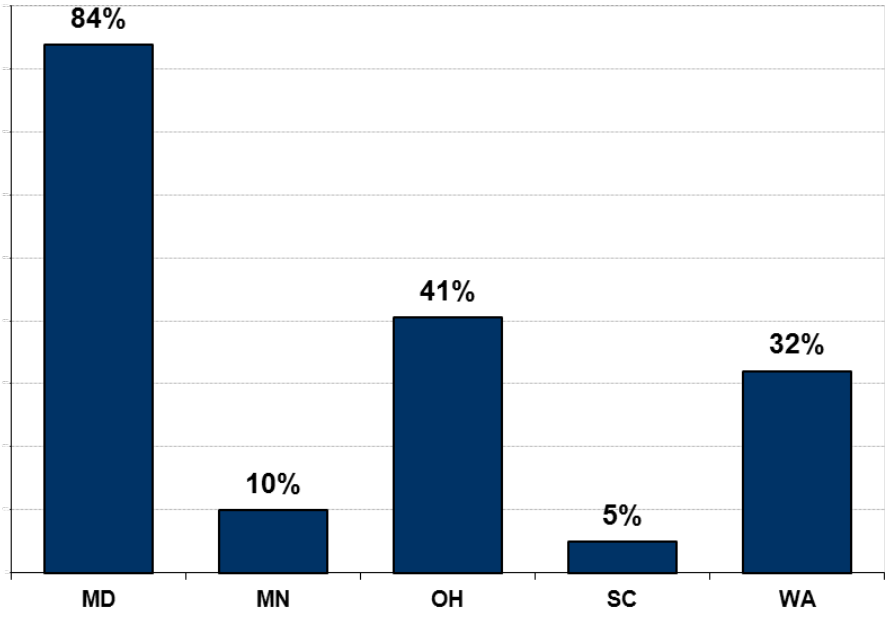
Finally, parents were asked the following question: "How hard was it for you and your teen to find the time to complete the required number of hours?" Among parents who knew the correct number of required hours for their States, only 5% said it was "very hard" to find time to complete the hours. Another 28% of parents said it was "somewhat hard," while 67% said "not at all hard." Since awareness of the correct number of hours was very low for most States, responses on this item were not broken out by State.

Perceptions of Enforcement of Supervised Driving Requirements by Licensing Agencies

Several questions in the interview focused on parents' perceptions of whether (and how) the licensing agencies in their States enforce the requirements for supervised driving. First, parents were asked whether their States required them to keep logs to record the number of hours their teens drove during the permit stage (see Figure 12).

Figure 12

Percent of Parents who Report They Were Required to Keep a Log by State



Overall, 35% of parents reported they were required to keep logs. Once again, the difference between States was highly significant (χ^2 = 180.00, *df* = 4, p < .001). Most parents in Maryland reported this requirement, whereas almost no parents in Minnesota or South Carolina believed this. As mentioned previously, Maryland is the only one of the 5 States that requires parents to keep logs. In light of this, it is somewhat surprising that roughly a third of parents in Ohio and Washington reported that a log was required. In both States, logs are made available to parents to help keep track of hours. However, it appears some parents did not realize the log was optional.

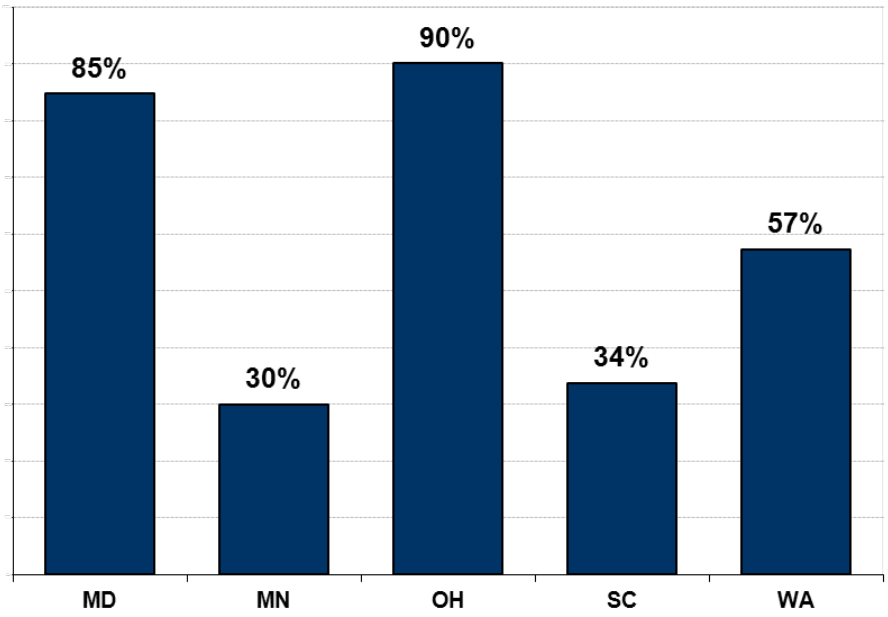
Those parents who said their States required logs were asked whether they were required to turn in the logs when their teens obtained their licenses. In Maryland, 73% of

these parents reported that they were required to turn in the logs. This suggests that not all licensing offices in Maryland may have been diligent in collecting driving logs from parents.

Parents were also asked whether they were required to sign forms stating that their teens had completed the required number of hours of supervised driving. Figure 13 shows the percentage of parents who said they were required to sign a form.

Figure 13

Percent of Parents who Report They Were Required to Sign a Form by State



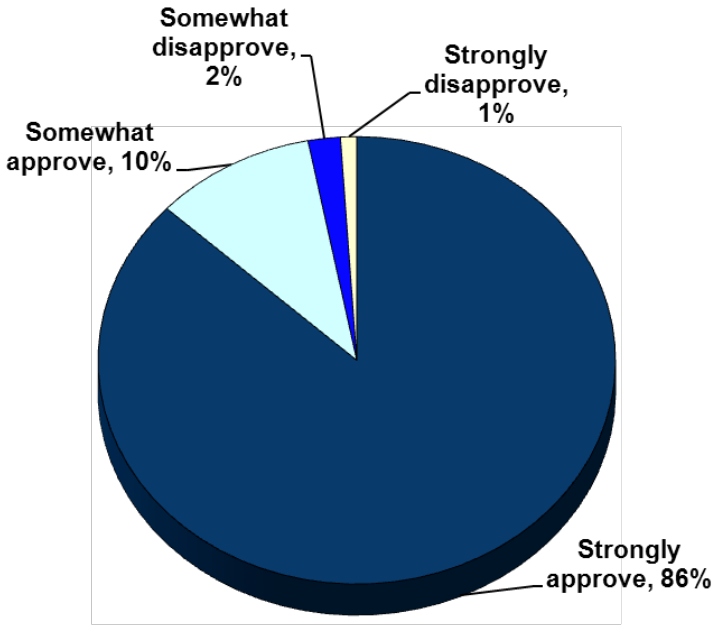
Fifty-nine percent of parents said they were required to sign a form stating that their teens had completed the required number of hours of supervised driving. The difference between States was highly significant (χ^2 = 131.30, *df* = 4, $p < .001$). Each of the 5 States requires an affidavit signed by a parent or guardian. Most parents in Maryland and Ohio reported that they signed a form, compared to just over half of parents in Washington and only a third of parents in Minnesota and South Carolina. If parents in these latter States are in fact signing affidavits at the licensing offices, as States currently require, it appears that many are not aware of what they are signing.

Approval of Supervised Driving Requirements

One goal of the study was to determine the degree to which parents approve of supervised driving requirements and what parents who have recently supervised beginning teen drivers believe those requirements should be. As shown in Figure 14, approval is quite high for requiring teens to drive a certain number of supervised hours before they can obtain licenses that allow independent driving.

Figure 14

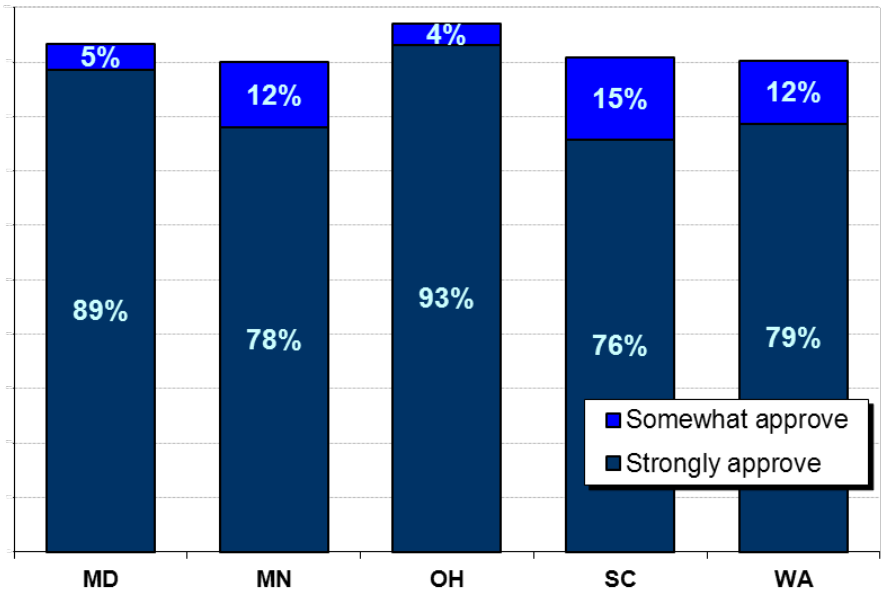
Percent of Parents who Approve of Requiring Teenage Drivers to Obtain a Certain Number of Hours of Supervised Driving



Overall, 86% of parents said they “strongly approve” of hours requirements, and there was almost no disapproval of supervised hours requirements. Approval of the requirement was high in all 5 States (see Figure 15). The only apparent variation was in the extent to which parents approved strongly.

Figure 15

Percent of Parents who Approve of Requiring Teenage Drivers to Obtain a Certain Number of Hours of Supervised Driving by State

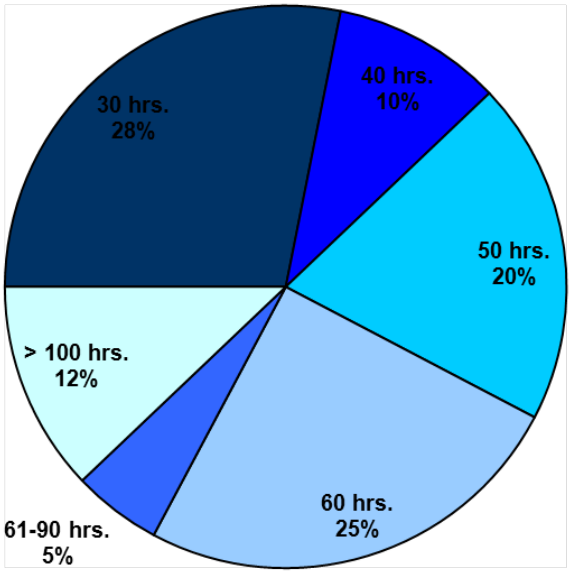


A series of questions was asked to determine how many hours of supervised driving parents thought were sufficient to result in a teen being ready to drive unsupervised. First, they were asked "In your opinion, are teens who have gotten 30 hours of driving experience with an adult in the car ready to drive safely on their own?"[7] Those who said teens were not ready after 30 hours of driving experience were asked whether 40 hours was adequate. Subsequent questions asked about 50 hours then 60 hours of driving experience, stopping when a level was reached that the parent thought was sufficient. Those who believed that 60 hours were still not sufficient were asked the open-ended question: "How many hours would you say *are* enough?" Figure 16 shows the number of hours of driving experience that parents believe are needed before teens are ready for independent driving.

[7] For those who responded, "It depends on the teen," interviewers clarified that the question referred to: "most teens generally."

Figure 16

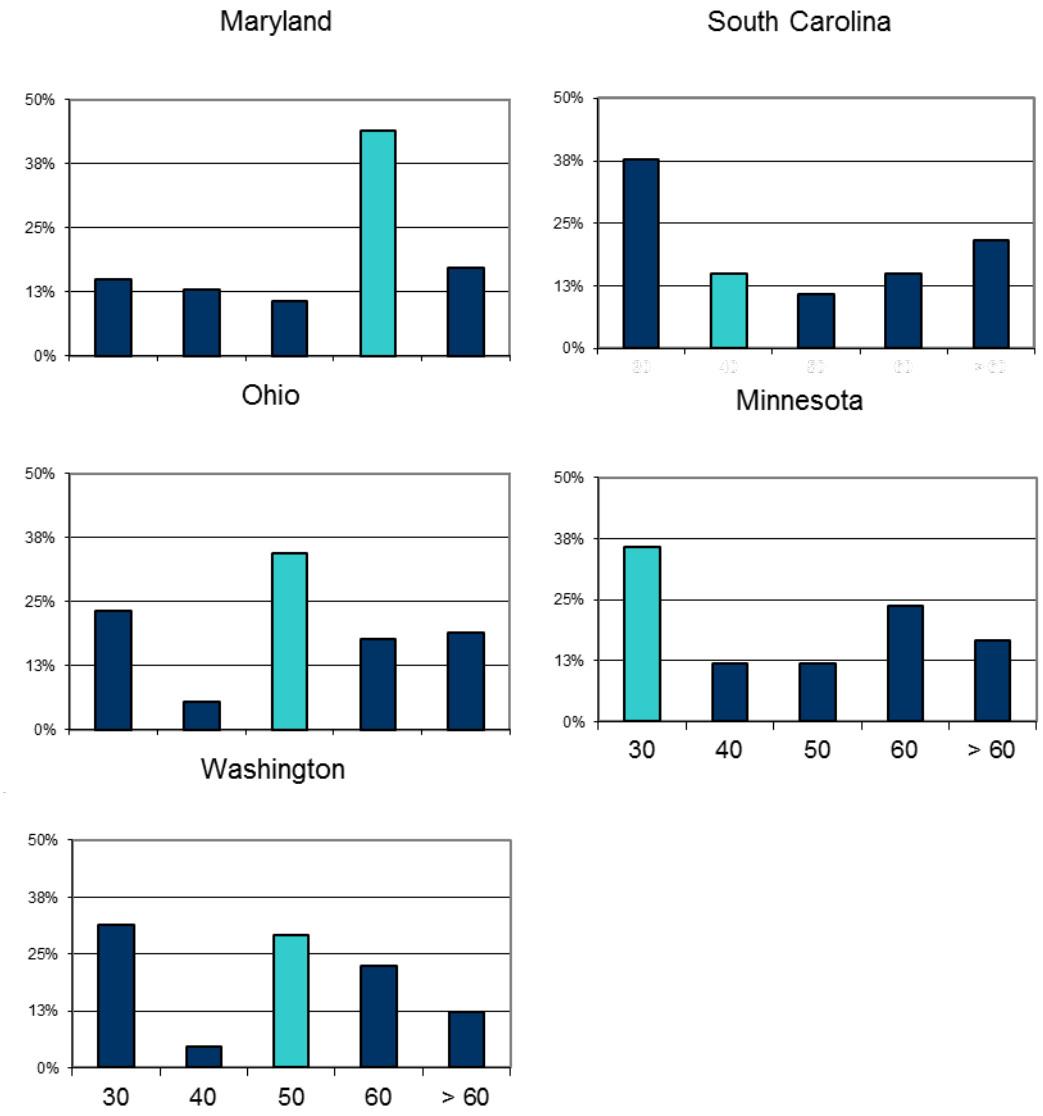
Hours of Driving Experience Parents Believe are Needed Before Teens are Ready to Drive Safely on Their Own



Across all States, the mean number of hours that parents considered to be adequate was 56 (median = 50). However, the most commonly selected number of hours was 30, followed by 60. The number of hours that parents consider to be adequate appears to be influenced by individual State requirements. Figure 17 shows the percentage of parents in each State who reported that they believe various numbers of required hours are sufficient. The bar corresponding to what the State required is shown in light blue.

Figure 17

Number of Hours of Driving Experience Parents Believe Are Needed Before Teens Are Ready to Drive Safety on Their Own by State



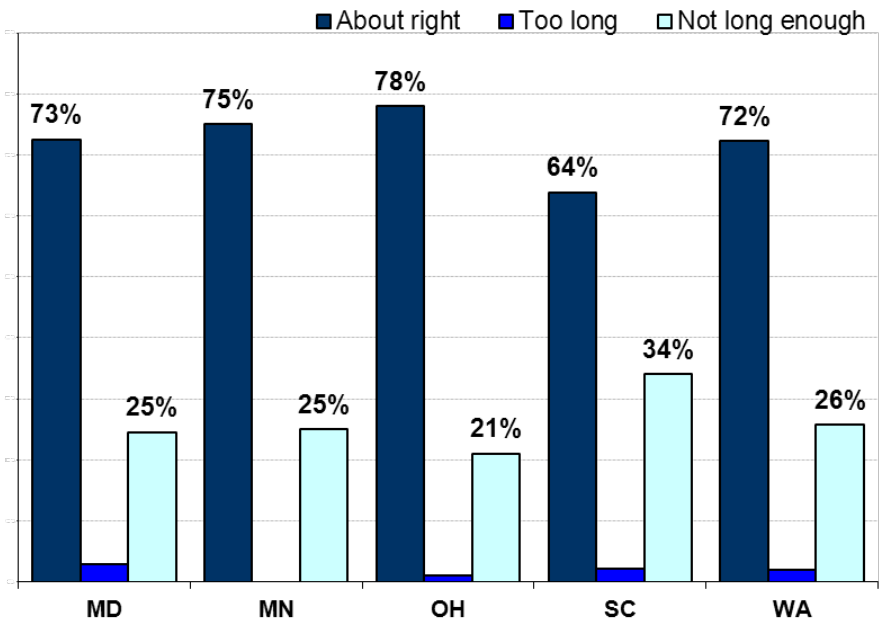
In Maryland, which requires 60 hours of supervised driving during the learner stage, the modal response was 60 hours. The modal response in Ohio was the same as the requirement – 50 hours. The distribution in Washington, which also requires 50 hours of supervised driving, was bi-modal, concentrating at either 50 or 30 hours. In both Minnesota and South Carolina, 30 hours was by far the most common response. Minnesota requires 30 hours of supervised driving, whereas South Carolina requires 40 hours. The similarity of findings in these States may simply reflect a tendency to agree with the first option offered to respondents. However, among parents in Minnesota who

knew the number of hours required (30), a substantial majority (70%) said that was enough.

Each of the 5 States has a mandatory holding period of 6 months for the learner's permit. To probe parents' opinion of the length of the learner stage, we asked the following question: "[State] requires teens to have a learner's permit for 6 months before they can apply for a license to drive without an adult in the car. Do you think 6 months is about right, too long, or not long enough?" Responses to this question are shown in Figure 18.

Figure 18

Parent Opinion of a Six Month Requirement for the Learner Stage by State



Overall, 72% of parents reported that a 6-month learner stage is "about right." It is noteworthy that 26% reported that 6 months was "not long enough" whereas almost nobody (2%) said it was "too long." Responses did not differ meaningfully by State (χ^2 = 8.03, *df* = 4, *p* = .43).

Those parents who said that 6 months was not long enough were asked a follow-up, open-ended question: "How many months do you think teens should be required to have

a permit before they can apply for a regular license?" By far the most common response was 12 months, mentioned by 74% of these parents.

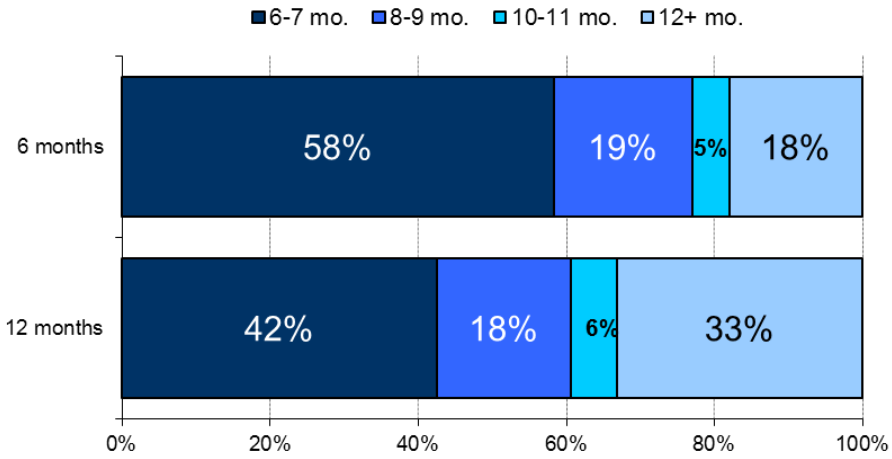
Analysis by Length of Time to Complete Learner Stage Requirements

Although each of the States has a mandatory holding period of 6 months, some only allow 6 months to get the required 6 months and required hours practice, prior to the earliest possible licensing age. Others allow 12 months during which teens can amass the required 6 months and required number of hours. This is important because the latter provides more time to obtain the required hours of supervision. Hence, a follow-up analysis compared States that allow only 6 months to complete learner stage requirements (Maryland, Ohio, and South Carolina) with States that allow 12 months (Minnesota and Washington).

As might be expected, teens held their permits for a longer period of time in States that allow 12 months to complete the requirements compared to States that allow just 6 months (8.8 months vs. 7.8 months; $t = 4.48$, $df = 4$, $p < .001$). Figure 19 shows that in States where teens had 12 months to accumulate supervised driving, far fewer held the permits for the minimum (Somer's $d_{yx} = .21$, $p < .001$). There were no other differences between the 6-month and 12-month groups in responses to any other questions, including how difficult parents felt it was to complete the required hours in the specified time.

Figure 19

Duration Teens Held Learner Permit by Period State Allows Between Minimum Ages for Learner and Intermediate license



Unstructured interviews

To gain insight into parents' interpretation of supervision requirements and to learn how they dealt with the varying requirements and supporting guidance provided by the States, unstructured interviews were conducted with a sub-sample of parents who completed the structured interviews. Of the parents who completed the structured interviews, the majority (range 63% to 73%) agreed to be contacted for follow-up interviews. At least 10 parents were randomly sampled from each State.

The unstructured interviews with parents examined:

- What parents tried to accomplish during the learner stage;
- The difficulties parents faced in providing supervision and how these affected the type and amount of supervision;
- How parents learned about supervised practice requirements;
- Parents' understanding of the rationale for required hours practice;
- How and whether parents kept track of their teen's driving practice;
- Whether the supervised driving requirement affected how and when teens obtained practice;
- Procedures parents encountered at licensing offices for certifying that teens had completed the required number hours of practice;
- How parents decided when their teen was ready to obtain a license to drive unsupervised; and
- Overall thoughts about their experience and advice for other parents.

Respondent Characteristics

Of the 510 parents who participated in the structured interview, 343 agreed to be contacted to complete the follow-up unstructured interview. Of the parents contacted, 5 subsequently refused to participate. A total of 56 unstructured interviews were conducted with parents who previously completed the structured interviews. Sixty-six percent of interviews were conducted with mothers and the remaining 34% of interviews were conducted with fathers. Of the teens who were discussed in the interviews, 55% were male. As shown in Table 11, we conducted interviews with some parents who reported that they were aware of their States' supervised driving requirement and others who were not.

Table 11

Unstructured Interview Respondents' Awareness of Supervised Driving Requirement by State

Aware of Requirement	MD (*n* = 10)	MN (n = 10)	OH (n = 12)	SC (n = 13)	WA (n = 11)
Yes	9	5	11	9	8
No	1	5	1	4	3

What Parents Tried to Accomplish During the Learner Stage

One of the topics discussed with parents was whether they had things they wanted to accomplish with their son or daughter during the learner period and, if so, what those were. The majority of parents mentioned they wanted to make sure their teens had exposure to a variety of driving situations and roadways before they drove on their own. Several specifically noted that they wanted their teens to get experience driving on interstates and highways. Many parents also stated they wanted to make sure their teens had practice driving at night and in different weather conditions (such as ice and snow); however, some parents explicitly mentioned that a 6-month permit phase was too short because it did not take into account daylight savings time or provide opportunities for teens to get driving practice in all seasons and weather conditions. Depending on the location and time of year, a 6-month period may provide few opportunities other than weekends for beginning drivers to practice during daylight hours; in other cases, obtaining practice during darkness could require waiting until 10 p.m. Parents who were aware of the supervised driving requirements reported that they wanted to complete the hourly driving requirement, but no clear indications emerged from the discussions regarding how the requirement influenced the ways they went about teaching their teens to drive.

Parents' Opinions Concerning Mandated Hours of Supervision

In an effort to understand the reasons that parents so strongly approve of the requirement for teens to amass a certain amount of supervised driving, this issue was discussed as part of the unstructured interviews. Because some parents did not know their State's required number, the interviewer mentioned this number in a matter-of-fact manner when bringing up the issue. Although we anticipated that a variety of issues

might be mentioned, parents' responses invariably focused on the *number* of hours required rather than on difficulties the requirement created or the perceived appropriateness of such mandates. Opinions varied as a function of the States' specific requirements. In South Carolina, the majority of parents mentioned that they thought that 30 hours practice was not enough and more hours should be required. In addition, many parents mentioned that teens are allowed to get their licenses too early in South Carolina (where an intermediate license can be obtained at age 15 ½).

There was no consensus in opinion among parents in Minnesota regarding the supervised driving requirement. About half of the parents in Minnesota thought the 30-hour requirement was sufficient and the other half thought it was inadequate and recommended that the State require anywhere from 50 to 200 hours. Likewise, In Ohio and Washington approximately half of the parents reported that 50 hours of supervised driving was appropriate and the other half thought it was not enough. There was much more agreement among parents in Maryland. The majority of parents in Maryland reported that 60 hours was a reasonable requirement, but most said that more practice would be even better.

Regardless of their opinions about their States' specific hourly requirements, parents in all 5 States broadly agreed that learning to drive is an individual process, mentioning in a variety of ways that each teenager has unique needs. Many parents reported that it was hard to say how many hours were enough because "all teens are different." A parent in Washington said, "Putting guidelines in place is not enough. Ultimately they have to prove they can drive well." Some parents also stated that no number of hours would be enough because 16-year-olds are "just too young to drive." Several indicated awareness of the recent reports that adolescent brains have not yet fully developed (cite Giedd), so no number of hours was considered sufficient. Similarly, a Maryland parent stated, "Sixty hours doesn't make teens safer drivers, just because they are teens."

How Parents Decided When Their Teens Were Ready to Obtain Licenses

When queried about how they decided when their teens were ready to get licenses, parents did not mention the hourly driving requirement as a deciding factor. Although they reported that they wanted to ensure their teens completed the required hours, they did not assume that indicated their teens were ready to get licenses. Rather, they tended

to base the decision on their teen's individual driving skills and demeanor while driving (e.g., comfortable, timid, overly confident). The majority of parents reported that they allowed them to get licenses when they felt "comfortable" with their teens' driving skills and demeanor. However, some parents prefaced this with the comment that they would never feel completely comfortable with their teens driving on their own, although they acknowledged that the teens would only become better drivers through experience.

Feasibility of Completing Supervised Driving Requirements

One of the issues discussed with parents was the ease or difficulty of, and barriers to, spending many hours supervising their teens' driving. Across all States, the vast majority of parents said it was not difficult to complete the driving practice. Parents commonly reported that they fit driving practice into their normal daily routines. Many mentioned that they let their teens drive every time they were in the car. Most parents also reported that they had a few specific sessions for their teens to practice specific skills, such as parking, or to practice in particular road/weather conditions. A few parents who lived in small towns said it was hard to complete the number of required hours because the places they usually drive are not very far away. These parents reported having to take special trips or letting their teens drive a lot on family vacations in order to meet the requirements.

How Parents Learned About Supervised Practice Requirements

In view of the low awareness of supervised driving requirements in some of the States, we talked with parents how they had learned about these requirements to see whether there are variations in how States acquaint parents with the requirement. Among parents who knew about the requirements, the majority reported that they obtained information either from the driver-licensing bureau or through their teens' driver education courses. However, a number of differences were noted between States. In South Carolina, where awareness was quite low, parents' responses were more varied and included other parents, their teens, the Internet, driver education instructors, and from the Department of Motor Vehicles when their teens received their learner's permits as sources of information about the requirement.

In Minnesota, all of the parents reported that they learned about the supervised driving requirements from their teens' driver education program. This is most likely due to the

fact that driver education is required for all teens in Minnesota before they can receive learner's permits. Conversely, in the other States there are various requirements concerning the sequence to obtain a learner's permit and completing driver education. In South Carolina, Maryland, and Ohio a teen can receive a permit before completing driver education. In Washington a teen can receive a permit either concurrently with driver education or prior to completing driver education.

In Washington, parents reported that they found out about the hourly requirement either from the Washington State Department of Licensing or their teens' driver education programs.[8] Similarly, in Ohio parents were split equally in whether they found out about the requirement from the teens' driver education program or from the Bureau of Motor Vehicles. In Maryland, the majority of parents said they found out about the requirement from the Motor Vehicle Administration when their teens received their learner's permits.

Parents' Understanding of the Rationale for Required Hours Practice

An important question is how parents interpret State requirements for a particular number of hours supervised driving. In the structured interviews, there was a tendency for parents to view the number required number of hours in their State as sufficient to produce a safe driver. Accordingly we explored this issue with parents by asking why they thought there was such a requirement, how it came about, etc. Few parents were certain about why their State had a particular hourly requirement. Most said they thought there must have been some type of scientific evidence showing that a certain amount of driving practice would make teens safer drivers and reduce crashes. Parents also reported that they thought supervised driving was required because teens do not get enough driving practice during driver education courses.

How Parents Kept Track of Their Teens' Driving Practice

Discussions also focused on whether, and if so how, parents tried to keep track of the amount of practice their teens obtained. In South Carolina, the majority of parents reported that they did not keep track of the number of hours their teens drove. However, half of the parents mentioned that if a State is going to require a certain amount of

[8] This parallels the two paths to licensure in Washington, as discussed above. A teen who is enrolled in a driver education class can get a learner permit at age 15. Those not enrolled in a driver education class can get a permit when they are 15½ or older and then must take driver's education before receiving an intermediate license.

supervised driving, then there should be a system in place – such as the mandatory use of a log – to verify the hours are completed. Similarly, in Minnesota the majority of parents said they did not write down the number of hours their teens drove. Given the low awareness of the supervised driving requirement in South Carolina and Minnesota, it comes as little surprise that few parents in these States kept track of their teens' driving.

In Washington, approximately half of the parents reported that they kept logs of their teens driving. Parents were most likely to report using logs as part of their teens' driver education courses. These parents reported that the driver education instructors sent home driving logs and assigned different driving practice tasks each week. Parents in Washington also thought teens should be required to turn in logs showing the driving hours had been completed.

The majority of parents interviewed in Ohio reported that they used logs to keep track of their teens' hours. This is interesting given the fact the Ohio Bureau of Motor Vehicles does not require a log to be turned in. However, several parents noted that the licensing office encourages parents to complete logs and some parents reported that they thought they would be required to submit them to the licensing agency for their teens to obtain licenses. One parent said, "They [licensing office representative] recommended that we keep a log and they went over the specifics on how to keep track of the hours."

In Maryland, most parents reported that they kept track of their teens' driving practice because they were required to turn in logs when their teens applied for intermediate licenses. They also reported that when their teens received a learner permit the parent was given a driving log with instructions for completing the supervised driving requirement.

In almost every State, a couple of parents mentioned that they kept track and recorded their teens driving hours in a logbook in order for their teens to qualify for insurance discounts. State Farm's *Steer Clear* Program was mentioned repeatedly as the reason they kept logs.

Among the parents who used logs to keep track of their teens driving hours, the vast majority reported that it was not difficult. Many stated they kept the logs in the glove

compartment and their teens filled out the logs immediately after each trip. Some parents reported that they filled out the logs on a weekly basis. A few parents reported that it was difficult to record the hours because the teens drove with different parents in different automobiles or that they kept the logs at their houses and often forget to fill them out.

Overall Thoughts About Their Experience and Advice for Other Parents

A theme among all parents was that they were surprised about how little teens know about driving, especially the many aspects of driving that seem to come naturally to parents as experienced drivers. As a parent in Washington said, “An unconscious response is a sign of a good driver that teens do not initially possess.” Parents noted that teens lack the ability to – or at least don’t – anticipate the actions of others, instead assuming that other drivers will drive properly (e.g., stop at stop signs and red lights, not back into them in a parking lot). Numerous parents emphasized that the only way for teens to gain this type of awareness and automatic response is through “practice, practice, practice.”

Licensing Bureau Interviews

To assess how supervised driving requirements are administered and enforced by licensing agencies, UNC/HSRC held informal conversations with a representative in each of the 5 States where parents were interviewed. Research team members posing as either a parent of a teenager, or a teenager, contacted bureau representatives and asked questions pertaining to licensing requirements for beginning teenage drivers. In Minnesota, Ohio, and Washington the representatives were at local offices and in South Carolina and Maryland the representatives were at central call centers. In Maryland, the telephone number for the central call is the only number that is made publicly available. In South Carolina we called a local office but were then prompted by a voice messaging system to contact the central call center for a detailed inquiry.

These interviews focused on:

- How supervised driving requirements are conveyed to parents and/or teenagers;
- Procedures at licensing offices for certifying that teens have completed the required hours of practice;
- Recommendations to parents/teenagers who report they have not kept track of the number of supervised hours a teen has acquired.

Results

Licensing bureau employees were first asked about requirements for a teenager to get a license. In all of the States, the licensing representatives indicated that a learner permit must be held for a required time period. However, with the exception of Maryland, none of the licensing representatives mentioned that the teen needed to complete a specific number of hours of supervised driving during the permit phase. In Maryland, the representative explained that 60 hours of supervised driving had to be completed with a parent and 10 of those hours had to be completed at night.

In each of the States other than Maryland, the interviewer probed further to see if the agency represented knew about the supervised hours requirement by saying, “I’ve heard there is some type of hourly driving requirement for teens before they can get a license.” In Minnesota, the representative gave the correct number of hours after being prompted. In South Carolina, the representative said she was unsure, then looked up the requirements and shared the correct information with the interviewer. In Ohio and

Washington, the representatives mentioned the hourly behind-the-wheel training requirement that must be completed as part of the States' driver education curriculum, but they did not mention the supervised driving requirement. In these cases, the interviewer probed further by saying, "I've heard that parents are supposed to complete a certain number of hours of driving practice with their teen before the teen can get a license." After this last probe, the representative in Ohio stated the correct number of day and nighttime hours. In Washington the representative said, "I think it's 50," but she did not mention the nighttime driving requirement.

After establishing that supervised hours were required, representatives were asked whether any forms had to be signed regarding this requirement. In all of the States, the licensing bureau representatives reported that a form had to be signed by the parent certifying the supervised driving hours had been completed. In Maryland, the only State that requires a driving log, the representative also stated that a log had to be completed and signed by a parent certifying that the hours were completed.

Finally, the caller told the licensing bureau representative that she had not kept track of the hours of supervision. In Maryland, the representative said that the log had to be completed and signed by the parent. She said that it must include the date, along with the start and end time for each driving session. She stated, "The log shows that you get the experience that you need to actually prepare you for a driver's license." She then offered to mail the log to the caller. In all of the other States, the representatives told the interviewer that as long as the parent thought the teen had completed the hours then they just had to sign the affidavit. In Washington the representative mentioned that, "We just don't question you."

DISCUSSION AND CONCLUSIONS

This is the first study to investigate the independent effect of mandating a specific number of hours of supervised driving during the learner stage of GDL. Overall, the national database analyses failed to find evidence that a 30- to 60-hour supervised driving State requirement affects crash rates for teenagers once they begin driving without supervision. This conclusion is supported by an analysis of fatal crash involvement by 16- and 17-year-old drivers from all 50 States and an interrupted time-series analysis of teen driver crashes in Minnesota following a new requirement for minimum hours of supervised driving in that State. Interviews with parents in 5 States that require a range of 30 to 60 supervised hours suggest that not many parents are aware of their State's supervised driving requirement, few understand specific driving activities the parents should accomplish during the supervision, and many believe teens need more practice and a longer time before they become fully licensed. Only one State verifies the number of supervised driving hours and requires parents to turn in a completed log.

Crash Analyses

A cross-sectional comparison of fatal crash rates throughout the United States examined whether crash rates were related to State's supervised practice requirements. This pooled cross-sectional time series analysis carefully controlled for the possible effects of other elements of States' young driver licensing systems, other traffic safety laws, and other factors such as population and general economic conditions to isolate the possible effect of mandated hours of supervision. This national analysis did not find any fatal crash effects among 16- and 17-year-old drivers by differing required amounts of supervision.

There are limits to the usefulness of national analyses of traffic safety regulations, especially those as complex as GDL. The national analysis only examined fatal crash data. Although fatal crashes seem to be responsive to the overall effects of graduated licensing systems, they represent a very small subset of all young-driver crashes. For these reasons, the effects of changed supervised driving requirements in individual States were also examined.

The most direct evidence concerning whether a supervised-hours requirement influences crashes comes from Minnesota. In 1999, Minnesota introduced a new requirement that teens obtain 30 hours supervised practice during the learner stage of GDL, plus an additional 10 hours in the intermediate phase for a total of 40 hours supervised practice. This requirement was implemented independent of any other changes to the State's GDL system. An interrupted time-series analysis did not find a significant change in the crash rates of either 16- or 17-year-old drivers after Minnesota implemented the new supervised driving requirement. The interview data provide a possible explanation for this finding. Parents who had recently been through the process of licensing a teenage driver in Minnesota were largely unaware of the requirement that they supervise their teen's driving for any period of time, and even fewer – just 15% – knew the requirement was 30 hours.[9] Moreover, in the unstructured interviews, none mentioned the additional 10 hours they were supposed to provide during the intermediate license period. It is not possible to know whether there might have been an effect for this requirement had it been more effectively communicated to the parents of new teenage drivers and parents recorded the amount of supervised driving their teen accomplished.

Unfortunately, for a series of reasons, the findings from the State analyses in Illinois, South Carolina, Virginia, and Pennsylvania cannot be interpreted as providing even suggestive evidence about the effect of adding a requirement for hours of supervision.

Parental Knowledge, Understanding and Beliefs

Telephone interviews with parents of newly licensed teenage drivers in 5 States with varying supervised driving requirements examined their awareness, approval, and behaviors in response to these requirements. Parental knowledge of State requirements for supervised driving varied widely among the 5 States. Generally, awareness of the hours requirement appeared largely dependent on the mechanisms within each State to inform parents about, and encourage them to comply with, the requirement. For example, in Maryland, licensing agency representatives are careful to draw attention to the requirement and that a parent is required to turn in a log. The result is that nearly every parent interviewed (96%) knew of the requirement. Ohio provides a similarly

[9] It is important to keep in mind that these interviews were conducted in 2008, with parents of teens who had obtained unrestricted licenses during the preceding year. Awareness of the 30-hour requirement may have been different during the period more closely following its introduction in 1999.

successful approach to ensuring that parents know that they are required to provide a specified amount of supervision. Although a driving log is not required, it is made clear to parents when their teens obtain learner permits that the parents will be expected to certify, with a notarized affidavit, that the teens have obtained the required amount of supervised driving. Agency representatives explain to parents that the only way they can know this has been accomplished is by keeping a log, and a sample is provided. Not surprisingly, 98% of parents are aware of the hours requirement.

By contrast, parents in Minnesota and South Carolina are merely asked to affirm – at the licensing office when the teen returns to obtain an intermediate license – that they have done the required amount of supervised driving. They are not provided with a log or encouraged to keep track of hours. Moreover, our conversations with personnel at licensing offices suggest the message about the requirement is unclear and sometimes contradictory. It is not surprising that parents are confused about what they are expected to do and about the States' seriousness about the requirement.

It is noteworthy that even in Maryland and Ohio, where nearly all parents realized there was a supervised hours requirement, only about half could accurately report the number of hours required. This may suggest that regulatory concern with details about the exact number of hours to be required, or whether a certain number of these hours must be done at night or in other settings, may be futile. It was clear from the unstructured interviews that parents focused less on the number of hours practice being obtained, and more on how their teenager was doing with the myriad driving tasks and conditions that the parents could observe. Few allowed their teens to obtain licenses, regardless of the number of hours of driving amassed, if they did not believe they were sufficiently accomplished drivers to begin driving on their own. Nearly all parents mentioned a belief that their teenagers just needed to do a lot of driving to obtain plenty of experience, and they seemed to have a general plan to accomplish this.

Findings

It appears that getting the word clearly and effectively to parents about supervised hours requirements is far more challenging than many States have realized. Few, if any, States other than Maryland require a log to be kept and submitted. Even in Maryland, barely

half of parents know the actual number of hours required. Accordingly, it is unlikely that awareness is better in States that do not include a verification log.

It is important to bear in mind that lack of awareness by parents is not necessarily the only, or the most important factor explaining the lack of evidence for an influence of mandated hours-of-supervision on crashes. Despite lack of awareness of specific hour mandates, parents reported providing a substantial amount of supervision during the unstructured interviews conducted for this study, as well as in other studies (Waller et al., 2000; Goodwin et al., 2006). Having obtained a particular number of hours driving while supervised may simply be insufficient to influence crash rates. None of the amounts currently required in the United States are based on evidence showing that subsequent crash risk is lower if they are amassed. The largest number required by any State – 60 – may not be enough to influence subsequent crash risk.[10]

Several Australian States now require 120 hours of supervision (Senserrick, 2007). This requirement appears to be based on findings from Gregersen (1997), who reported that an average of 118 hours supervised practice was associated with lower crash rates among Swedish teenagers. However, given the study design, it was not possible to determine whether the lower rate was the result of the extensive practice or the self-selection of study participants. Thus, at least two questions remain: (1) does any amount of supervised driving translate into subsequent lower crash risk for teenage drivers and (2) if so, does mandating this amount for a population of novice drivers produce a populationwide reduction in crashes, given that full compliance cannot be expected? The present study suggests the answer to the second is no, at least for requirements of up to 60 hours of supervision. It also clearly indicates that an effect is unlikely for any mandated amount of practice in the absence of more effective mechanisms to ensure that parents (and teens) know about such a requirement.

An additional issue that merits consideration is whether the type, rather than the amount, of supervised driving experience teenagers are currently obtaining is optimal for reducing young driver crashes once they begin driving unsupervised. Perhaps the

[10] Although Oregon requires 100 hours of supervised practice, it allows discounting to 50 hours for those teens who take driver education courses. This type of time discount has been shown to be counterproductive in several studies (Hirsch, Maag & Laberge-Nadeau, 2006; Mayhew et al., 2003), though it appears not to have had that effect in Oregon (Raymond et al., 2007).

mandated amounts would be adequate if the required time were spent more productively. The possibility that obtained practice is of less than optimal form probably does not explain the lack of effect on crashes found in the present study. States' failure to effectively promote awareness of the requirements presently in place would have precluded the opportunity to stimulate particularly useful kinds of supervision as well as activities that may have been less useful. Nonetheless, the nature and quality, as well as amount of supervision, merits attention. There is intense interest about this issue within the young driver research community, but at present there appear to be no data – or guiding theoretical principles – to suggest the type of supervised experience that may be necessary or even useful.

State requirements for teens to obtain some supervised driving at night represent a small step toward encouraging novices to obtain supervised experience in a variety of conditions. There are several dimensions in addition to night-day (light-darkness) along which driving varies that are probably also important. In principle, the ideal would be for beginning drivers to experience the full range of driving conditions they will deal with when they begin driving without supervision – on two-lane rural roads, during inclement weather, in fast- and slow-moving rush hour traffic. Ideally, this principle would extend to the varying conditions within the vehicle as well, such as distractions caused by multiple occupants, or by dealing with the radio, climate controls or MP3 players. The need for experience handling such detailed conditions cannot realistically be specified as part of licensing requirements, but they could be recommended to parents as part of what they should provide in their role as supervisors. Although there is no direct evidence to suggest that providing these experiences would produce an effect, encouraging a wide variety of experience while supervised, with the full range of conditions to be experienced by licensed drivers, is consistent with the general principle upon which supervised driving is encouraged or required – novice drivers clearly do learn through experience (Mayhew, Pak, & Simpson, 2003).

Two States considered here provide good examples of how to ensure awareness of a requirement. Neither, however, provides a model for ensuring parents know, remember, or attend to the details of such a requirement. Information obtained from the parent interviews suggests a possible alternate approach to ensuring – or at least more effectively encouraging – parents to provide beginning teenage drivers with adequate

experience before they begin driving unsupervised: Adopt a significantly extended (i.e., 9-month or 12-month) learner stage.

Although it seems like a long time, a 6-month learner period limits opportunities for parents to provide their teens with experience in certain driving conditions. Several parents mentioned difficulties they experienced that result from the learner period lasting only 6 months. A clear example of how this can occur would be a teenager living in a State with harsh winter driving conditions who obtains a learner permit in the springtime. This leaves no opportunity for the teen to drive on snowy, icy roads or difficult winter light conditions during the learner period. The reverse also can be problematic. Extensive inclement weather during the winter months limits the time available for highly inexperienced teens to begin driving in relatively benign conditions. Another example mentioned by parents is that in some States it is unrealistic for teens to obtain much supervised driving at night if their learner permit only covers late spring and summer when it may not be dark until 9 p.m. or later. And again, the reverse can be problematic. Teens in some northern States who obtain permits in the late fall have substantially diminished opportunity to practice driving under daylight conditions, especially in locations where persistent overcast skies commonly exacerbate early sunset times during winter months. In these locations, weekends may provide the only feasible driving opportunity for many.

Although it is within the purview of parents to overcome barriers like those mentioned, and some will marshal the resources to do so, expecting this from all families is contrary to the principles of GDL. One of the clear benefits of GDL, in the eyes of parents, is that it provides a structure that supports what they want to accomplish, rather than imposing barriers. Simply extending the learner period to 12 months would substantially reduce the difficulties parents report from misalignment of the learner period with the seasonal flow of life. Extending the learner period beyond 6 months may have other benefits as well, inducing greater amounts of driving and – if structured carefully – resulting in a cohort of intermediate license drivers who are somewhat older and more emotionally mature as they begin driving unsupervised (Williams, 2009).

There appears to be movement toward extending learner periods. In the past few years, Illinois and Maryland have moved to a 9-month learner period. Kansas has implemented

a 12-month learner period, joining 6 other States. Surveys of parents suggest that support for a full-year permit is high (Foss, 2007), and the present findings are generally consistent with this. Although the majority of parents were satisfied that 6 months was long enough, about a quarter reported that 12 months would be more appropriate. Moreover, less than half of teens held their permits the minimum 6 months required, with about a quarter holding them for 12 months or longer. In Minnesota, 57% of parents indicated that their teens held the learner permits for 9 months or longer, perhaps reflecting a perceived need for greater driving experience with the seasonal variations in roadway and lighting conditions that are found in far northern States.

One of the concerns about mandating a certain number of hours of supervision is that it may be interpreted by parents as sufficient rather than the minimum acceptable. There was some evidence from interviews that parents do indeed interpret mandates this way. Parents generally believed that the number of hours their States required was sufficient for teens to become safe drivers, regardless of whether the requirement was 30 or 60 hours, or something in between. Those who participated in the unstructured interviews generally seemed to believe that such requirements are based on some kind of evidence. Nonetheless, the parents we talked with seem not to have been particularly concerned about a specific amount of driving practice, focusing instead on their own assessment of how well their teens were driving. Most were quite alert to the fact that teenagers vary widely in their demeanor, abilities, and learning rates and they seemed to focus on those rather than on the formal requirements of the licensing process. With respect specifically to hours of supervision, many appeared initially to pay some attention to the amount until they realized their teens were likely to easily exceed the requirement. In sum, even though parents may believe the hours-of-supervision requirement represents an objective level that should produce accomplished drivers, this does not override their consideration of their own teenagers' driving abilities and demeanors.

Study Limitations

The results of national analyses of traffic safety regulations that involve fitting complex statistical models to multifaceted programs like GDL should be interpreted cautiously. The primary concern with such analyses is whether fitting models to cross-sectional data can adequately identify effects to be found with interventions (cf., Hauer, 2002). Several

studies have reported effects of the central elements of GDL systems (Baker et al., 2006; Dee et al., 2005, Morrisey et al., 2006). The analytic approach used here was particularly powerful with the ability to examine changes over time as part of the complex model-fitting but it was unable to find an association between fatal crash involvement by young teenage drivers and mandated hours of supervised driving.

An important consideration in interpreting the national analysis reported here and elsewhere, is that these analyses necessarily include assumptions, some of which are inconsistent with how young driver licensing occurs. There is no way, for example, to verify in almost every State that young drivers actually get the specified number of supervised driving hours, whether it be 30 hours or 60 hours or somewhere in between. Most parents are unaware of the requirements. When conducting multijurisdiction analyses of programs that differ from State to State it is not possible to represent the multiple ways in which a system may influence teenagers. For example, some States require teenagers to complete formal driver education classes prior to applying for learner permits, whereas others allow learner permits prior to or in conjunction with enrollment in driver education. The former approach can produce a delay in the age at which many teenagers obtain learner permits, effectively increasing the minimum licensing age beyond that specified by statute. The series of requirements and practical barriers that initial licensing entails may create a real effect that is not specified in the licensing statute. Some of these effects may influence teenagers' driving exposure and resultant crash risk, but they cannot be incorporated in complex statistical models. Single State analyses generally address such *de facto* elements of young driver licensing systems more effectively.

Another assumption upon which multijurisdiction analyses must be based is that all new drivers proceed through the licensing steps as prescribed, beginning at the earliest possible age, spending the minimum time at each level and not taking advantage of the many allowed exemptions (younger driving age if driving only to school; exemption from passenger and night restrictions on certain kinds of trips, etc.). This is clearly at variance with the ways in which many teens approach the licensing process. Representation of reality of even the main elements of GDL systems in multivariable models is crude at best. For the analyses conducted in the present study, we made extensive efforts to minimize problems like this by including numerous interactions to allow for varying

operation of GDL elements within individual age groups, single jurisdictions, and single time periods. Typically, this is not done in such analyses.

In a few States, ARIMA interrupted time series analysis was used to estimate the effect of hours-of-supervision requirements on crashes because of its ability to avoid many of the complications of multijurisdiction analyses. There are constraints on this approach as well. The most significant is that ARIMA analysis cannot isolate the effects of interventions that occur in close temporal proximity. This presents particular difficulties for estimating the effects of young driver licensing policies. Many States have paid substantial attention to young driver licensing in recent years, first introducing some version of GDL, and then making numerous changes to fine-tune the system. Among the States considered in the present study, Virginia was the most active, revising their licensing system 5 times between July 1995 and July 2003. The pattern of legislative activity also prevented definitive analysis of whether mandated hours of practice influenced young driver crashes in Maryland and Ohio where awareness of the requirement was high. Maryland simultaneously increased both the duration of the learner period and the required amount of supervised driving in 1999 and again in 2005. Ohio added both a 6-month mandatory learner period and a 50-hour supervision requirement at the same time, in 1999.

Needed Research

The present study suggests States can ensure parents know about required hours of supervision and encourage their recordation and completion. It remains unclear, however, whether this has any effect on crash rates. The ideal opportunity to examine this question would be for a State that does not presently have a requirement for hours of supervised driving to enact one. To provide the best chance of identifying an effect, should one exist, this would occur at least two years after any other meaningful change in the young driver licensing system and not be followed by additional changes for another two years or longer. Finally, the system would need to be structured in such a way that parents and teens are highly likely to be aware of the requirement, understand the details and be motivated to comply.

Another approach is to obtain data in those few States that either began requiring, or substantially increased the number of hours of supervised driving independent of other changes. While crash data were not readily available for analysis in this study, they may be available later. Such an analysis could provide useful information if the State's requirements are better known by parents and teens.

Additional research is needed about how parents can be persuaded to ensure that their teenager obtains substantial practice in driving conditions that may not occur in the family's daily routine. One option for accomplishing this is through an extended, full year learner permit period. Another might be through requiring parents to attend a pre-licensing meeting during which they are instructed with the important aspects of their role in their teen's driver licensing experience. Some States have both of these approaches in place and it seems likely that more States will be adopting one or both approaches, potentially establishing opportunities to examine their effectiveness.

Conclusion

Parents with whom we talked were broadly in favor of beginning teenage drivers obtaining extensive amounts of supervised driving experience and of requirements to encourage this. They strongly endorsed their States' requirement – regardless of how much or how little it involved. They expressed little concern about being required to do this and said they found the time to do the required supervision. They generally thought that more hours than mandated were needed and they believed States should be more proactive in efforts to ensure that parents provide the amount of supervision their teenagers need and gather documentation such as a driving log. Finally, whenever graduated licensing legislation is discussed, usually there is discussion of whether States ought to be telling parents how to deal with their children, this "issue of principle" was never mentioned during the unstructured interviews, even when parents were given a clear opportunity raise such concerns.

Among the 5 States where parents were interviewed, the licensing agencies success in familiarizing parents with mandated hours of supervision was not good. Even among the two States where awareness of the requirement was quite high, knowledge of the actual number of hours required was limited.

REFERENCES

AAA Foundation for Traffic Safety. (2007, February). Nationwide Review of Graduated Driver Licensing. .Washington, DC: Available at www.aaafoundation.org/pdf/NationwideReviewOfGDL.pdf .

Advocates for Highway and Auto Safety. (2009). Graduated Driver Licensing. Washington, DC:. Available at www.saferoads.org/graduated-driver-licensing

American Academy of Pediatrics. (2006). The Teen Driver. *Pediatrics*, 118, 2570-2581.

American Association of Motor Vehicle Administrators. (1999, December). Comparative Data: State and Provincial Licensing Systems. Washington, DC.

Baker, S.P., Chen, L-H., & Li, G. (2006). *National evaluation of graduated driver licensing programs*. (Report No. DOT HS 810 614). Washington, DC: National Highway Traffic Safety Administration. Available at www.nhtsa.gov/staticfiles/DOT/NHTSA/Communication%20&%20Consumer%20Information/GDL_6-20-2006.pdf .

Bernat, D. H., Dunsmuir, W. T. M., & Wagenaar, A. C. (2004). Effects of lowering the legal BAC to 0.08 on single-vehicle-nighttime fatal traffic crashes in 19 jurisdictions. *Accident Analysis & Prevention*, *36*, 1089-1097.

Brockwell, P., & Davis, R. (2002). Introduction to Time Series and Forecasting. New York: Springer-Verlag.

National Center for Injury Prevention and Control. (2009). Web-based injury statistics query and reporting system. Atlanta, GA: Centers for Disease Control and Prevention. Available at www.cdc.gov/ncipc/wisqars/ .

Chen, L-H., Baker, S. P., Braver, E. R., & Li, G. (2000). Carrying passengers as a risk factor for crashes fatal to 16- and 17-year-old drivers. *Journal of the American Medical Association*, *283*, 1578-1582.

Dang, J. N. (2008). *Statistical analysis of alcohol-related driving trends, 1982-2005*. (Report No. DOT HS 810 942). Washington, DC: National Highway Traffic Safety Administration.

Dee, T. (2001). Does setting limits save lives? The case of 0.08 BAC laws. *Journal of Policy Analysis and Management*, *20*, 111–28.

Dee, T., Grabowski, D., & Morrisey, M. (2005). Graduated driver licensing and teen traffic fatalities. *Journal of Health Economics, 24*, 571–89.

Federal Highway Administration. (1967 to 1996). Driver License Administration Requirements and Fees. Washington, DC. Federal Highway Administration.

Ferguson, S. A., Teoh, E. R., & McCartt, A. T. (2007). Progress in teenage crash risk during the last decade. *Journal of Safety Research, 38*, 137-145.

Foss R. D. (2007). Improving graduated driver licensing systems: A conceptual approach and its implications. *Journal of Safety Research; 38*(2):185-192.

Freeman, D. G. (2007). Drunk driving legislation and traffic fatalities: New evidence on BAC 08 laws. *Contemporary Economic Policy, 25*, 293-308.

Goodwin, A., Foss, R., Sohn, J., & Mayhew, D. (2007). *A guide for reducing collisions involving young drivers*. Washington, DC: Transportation Research Board. Available at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v19.pdf .

Goodwin, A. H., Waller, M. W., Foss, R. D., & Margolis, L. H. (2006). Parental supervision of teenage drivers in a graduated licensing system. *Traffic Injury Prevention, 7*, 224-231.

Gregersen, N. P. (1997). *Evaluation of 16-years age limit for driver training*. VTI Report 418A. Linköping, Sweden: Swedish National Road and Transport Research Institute.

Gregersen, N. P., Berg, H-Y, Engstrom, I., Nolen, S., Nyberg, A., & Rimmo, P. (2000). Sixteen years age limit for learner drivers in Sweden – An evaluation of safety effects. *Accident Analysis & Prevention, 32*, 25-35.

Hauer, E. (2002). *Observational before-after studies in road safety*. New York: Pergamon Press (Elsevier).

Hedlund, J. H., Ulmer, R. G., & Preusser, D. F. (2001). *Determine why there are fewer young alcohol impaired drivers*.(Report No. DOT HS 809 348). Washington, DC: National Highway Traffic Safety Administration.

Hirsch, P., Maag, Y., & Laberge-Nadeau, C. (2006). The role of driver education in the licensing process in Quebec. *Traffic Injury Prevention, 7*,130-142.

Insurance Institute for Highway Safety (2006). *Unreliability of FHWA licensure data causes institute to stop use*. Arlington, VA . Available at www.iihs.org/externaldata/srdata/docs/sr4105.pdf .

Insurance Institute for Highway Safety. (2007, November). GDL Effective Dates. Excel spreadsheet obtained from the institute.

Insurance Institute for Highway Safety. (2009). *U.S. licensing systems for young drivers: Laws as of June 2009*. Arlington, VA. Available at www.iihs.org/laws/pdf/us_licensing_systems.pdf .

Liu, L. (2006). *Time series analysis and forecasting.* (2nd ed.). Villa Park, IL: Scientific Computing Associates Corp.

Lovenheim, M. F., & Slemrod, J. (2008). The fatal toll of driving to drink: The effect of minimum legal drinking age evasion on traffic fatalities. Unpublished manuscript available at www.stanford.edu/~mlovenhe/Alcohol.pdf .

Mayhew, D. R., Simpson, H. M., Desmond, K., & Williams, A. F. (2002, August). Specific and long-term effects of Nova Scotia's graduated licensing program. *Traffic Injury Prevention, 4*, 91-97. Available at www.tirf.ca/publications/PDF_publications/grad_licensing_Nova_Scotia.pdf .

Mayhew, D. R., Simpson, H. M., & Pak, A. (2003). Changes in collision rates among novice drivers during the first months of driving. *Accident Analysis & Prevention, 35*, 683-691.

McCartt, A. T., Shabanova, V. I., & Leaf, W. A. (2003). Driving experience, crashes, and traffic citations of teenage beginning drivers. *Accident Analysis & Prevention, 35*, 311-320.

McCleary, R., & Hay, R. A. (1980). *Applied time series analysis for the social sciences*. Newbury Park, CA: Sage Publications.

McCullagh, P., & Nelder, J. A. (1989). *Generalized linear models*. New York: Chapman & Hall.

McDowall, D., McCleary, R., Meidinger, E. E., & Hay, R. A., Jr. (1980). *Interrupted time series analysis*. Beverly Hills, CA: Sage Publications.

Morrisey, M. A., Grabowski, D. C., Dee, T. S. & Campbell, C. (2006). The strength of graduated drivers license programs and fatalities among teen drivers and passengers. *Accident Analysis & Prevention, 38*,135–141.

National Conference of State Legislatures. (2004, July). State .08 BAC laws. Accessed February 2009: www.ncsl.org/programs/transportation/bac08.htm.

NHTSA. (2008a). Traffic Safety Facts, 2007 Data: Young Drivers. (Report No. DOT HS 811 001). Washington, DC: National Highway Traffic Safety Administration. Available at http://www-nrd.nhtsa.dot.gov/Pubs/811001.PDF .

NHTSA. (2008b, January). Traffic Safety Facts, Laws: Graduated Driver Licensing System. (Report No. DOT HS 810 888W). Washington, DC: National Highway Traffic Safety Administration. Available at: www.nhtsa.gov/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/810888.pdf .

Raymond, P., Johns, M., Golembiewski, G., Seifert, R. F., Nichols, J. & Knoblauch, R. (2007, September). *Evaluation of Oregon's graduated driver licensing program*. (Report No. DOT HS 810 830). Washington DC: National Highway Traffic Safety Administration. Available at www.oregon.gov/ODOT/TS/docs/DE/OR_GDL_Study07.pdf?ga=t .

Senserrick, T. M. (2007). Recent developments in young driver education, training and licensing in Australia. *Journal of Safety Research, 38*, 237-244.

Shope, J. T. (2007). Graduated driver licensing: Evaluation results since 2002. *Journal of Safety Research, 38*, 165-175.

Simons-Morton, B., & Ouimet, M. C. (2006). Parent involvement in novice teen driving: A review of the literature. *Injury Prevention, 12*(Suppl I), i30-i37.

Twisk, D. A. M., & Stacey, C. (2007). Trends in young driver risk and countermeasures in European countries. *Journal of Safety Research, 38*, 245-257.

U.S. Bureau of Labor Statistics. Local Area Unemployment Statistics. Accessed via the Graphical Economy Tool at blogmybrain.com/2008/08/04/the-graphical-economy-tool.

U.S. Census Bureau. 1990 to 1999 Annual Time Series of State Population Estimates by Age and Sex: 1990 to 1999 Accessed February 19, 2009: www.census.gov/popest/archives/1990s.

U.S. Census Bureau. Historical Annual Time Series of State Population Estimates and Demographic Components of Change: 1980 to 1990, by Single Year of Age and Sex. Accessed February 19, 2009: www.census.gov/popest/archives/1980s.

U.S. Census Bureau. State Interim Population Projections by Age and Sex: 2004 – 2030: Detailed Data Files: File 3. Annual projections by single year of age. Accessed February 19, 2009: www.census.gov/population/www/projections/projectionsagesex.

U.S. Census Bureau. State Single Year of Age and Sex Population Estimates: April 1, 2000 to July 1, 2007 – RESIDENT. Accessed February 19, 2009: www.census.gov/popest/datasets.

Wagenaar, A. C., & Maldonado-Molina, M. M. (2007). Effects of drivers' license suspension policies on alcohol-related crash involvement: Long-term follow-up in forty-six States. *Alcoholism: Clinical and Experimental Research, 31*, 1399-1406.

Wagenaar, A. C., Maldonado-Molina, M. M., Erickson, D. J., Ma, L., Tobler, A. L., & Komro, K. A. (2007). General deterrence effects of U.S. statutory DUI fine and jail penalties: Long-term follow-up in 32 States. *Accident Analysis & Prevention, 39*, 982-994.

Wagenaar, A. C., Maldonado-Molina, M. M., Ma, L., Tobler, A. L., & Komro, K. A. (2007). Effects of legal BAC limits on fatal crash involvement: Analyses of 28 States from 1976 through 2002. *Journal of Safety Research, 38*, 493-499.

Wagenaar, A. C., O'Malley, P. M., & LaFond, C. (2001). Lowered legal blood alcohol limits for young drivers: Effects on drinking, driving, and driving-after-drinking behaviors in 30 States. *American Journal of Public Health, 91*, 801-804.

Waller, P. F., Olk, M. L., & Shope, J. T. (2000). Parental views of and experience with Michigan's graduated licensing program. *Journal of Safety Research, 31*, 9-15.

Williams, A. F. (2009). Licensing age and teenage driver crashes: A review of the evidence. *Traffic Injury Prevention, 10*(1), 9-15.

Williams, A. F., Nelson, L. A., & Leaf, W. A. (2002). Responses of teenagers to California's graduated licensing system. *Accident Analysis & Prevention, 34*, 835-842.

Williams, A. F., Preusser, D. F., Ferguson, S. A., & Ulmer, R. G. (1997). Analysis of the fatal crash involvements of 15-year-old drivers. *Journal of Safety Research, 28*, 49-54.

Zador, P. L., Lund, A. K., Fields, M., & Weinberg, K. (1989). Fatal crash involvement and laws against alcohol-impaired driving. *Journal of Public Health Policy, 10*, 467-485.

APPENDIX A

Identification of details of coded State traffic safety laws

Coding of the GDL components from 1994 to 2007 was based largely on historical documentation of changes in State teen licensing laws maintained by the Insurance Institute for Highway Safety (IIHS; November 2007) and coding used in the AAA Foundation for Traffic Safety *Nationwide Review of Graduated Driver Licensing* (AAAFTS; 2007, February). Coding of teen licensing requirements prior to 1994 was largely collected from a series of reports published from 1967 to 1996 by the Federal Highway Administration called *Driver License Administration Requirements and Fees* (FHWA, 1967, 1968, 1970, 1972, 1974, 1976, 1978, 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996), along with a report titled *Comparative Data: State and Provincial Licensing Systems* (American Association of Motor Vehicle Administrators, 1999). The information in these reports was also compared to that from the IIHS and AAAFTS databases where possible to insure consistency across these sources. Discrepancies in the information between sources were resolved by examining State vehicle codes, chaptered bills, statutes, and regulations, along with searches of other published reports on teen licensing laws, historical news articles, and contacts with State legislative and licensing officials.

Coding of other traffic safety laws was based on reconciling existing coding obtained from several different sources, updating the coding where necessary to extend the time period to 2007, and adding coding for Alaska, Hawaii, and the District of Columbia. Coding for State maximum speed limits, safety belt laws, zero tolerance alcohol laws, BAC *per se* alcohol limits, and administrative license suspension/revocation for the years 1982-2006 as used in prior publications by Dee (Dee, 2001; Dee, Grabowski, & Morrisey, 2005). The Dee coding was compared with another independent source of coding for these laws plus that for statutory minimum legal drinking ages from 1980-2004 used by Freeman (2007). Coding for minimum State legal drinking ages from 1967 to 2004, including adjustments for grandfathering during the implementation of these laws, was obtained from Lovenheim (Lovenheim & Slemrod, 2008). Independent coding based on primary research of State statutes from 1976 to 2002 that included coding for BAC per se limits, administrative license suspension/revocation, and other alcohol-related laws, as used in several recent studies was obtained from Wagenaar

(Wagenaar & Maldonado-Molina, 2007; Wagenaar, Maldonado-Molina, Erickson, Ma, Tobler, & Komro, 2007; Wagenaar, Maldonado-Molina, Ma, Tobler, & Komro, 2007).

The secondary sources of coding detailed above were compared with each other and further checked against a number of other available compilations of laws including Bernat, Dunsmuir, and Wagenaar (2004), Dang (2008), Hedlund, Ulmer, and Preusser (2001), Wagenaar, O'Malley, and LaFond (2001), Zador, Lund, Fields, and Weinberg (1989), the Web site for the National Conference of State Legislatures (2004), and the Web site for IIHS. Where pre-existing coding was not available (e.g., for Alaska, Hawaii, and Washington D.C., and for all States in 2007) or where there were differences among the various sources, the quarters were coded based on examination of State vehicle codes, chaptered bills, statutes, and regulations, along with searches of other published reports on licensing laws, historical news articles, and contacts with State legislative and licensing officials.

Reconciled coding from Dee and Freeman was used for speed limit laws, safety belt laws, and zero-tolerance laws in the analyses. The minimum legal drinking age coding from Lovenheim and Slemrod was chosen over the other sources because it took into consideration the grandfathering of these laws when they were implemented and would therefore be more accurate than simply using statutory minimum legal drinking ages. The coding provided by Wagenaar for BAC per se limits and administrative license suspension/revocation was based on primary review of State statutes by a legal team, and was therefore deemed to be most desirable to use in the analyses. As with GDL elements, a law was considered to be in effect during an entire quarter if it was in effect for at least two of the three months during the quarter (+/- up to 5 days).

DOT HS 811 550
March 2012

U.S. Department of Transportation
National Highway Traffic Safel
Administration

8356-030912-v1