Preliminary Evaluation of the North Carolina Graduated Driver Licensing System:

Effects on Young Driver Crashes

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Executive Summary

In December 1997, North Carolina became the second state to enact a comprehensive Graduated Driver Licensing (GDL) system. The purpose of GDL is to reduce young driver crashes by introducing beginning drivers to the full range of driving experience in stages, thereby allowing them to obtain needed experience and develop maturity. This report describes changes in young driver motor vehicle crashes following enactment of the GDL program. We examined information about crashes involving drivers of passenger vehicles which was obtained from the North Carolina Crash Data File for 1997 and 1999. By 1999, nearly all 16 year-old drivers in North Carolina had begun their driving experience under the GDL program as opposed to the previous system.

During 1999, 16 year-old drivers in North Carolina had 26% fewer crashes than in 1997. There was a similar pattern in injuries and fatalities among 16 year-old drivers, which declined 29% from 1997 to 1999. To address the possibility that this decline was due to a general decline in crashes throughout North Carolina, these results were compared with those for older drivers. These older drivers would reflect any general patterns, but would not have been affected by the GDL program. Whereas crashes declined by 26% among 16 year-old drivers, there was a 4% increase among drivers age 20 and older, clearly indicating that the decline among young drivers was not due to a general trend. Crashes among 17 year-old drivers declined by 6%. This probably reflects the early effects of GDL in this age group, although many 17 year-old drivers during 1999 were licensed before the GDL program took effect.

The driving age population of North Carolina has been growing in recent years and this alone will result in more crashes. To adjust for population increases between 1997 and 1999, age-specific crash rates per 10,000 persons were calculated. With these adjustments for population growth, 16 year-old driver crashes were down even more (29%). Crash rates among 17 year-old drivers declined 9% and the rate for drivers 20 and older increased by one percent.

A central feature of the North Carolina GDL program is a restriction on unsupervised nighttime driving by novice drivers who have reached the second level of licensure. Crash data indicate that this restriction has produced the expected benefit. Whereas 16 year-old driver crashes declined by 22% during daytime hours (5 a.m. to 9 p.m.), the decrease was 47% during the restricted hours (9 p.m. to 5 a.m.). This benefit was realized despite the fact that during 1999, many 16 year-old drivers would have progressed to a Level 3 license, which does not restrict nighttime driving.

A large number of young North Carolina drivers are still making their way through the initial licensing levels. Consequently, it is not yet possible to estimate the enduring effect of graduated licensing in North Carolina. It is important to recognize that the initial effects will not persist at the same magnitude over time. Although these initial effects will likely decline to some extent, there is good reason to expect that a permanent decrease in young driver crashes will result from the GDL system, since these early findings indicate that GDL is working as was envisioned when it was enacted.

In sum, preliminary analyses indicate that the North Carolina GDL program is having the anticipated effect on young driver crashes. Future analyses will examine effects on 17 year-old drivers, will determine which elements of the GDL program produce the greatest benefit and will look at the enduring effects of GDL on older drivers who began their driving experience under the GDL system.

BACKGROUND

On December 1, 1997 North Carolina became the second state – following Michigan – to enact a comprehensive Graduated Driver Licensing (GDL) system. The North Carolina GDL system was hailed by traffic safety experts as a model that other states would do well to emulate. As of July 2000, 32 jurisdictions have enacted 3-tier GDL systems. However, the North Carolina GDL system remains one of the most comprehensive, carefully-integrated programs in the U.S. The present report presents findings from an initial investigation of the effects of the North Carolina GDL program on young driver crashes.

Graduated driver licensing systems are designed to address the disturbingly high rate of crashes experienced by young beginning drivers. Prior to enactment of the North Carolina GDL system, 25% of licensed 16 year-old drivers were involved in a reportable motor vehicle crash during their first year driving. This compared to only 7% of drivers ages 25 - 34. There are several specific reasons for this high crash rate among young drivers. These can be grouped generally into two categories: inexperience and immaturity. GDL systems are designed to address both issues. By introducing beginning drivers to the surprisingly complex task of driving in stages, each of which includes a variety of restrictions, GDL provides the opportunity and encouragement for young drivers to obtain substantial experience under relatively safe conditions. This addresses the issue of inexperience and, in part, also moderates the impulsiveness that characterizes the adolescent years. Impulsive actions while driving are discouraged by limitations in the initial stages of licensing (e.g., having a parent in the vehicle) and the long practice period (12 months in North Carolina) encourages the development of safe driving habits. Moreover, by delaying the age of unrestricted licensure somewhat, GDL also results in unsupervised novice drivers being several months older than was previously the case.

The North Carolina Graduated Licensing System

The North Carolina GDL program is a three-tier licensing system. The conditions and restrictions for each level are briefly summarized below.

Level 1 (Limited Learner permit)

Minimum age 15
Must have completed Driver Education and passed written, sign and eye tests
Must be supervised by parent or guardian at all times when driving
May only drive between 5 a.m. and 9 p.m. during initial 6 months
All vehicle occupants must wear seat belts
Must spend at least 12 months at this level
Final 6 months must be violation-free to advance to Level 2

Level 2 (Limited provisional license)

Minimum age 16
May drive unsupervised between 5 a.m. and 9 p.m.
Must be supervised by parent or guardian when driving between 9 p.m. and 5 a.m.
All vehicle occupants must wear seat belts
Must spend at least 6 months at this level
Final 6 months must be violation-free to advance to Level 3

Level 3 (Full provisional license)

Minimum age 16 ½
All vehicle occupants must wear seat belts

PROCEDURE

Examination of the effects of graduated licensing systems involves a substantial number of complications that are not usually present when evaluating the effects of other traffic safety legislation. First, following implementation of GDL, 18 months passed before there was even one young driver on North Carolina roadways who had progressed to the third, essentially unrestricted, licensing level. Second, since young drivers do not all begin the licensing process at the same time, or the same age, in the beginning years of the GDL program there was a mixture of ages at differing levels of licensure at any one time. Finally, because a group of young drivers was 'grandfathered' by the GDL law, the mixture of drivers in terms of age, experience and license restrictions during 1998 was particularly great. During that year, there were 16 year-old drivers who had avoided the GDL system entirely (by obtaining a learner permit prior to December 1, 1997), there were others – some of whom were older than those who avoided GDL – who were at Level 1 and were allowed to drive only with adult supervision.

Because of the very heterogenous nature of young drivers in the first years after a GDL system takes place, the standard approach when evaluating GDL is to exclude crash data for at least the initial year of the program. We have followed that procedure here, comparing crash data for 1999 with those from 1997. It is important to recognize that this approach does not resolve all problems with confounding factors. In particular, this comparison does not adequately address the effects of the GDL system on 17 year-old drivers. During 1999, there were a substantial number of 17 year-old drivers in North Carolina who had not been licensed under the GDL system. Analyses of 2000 crash data will speak more directly to the benefits of the North Carolina GDL system for 17 year-old drivers. Hence, the focus of this report is on 16 year-old drivers. Although it is not known what proportion of 16 year-

old drivers were at each of the three licensing levels during 1999, nearly all of them were licensed under the GDL licensing program.[1]

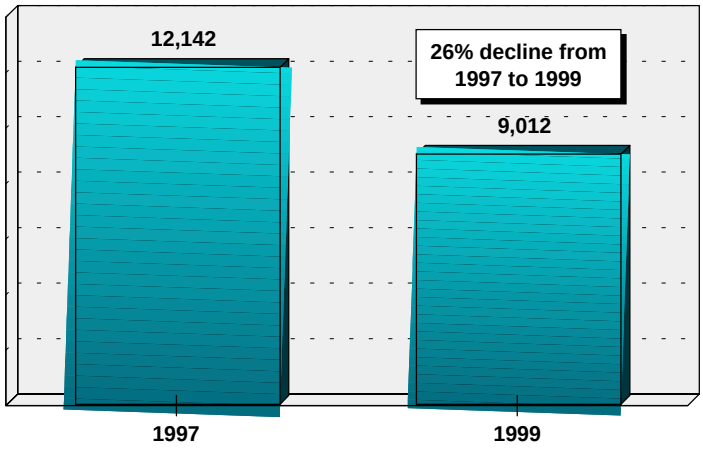
Data on crashes for all drivers of passenger vehicles were obtained from the North Carolina Crash Data File for 1997 and 1999. Analyses focused on two outcomes: all reportable crashes and more serious crashes, which include only those involving a fatality or serious injury to the driver.

RESULTS

As noted above, the effect of the various elements of the GDL system should be seen most clearly among 16 year-old drivers. Figure 1 shows that during 1999 there was a dramatic decrease in crashes among this age group in comparison with 1997. Whereas there were 12,142 crashes by 16 year-old drivers in 1997, there were only 9,012 in 1999 – a decrease of 26%.[2]

Although all crashes are of concern, there is a special interest in reducing the most serious crashes – those that kill or injure. The decrease in crashes where a 16 year-old driver was killed or injured seriously enough to require medical treatment is similar to that for all crashes, declining 29%, from 449 to 320 between 1997 and 1999 (see Figure 2). These findings refer only to injury to the driver. Future analyses will examine injuries to other occupants in the vehicles of young drivers as well as injuries to persons in other vehicles.

Figure 1
Sixteen year-old driver crashes in North Carolina, 1999 vs. 1997



[1] Young persons who moved into North Carolina from other states and who had obtained some form of license before arriving in the state were not subject to all the provisions of the North Carolina GDL system. In addition, persons driving in North Carolina but who were residents of other states were not subject to the North Carolina GDL requirements.

[2] It is important to keep in mind that even this group, which contains only 16 year-old drivers, is a heterogeneous group in terms of type of license they held and, therefore, conditions under which they were driving. While some would have been driving with no restrictions, others were limited to driving unsupervised only during the daytime; still others were allowed to drive only while supervised by a parent or guardian, regardless of time of day.

Overall Crash Trend

In comparing the incidence of crashes over time, it is important to consider whether changes may be due to a general trend, rather than to specific changes in laws or regulations such as the GDL program. In the present case, a simple way of controlling for the effect of any general trend is to compare changes in crashes for drivers affected by GDL with another group that did not experience GDL. Figure 3 shows 1997 and 1999 crashes for drivers of several ages – 16, 17, 18 & 19 along with those 20 and older. During 1999, some 17 year-old drivers were a product of the GDL program while many others were not. No driver older than 19 and only a very small fraction of 18 year-old drivers in 1999 would have experienced the effects of the GDL system. It is clear that those drivers who were not licensed under the GDL system continued to crash in 1999 at rates similar to those in 1997. Therefore, the decrease in crashes among young drivers is not due to a general trend toward fewer crashes.

Figure 2
Sixteen year-old driver fatal and serious injury crashes in North Carolina, 1999 vs. 1997

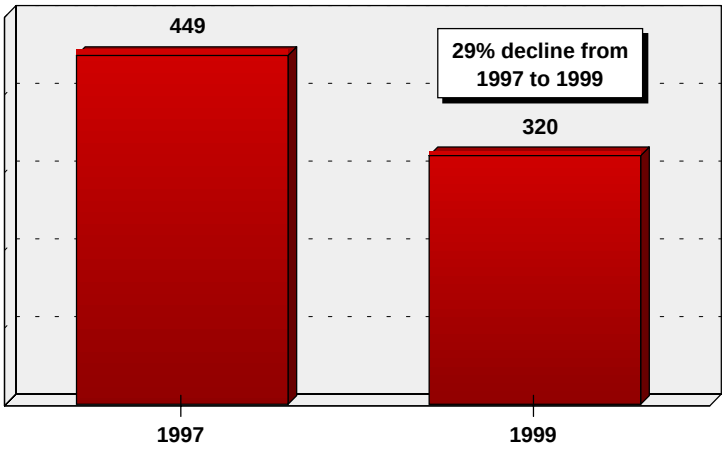
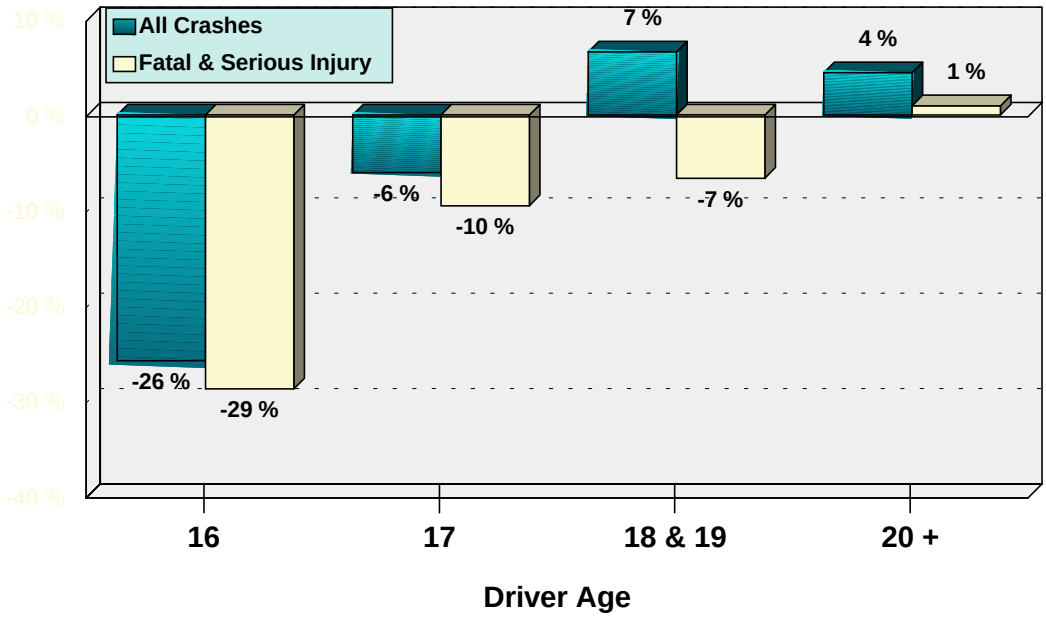
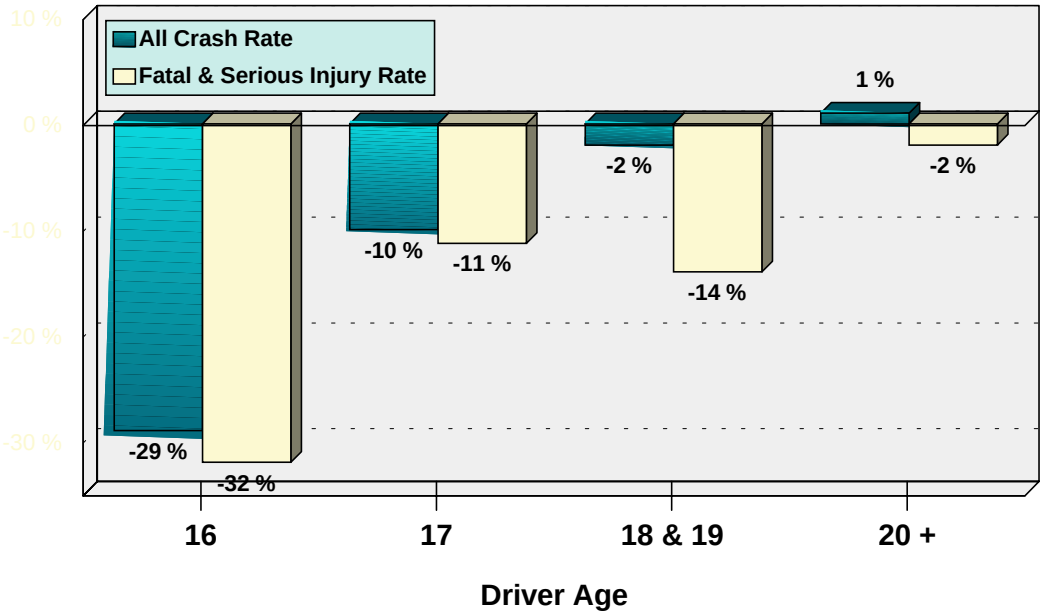


Figure 3
Change in number of crashes by driver age and injury severity in North Carolina, 1999 vs. 1997



Another important factor in the number of crashes that will occur in a given time period is exposure. That is, if more people are driving then more crashes will be expected, even though the risk may remain the same. Because North Carolina is experiencing substantial growth, it is to be expected that the number of crashes will increase from year to year. To adjust for this, the numbers of crashes were adjusted to reflect a population-based crash rate. Figure 4 shows the change in age-specific crash rates per 10,000 persons. When population growth is taken into account, crash rates overall were fairly stable as indicated by the bars for drivers age 20 and older; serious crashes were down slightly (about 2%) whereas all crashes were up slightly (about 1%). It is important to note that the population based rates include all persons in the age group, not merely those who are licensed (at some level) to drive. Although crash rates could be calculated based on the number of licensed drivers per age group, in the present case, that would understate the effect of the GDL system. Other studies have indicated that some of the benefit of GDL systems is that they result in some young persons delaying the time at which they begin driving. Although that is not the intent of GDL, it is one of the benefits since some young persons are not exposed to the risks of driving as early as would be the case without GDL and are involved in fewer crashes as a result. Hence, using general population information, rather than number of licensed drivers, to calculate crash rates captures the full effect of a GDL system.

Figure 4
Change in crash rate per 10,000 population by driver age and injury severity in North Carolina, 1999 vs. 1997



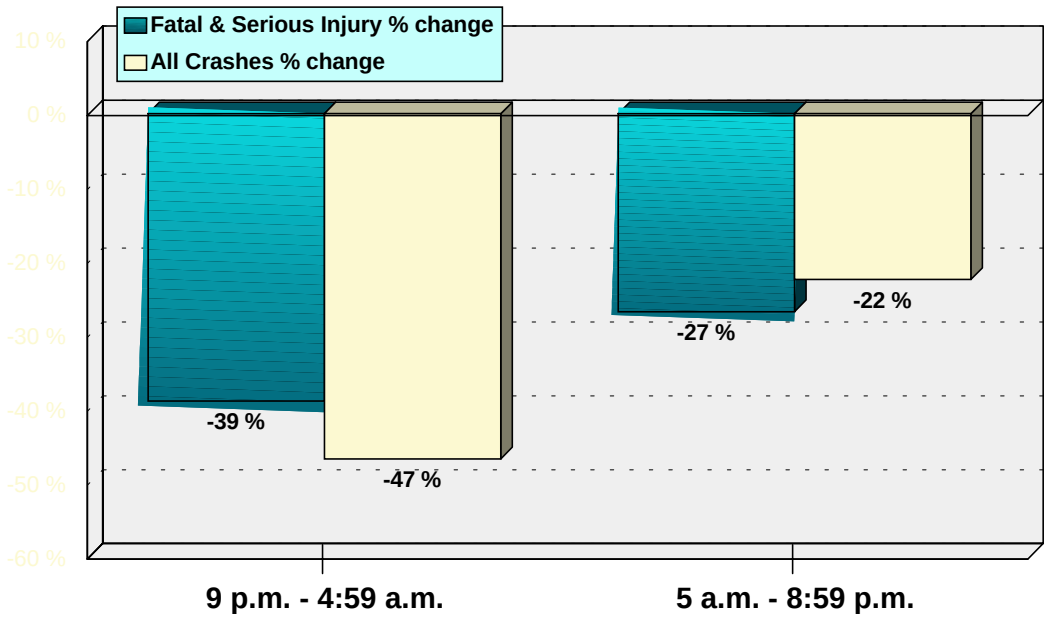
Effects of the Night Driving Restriction

Many states have set their nighttime driving restriction at a very late hour – too late to effectively address much of the increased risk of a crash during the nighttime hours for young drivers. In contrast, the North Carolina system established 9 p.m. to 5 a.m. as the hours during which drivers in the second

stage of licensing require adult supervision. This restriction was designed to address the fact that crash risk increases at night, partly because this is when recreational driving – with multiple teen passengers – is most common among young drivers. A recent article in the Journal of the American Medical Association (*JAMA*) underlined the wisdom embodied in the North Carolina GDL system.[3] Using national data obtained prior to the enactment of any GDL system, the *JAMA* study found that risk of a crash for 16 and 17 year-old drivers is nearly three times as great between 10 p.m. and midnight as during the daylight hours. Although the risk per mile driven is even greater after midnight, most of the nighttime driving done by 16 and 17 year-olds occurs before midnight. In North Carolina, prior to enactment of the GDL program, 80% of 16 year-old driver nighttime crashes occurred between the hours of 9 p.m. and midnight; 73% of 17 year-old driver nighttime crashes occurred from 9 to midnight.

To determine the initial effect of the nighttime restriction, we compared the number of 16 year-old driver crashes during restricted hours in 1999 with 1997. The results are shown in Figure 5. There has been a dramatic benefit of the nighttime driving restriction on all crashes as well as the more serious (fatal and serious injury) crashes. Between 1997 and 1999, crashes in which a 16 year-old driver was killed or seriously injured declined by 39% during restricted hours and by 27% during daytime hours. That represents a 44% greater decline during nighttime hours, which clearly shows the benefit of the

Figure 5
Decline in 16 year-old driver crashes by time (restricted vs. unrestricted hours) and injury severity in North Carolina, 1999 vs. 1997



[3] Chen L-H, Baker SP, Braver ER, Li G Carrying Passengers as a Risk Factor for Crashes Fatal to 16- and 17-Year-Old Drivers. JAMA. 2000;283:1578-1582.

nighttime driving restriction.[4] The population-based rates declined 42% and 30% for nighttime and daytime crashes respectively, representing a 40% greater decline in night crashes.

There is an even greater relative decrease in crashes of all severity levels during nighttime hours. Whereas nighttime crashes decreased by 47%, daytime crashes declined by 22%. Stated differently, nighttime crashes declined by more than twice as much as daytime crashes. Adjusting for population increases, nighttime crashes declined 49% and daytime crashes decreased by 26%, an 88% greater decrease during restricted hours than during daylight hours. The benefit of North Carolina's 9 p.m. to 5 a.m. restriction on driving for inexperienced drivers is clear from all these findings.

The results concerning nighttime vs. daytime crashes may represent a somewhat conservative estimate of the benefits of the night driving restriction. This restriction applies for only six months during the second stage of licensing. Hence, during 1999, although many of the 16-year-old drivers were limited by the night driving restriction; a substantial proportion would have already moved on to the third and final licensing level, which imposes no restriction on nighttime driving.[5]

DISCUSSION

The results of the present analysis clearly indicates that the North Carolina Graduated Driver Licensing system is having the intended benefit. Among the age group of drivers who have all begun driving under this new system, both the number of crashes and crash rates based on population have declined dramatically. Moreover, there is evidence that at least one of the specific elements of the GDL system is having the intended effect as well. As a result of the night driving restriction, crashes during the hours when young driver crash risks are highest have declined even more dramatically. It is not yet clear whether this is due solely to the fact that less driving takes place during those hours or is a combination of that reduced exposure along with increased skill and safer driving behaviors developed through the longer learning period that produce greater benefits during higher risk times. Future analyses will examine this issue in more detail.

Some caution in interpreting the results presented here is in order. Although 2 ½ years have passed since the North Carolina GDL program was implemented, these findings are 'early returns.' They represent real declines in crash rates, but this magnitude of effect should not be expected to continue. Other GDL programs have produced initial crash reductions of similar magnitude to those seen here, but long-term benefits have been found to be smaller. Initial declines following enactment of GDL

[4] Although the number of drivers killed is a small fraction of those involved in crashes, it is worth noting that in 1997 between 9 p.m. and 5 a.m. thirteen 16 year-old drivers were killed. During 1999 *only one* 16 year-old driver was killed during these hours.

[5] A more refined analysis of this issue, to directly identify the proportion of young drivers who were under specific restrictions, will be presented in a future report.

programs reflect the combined effects of several factors, only some of which can be expected to continue. First, there is typically a rush by some young persons to become licensed just before GDL takes place and these individuals generally are more risky drivers than those who are content to wait and make their way through a GDL system. There is likely some effect of that phenomenon in the results presented above. Secondly, during the initial years of GDL there is a reduction in various kinds of driving exposure – compared to pre-GDL driving – which results in fewer crashes. Young drivers may drive less, fewer may be driving at all, many more are driving under safer conditions (e.g., with parents, only during daylight hours or both). As this temporary phenomenon works its way through the young driving population, the enduring benefits of GDL become more apparent. In New Zealand, for example, although teen driver crashes initially declined by more than 20%, the long-term benefit of GDL was a sustained decrease of 7 - 8% in crash-related injuries among teen drivers.[6] Another indication of the likely long-term effect of GDL comes from Florida. The Florida GDL system was implemented in separate pieces rather than as a comprehensive system. As a result of that approach, there was no 'roll-in' or period during which a combination of factors affected the young driver population. A recent examination of the effect of these changes found a decline of 9% in fatal and injury crashes among 15 - 17 year-old drivers.[7]

During 2000, effects of the GDL program should be manifest more clearly among 17 year-old drivers as that cohort is increasingly composed of drivers who experienced the GDL program. Following that, as GDL becomes the status quo, rather than a new approach to licensing, there will likely be a moderation of some of the initial effects of the program. Still, it appears prudent to expect perhaps a 10% overall decline in young driver crashes as a result of the North Carolina GDL system.

Despite the likelihood that in future years, the benefit of GDL will not continue to be so large as in the first year, the results are highly encouraging. Moreover, the lives saved and injuries prevented during 1999 alone are dramatic. Even should the effect of GDL disappear entirely in the next year or two, which it clearly will not, the one-time benefit would amount to dozens of lives saved, thousands of injuries prevented and millions of dollars saved as a result of a single year of dramatically reduced crashes. The UNC Highway Safety Research Center is continuing to examine the effects of the North Carolina GDL program to determine the long-term effect and also to learn the extent to which those effects are due to reductions in high-risk exposure, and what proportion is due to increased driving skills. Moreover, we will look at the extent to which the GDL program results in safer driving among older drivers, who began their driving experience under the GDL program compared to those who learned under the previous system.

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[6] Langley JD, Wagenaar AC, and Begg DJ. An evaluation of the New Zealand graduated driver licensing system. *Accident Analysis and Prevention*. 1996; 28(2):139-46.

[7] Ulmer RG, Preusser DF, Williams AF, Ferguson SA, Farmer CM. Effect of Florida's Graduated Licensing Program on the Crashes of Teenage Drivers. *Accident Analysis and Prevention*. 2000; 32(4):527-532.