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The evolution and effectiveness of graduated licensing

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Abstract

This paper traces the history of graduated licensing, starting about the point in time when Pat Waller's paper on the genesis of the concept ends, and examines the extent to which graduated licensing has produced reductions in collisions. It concludes with some general observations about future research needs, anticipating several of the papers that follow.

The evolution of graduated licensing is chronicled, beginning with the early and largely unsuccessful efforts to introduce it in the United States in the late 1970s, through the pioneering efforts in New Zealand, which resulted in the first truly graduated system in 1987, to Canada where the program was introduced 7 years later, to the United States where it has flourished in more recent years.

This 25-year history lesson hopefully creates an appreciation for the somewhat torturous journey that graduated licensing has experienced in achieving acceptance among the public and policy-makers—a journey that is not yet over, as subsequent papers in the symposium will show. The proliferation of graduated licensing in recent years is a mixed blessing—the wider adoption of graduated licensing has been a very positive development, but the programs that have evolved are anything but homogeneous in structure or content. Although this is often necessary for various reasons, it is worrisome that some programs are graduated licensing in name only. This suggests that future efforts to promote graduated licensing must emphasize adherence to the fundamental risk reduction and multistage principles on which the concept is based.

The paper also considers the extent to which graduated licensing achieves its objective of reducing collisions among those covered by the program. Understandably, most jurisdictions would not introduce graduated licensing until it was shown to be effective and this, to some extent, slowed the process of implementation. The obvious irony is that it could not be shown to be effective until it was introduced. Fortunately, as history demonstrates, some jurisdictions were prepared to try the system based on its very sound empirical rationale. And, their confidence has been rewarded. A growing body of research, which shows that graduated licensing has been associated with significant and substantial reductions in collisions, is briefly described.

The paper concludes with some general observations designed to anticipate the papers that follow. First, it outlines questions that still remain unanswered about graduated licensing—why or how it works, with whom it works, and what features are most effective. Precise and unambiguous answers to these questions are essential for the design of a system that maximizes the potential for reducing collisions, injuries, and deaths. Second, it signals a note of caution on the limits of graduated licensing—it is important to recognize just how effective and beneficial this program is; it is equally important to recognize that it is not the sole panacea for the problem of collisions involving new drivers.

Keywords: Evolution; Effectiveness; Graduated licensing

1. Evolution

As described in a previous paper in these proceedings (Williams, Nelson, & Leaf, 2002) and documented extensively elsewhere (e.g., Mayhew & Simpson, 1990a, 1990b, 1995), young drivers have a higher risk of collision than older, more experienced drivers. Historically, a mainstay of prevention strategies to address this serious road safety and public health problem has been some form of licensing system that requires beginners to qualify for a licence before achieving the privilege of operating a motor vehicle on public highways. The evolution of graduated licensing predates, therefore, its formal development over 25 years ago because it has roots in conventional, probationary, and provisional licensing.

1.1. Conventional licensing

Licensing systems were originally introduced as a form of driver control, serving the function of revenue gener-

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ation, driver identification, and selection and education (Mayhew & Simpson, 1990a, 1990b). The collection of revenue has come to be a less important function, with conventional driver's licenses being used more as a means to ensure that novices meet certain minimal requirements deemed necessary to operate a motor vehicle safely in traffic.

In most conventional systems, once the novice passes the vision and knowledge test, he or she is issued a learner's permit. This permit is issued prior to regular licensing to allow beginners to gain experience under the direct supervision of a licensed driver (Coppin, 1977). This requirement explicitly acknowledges that beginners need time and opportunity to develop driving skills under supervised conditions before obtaining a higher class of licence. For decades then, the learner's stage has been recognized as a key safety element in licensing and it continues to play a pivotal role in graduated licensing systems today, as described in a subsequent paper in these proceedings (Mayhew, 2003).

However, in conventional licensing systems that have a learner's permit, there is usually no mandatory time requirement for holding it, so beginners can choose to take the road test for a regular license very soon after receiving a learner's permit. Worse yet, in many jurisdictions, the learner's permit does not constitute a necessary precondition for obtaining a regular licence. The learner stage can be bypassed altogether and the novice can apply immediately for a higher class of licence. Under these circumstances, any potential safety benefits of a learner's permit are compromised considerably or completely lost.

In most conventional systems, to obtain a regular licence, the novice must, after fulfilling the condition of the learner's permit (if any), pass a road test to demonstrate competency in meeting minimal vehicle operating standards. If successful, they are granted unrestricted driving privileges. Subsequently, the response to "driver failures" (i.e., violations and accidents) in the conventional system typically involves warnings, meetings, and, ultimately, as a last resort, prohibition of driving and removal of the license. The same "treatments" are applied to all drivers—to those with only a few weeks of driving experience or those who have had many years of experience.

1.2. Probationary licensing

The recognition that new drivers have high rates of collisions and offences led several jurisdictions to modify their conventional approach by introducing probationary licenses. As the name implies, a probationary license establishes a trial period for new drivers during which their license can be suspended, or other actions taken, for less cause than normally applies to regularly licensed drivers. Simply put, it takes fewer demerit points to result in license suspension during the probationary period.

The probationary scheme is anchored in the concept of deterrence. It is assumed that safe driving habits, at least in the initial years when the risk of collision is much higher, will be encouraged by the threat of punishment or its application. If a violation-free and accident-free record is maintained, no restrictions are imposed and no punitive/rehabilitative action is taken. Indeed, it is this feature of the system that often makes it attractive because it is perceived as "fair" (i.e., it does not punish or restrict all new operators, only those who fail to comply with traffic laws).

However, if the driving errors that lead to violations and suspension reflect poor skill development rather than intentional risk taking or disregard for the rules of the road, then a suspension may be counterproductive. Given that driving experience plays a role in reducing the risk of collision among newly licensed drivers, a driving prohibition effectively eliminates the opportunity to obtain the road experience needed to correct the errors that led to suspension in the first place. Moreover, because the system basically operates "after-the-fact," remedial action may be too late if the driving errors result in a serious collision.

Many jurisdictions have probationary licensing systems but few have been evaluated. Those that have been studied were not shown to have substantial benefits (e.g., Eavy, Edwards, & Lee-Gosselin, 1987; Gorys, Pang, & Rosenbaum, 1983; Lynam & Twisk 1995; Rosenbaum, Hemsley, & Duncan, 1985).

1.3. Provisional licensing

Provisional systems differ from probationary systems in that they explicitly recognize that beginners are inexperienced and encounter difficulties in certain high-risk driving situations such as at night. Accordingly, these systems seek to limit the exposure of young drivers to hazards by imposing restrictions on their driving privileges. Thus, in some jurisdictions, provisional systems for young drivers include restrictions such as a night curfew, a measure that has proven effective in reducing collisions (McKnight, 1986; McKnight, Hyle, & Albrecht, 1983; McKnight, Tippetts, & Marques, 1990; Preusser, Zador, & Williams, 1993; Preusser, Williams, Zador, & Blomberg, 1984; Williams, Lund, & Preusser, 1985). In this regard, provisional systems are a forerunner of graduated systems. Indeed, considerable confusion has often arisen in differentiating between the two. Like probationary systems, provisional licensing programs also usually include a lower threshold of violations or demerit points to initiate punitive action.

Provisional licensing systems that have been evaluated have been found to produce some safety gains, but the observed reductions in collisions have not always been substantial nor has the impact been consistent (e.g., Hagge & Marsh, 1986; Jones, 1994; Lynam & Twisk, 1995; McKnight et al., 1983, 1990).

1.4. Graduated licensing

The basic ingredients for graduated licensing are inherent in conventional, probationary, and provisional systems. Like conventional approaches, graduated licensing systems have a learner's phase that involves a period of supervised driving. Unlike a conventional licence, however, this learner's period is viewed as critical and cannot be bypassed. Indeed, most graduated licensing systems stipulate that the learner's licence must be held for a certain minimum period of time—typically several months or a year.

Like some provisional systems, graduated licensing also imposes a set of restrictions on the novice driver that relate to when they can drive, where they can drive, with whom, and how. These conditions include, for example, restrictions from operating on certain high-speed highways, being accompanied by a licensed adult at all times, driving during daylight hours only, and prohibiting drinking any alcohol and driving. But the graduated system was designed to improve upon that of a provisional one in that the restrictions should be removed gradually and systematically, so that the novice enters the driving task and earns the privilege of full unrestricted driving in a step-by-step, progressive manner.

Like probationary systems, graduated licensing programs usually include a penalty structure that imposes sanctions at a lower threshold than what applies to fully licensed drivers. One of the more popular sanctions has been to extend the graduated licensing period, or move the driver back in the system, basically with holding full driving privileges for a longer period of time. Again, the threat of this punishment or its application is assumed to deter unsafe driving or other violations of the terms and conditions of the graduated license.

A fundamental purpose of graduated licensing is to provide new drivers with the opportunity to gain driving experience under conditions that minimize the exposure to risk. This premise was explicitly recognized over 25 years ago in a paper, "The Young Driver Paradox" (Warren & Simpson, 1976). They argued that experience was critical to the development of driving skills—increases in experience result in decreases in the risk of collision (Mayhew & Simpson, 1990a, 1990b, 1995). So, beginners need to drive as much as possible. Paradoxically, this exposes them to the risk of a collision. What is needed is a means for them to gain experience while minimizing risk. This is a basic tenet of graduated licensing.

Somewhat like an apprenticeship program, it is intended to ease the novice into the full range of traffic conditions. In this manner, graduated licensing provides a protective way for new drivers to gain experience. As experience and competency are gained, exposure to more demanding situations is phased in.

Graduated licensing also addresses age-related or lifestyle factors that give rise to the greater crash risk of young motorists by minimizing the opportunities for them to engage in risky behaviors or to encounter risky situations. For example, zero BAC provisions and limits on the number or age of passengers are designed to reduce the incidence of drinking and driving, which is particularly risky for youth, and to reduce opportunities for peer pressure.

Graduated licensing is certainly not new, as described in a previous paper in these proceedings by Patricia Waller, whose name is almost synonymous with the concept. It was first formally described in the early 1970s in the United States and a model system developed by the National Highway Traffic Safety Administration (NHTSA) in 1977. This model was never adopted by any of the states at that time, although both Maryland and California introduced elements of it.

For the next two decades, from the late 1970s to the late 1990s, there was virtually no progress on the legislative front in the United States, although many agencies continued to promote the concept vigorously. However, more tangible progress was occurring elsewhere. It is now generally agreed that the first truly graduated licensing system was introduced in New Zealand in August 1987. This three-stage program (described in more detail in another presentation at this symposium by Dorothy Begg) applied to all drivers between the ages of 15 and 25 years, inclusive, and all motorcycle operators, regardless of age. (It should be noted that the full program was modified in 1999 to apply to drivers of all ages, but that the features differ according to age. For example, the restricted period lasts for 18 months for 15- to 24-year-olds but only 6 months for drivers over the age of 24 years.)

This development was much heralded in North America and cited extensively as a legislative initiative to emulate. Of equal importance was the commitment by New Zealand officials to evaluate the program's effectiveness—an outcome anxiously anticipated by observers in North America and discussed later in this paper.

At about the same time, a keen interest in graduated licensing also emerged in Australia, at least at the federal level. Indeed, in a development that paralleled what happened in the United States two decades before, the Australian Federal Office of Road Safety designed a model program for discussion based on the pioneering work of Waller (1974, 1975) and others (e.g., Coppin, 1977; Croke & Wilson, 1977a, 1977b). And again, echoic of what happened in the United States, the comprehensive four-stage Australian model (Boughton, Carrick, & Noonan, 1987), strongly recommended by the Australian Federal Office of Road Safety, was not implemented.

Although several Australian states did adopt some of the recommended components in the model, none of them conformed adequately to the concept to be called graduated licensing (Haworth, 1994), and even the most comprehensive system, introduced in the state of Victoria, was described as a weak version of graduated licensing, at best (Mayhew, 1996). However, again paralleling the slow evolution of graduated licensing that took place in North

America, more recent initiatives in Australia demonstrate considerable progress. For example, a three-stage graduated licensing system was introduced in New South Wales in July 2000.

Back in North America, as noted previously, the developments in the late 1980s in Australia and New Zealand, in particular, were watched with interest and enthusiasm as events that might rekindle or even ignite interest in graduated licensing.

In Canada, the Traffic Injury Research Foundation had, through a variety of forums, continued since the mid-1970s to underscore the serious problem of road crashes involving young drivers and had emphasized the potential benefits of graduated licensing in addressing this problem. In 1985, an international symposium organized by TIRF, ''Young Driver Accidents: In Search of Solutions,'' strongly endorsed the concept of graduated licensing (Mayhew, Simpson, & Donelson, 1985). Other workshops and symposium that followed carried a similar message.

An important landmark in the history of graduated licensing occurred in Canada in 1990, which influenced one aspect of how the program was structured, and distinguished it from the approach taken in the United States. A unique and highly influential study was published (Mayhew & Simpson, 1990a, 1990b), based on a comprehensive analysis of collisions in the province of Ontario. A key finding was that increases in experience (defined in terms of years licensed) were associated with decreases in collision rates, even among older drivers. For example, newly licensed 30-year-old drivers had crash rates considerably higher than those of 30 year olds with several years of experience.

Given that the population of licensed drivers was changing in Canada—many new drivers were not young—the findings from the Mayhew and Simpson study dramatically shifted the focus of graduated licensing away from an exclusive application to young drivers to any new driver, regardless of age. To reflect this change in perspective, much of the subsequent research from TIRF and others used the phase ''new to the road'' to signify that all beginners were at increased risk, not just young ones. Of course, young beginning drivers were at substantially greater risk than older beginners because of the added impact of age-related factors, but it was clear that graduated licensing was needed for all new drivers. A few years later, Simpson and Mayhew (1992) replicated the results of the earlier study, this time with data from another province.

As testimony to the impact of this research, all the graduated licensing programs in Canada apply to new drivers, regardless of their age. This has, however, not been the norm in the United States, where graduated licensing has been viewed as a countermeasure for young beginners only (the exceptions to this are New Jersey and Maryland). It is important, however, that this difference be viewed in context because it is really the only fundamental distinction that can be drawn between them. Moreover, there is no disagreement that graduated licensing should be applied to older new drivers if warranted by the age distribution in the population of newly licensed drivers.

By the early 1990s in Canada, graduated licensing was being actively and aggressively promoted by a diversity of agencies and individuals, both inside government (laying the empirical foundation and making the case to politicians) and outside of government (creating a receptive public climate for change). Many have taken credit for its eventual introduction, but it is difficult and perhaps inappropriate to assign credit to any particular individual or agency.

The important point is that graduated licensing did finally emerge in Canada. In April 1994, the Ministry of Transportation for the province of Ontario introduced the first graduated licence system in Canada. Very shortly thereafter, in October of that year, the Province of Nova Scotia introduced a graduated licensing program. This was a watershed in the history of graduated licensing not only in Canada but also in North America. During the next 5 years, an additional four provinces introduced graduated licensing and, of greater significance for this symposium, 23 states introduced it, starting with the State of Florida on July 1, 1996.

Indeed, the public interest in graduated licensing reached such proportions that many states began to make rather minimal changes to their existing licensing programs, ostensibly to be able to say they had graduated licensing. This development was of some concern, particularly to the Insurance Institute for Highway Safety (IIHS) that had played a dominant leadership role for years, not only in the research that provided the groundwork for graduated licensing but also in actively promoting its adoption. In response to this concern and to provide direction regarding best practices in graduated licensing, the IIHS, together with the TIRF, produced a report, ''Graduated Licensing: A Blueprint for North America.'' This document has been updated several times and the most recent version (October 2002) can be found on the IIHS website. It contains details on the current state of graduated licensing and recommendations regarding the most effective structure and contents of such a program. The reader is urged to review this document carefully since it is the most comprehensive and authoritative summary available. Not only does it provide testimony to the wide acceptance of graduated licensing, but it also underscores the rather substantial variability that exists in the structure and content of programs.

Some variability is to be expected because of the social, economic, geographic, and political diversity among the various jurisdictions. At the same time, some programs are graduated licensing in name only, suggesting that future efforts to promote it must emphasize adherence to the fundamental risk reduction and multistage principles on which the concept is based and, presumably, its effectiveness is hinged. This is an issue of central importance to the current symposium, which is intended not only to encourage the adoption of graduated licensing but also to provide

empirical guidance to all jurisdictions regarding best practices.

1.5. Summary

Hopefully, this history lesson provides the reader with an appreciation for the somewhat torturous journey that graduated licensing has experienced in achieving acceptance among the public and policy makers—the present symposium testifies to the fact that the journey is not yet over.

Recent years have witnessed a proliferation of graduated licensing, which has been a mixed blessing. The wider adoption of graduated licensing has been a very positive development; at the same time, the programs that have evolved are anything but homogeneous in structure or content. Future developments must emphasize the importance of building systems that embrace the fundamental principles on which graduated licensing is founded.

2. Evaluation

The description of the evolution of graduated licensing provided above could lead to the conclusion that its adoption has been driven primarily by the so-called domino principle of road safety—a notion that my colleague Dan Mayhew and I introduced many years ago. It suggests that road safety policies and programs are often implemented with less regard for their scientific merit and proven effectiveness than for the fact that someone else adopted it. This cascading effect of follow-the-leader serves only to heighten the conviction that the program or policy is worthwhile, even if there is scant evidence to substantiate it.

Although there has undoubtedly been some "copycat" behavior at play in the proliferation of graduated licensing, in my opinion, the primary driving force has been its proven effectiveness. The research literature on the effectiveness of graduated licensing has recently been summarized by Mayhew (2001) and is described briefly here.

There is a growing body of research demonstrating that graduated licensing is an effective safety measure. All evaluations conducted to date have reported positive safety benefits. Studies into the safety effectiveness of graduated driver licensing in New Zealand, Canada, and the United States have shown overall reductions in crashes ranging from 4% to 60%. Given the diversity of the programs, it is not surprising that the magnitude of the crash reductions reported to date has varied so much.

However, this variability may also be a result of the different evaluation designs and statistical analyses used in the studies, ranging from simple pre–post comparisons with no control group(s), which are needed to account for the effects of other factors and events influencing collisions, to the use of powerful interrupted time series analysis. As well, the basic groups being studied have differed because, as discussed previously, the New Zealand program applies to drivers under the age of 25 years; the Canadian programs apply to all novices, not just young ones; and the United States programs apply primarily to drivers under the age of 18 years.

A number of evaluations have been conducted on the New Zealand program that was implemented in 1987 (Begg, Stephanson, Alsop, & Langley, 2001; Frith & Perkins, 1992; Langley, Wagenaar, & Begg, 1996). The initial evaluations reported rather substantial reductions in casualty collisions of approximately 25%, but the longer-term studies have found sustained and significant reductions more in the order of 7%. Dorothy Begg describes the New Zealand experience in detail in another paper in this symposium.

In Canada, studies into the effectiveness of graduated driver licensing programs implemented in Ontario in 1994, in Nova Scotia in 1994, and in Quebec in 1997 have reported collision reductions among all age groups of novice drivers. A summary of the findings is displayed in Table 1.

2.1. Nova Scotia

The recent evaluation of the graduated licensing program in Nova Scotia by Mayhew, Simpson, Groseillers, and Williams (2001) used a series of increasingly refined analyses that controlled for the influence of other explanatory variables. All the analyses showed that the graduated licensing program was associated with a significant reduction in crashes. For drivers of age 16 years, before and after comparisons (1993 versus 1995, the first full year of the program) showed a 24% reduction in total per capita crash rates, relative to the control group (drivers of age 25 years and over). Crash rates in 1996 were 36% lower than in 1993, showing that the initial impact was sustained. Comparable decreases occurred in injury crash rates.

Improvements were observed for all novice drivers, not just those who are young. The crash rate for all new drivers dropped by 19% between 1993 and 1995.

A more recent follow-up evaluation of the specific and long-term effects of the Nova Scotia program (Mayhew, Simpson, & Pak, in press; Mayhew, Simpson, Williams, & Desmond, 2002) confirmed the results described above but—of considerable interest—found that most of the declines in collisions occurred during the learner stage. Although the nighttime restriction was found to be effective in the intermediate stage, the overall crash reductions were nominal in this stage and not evident at all after drivers graduated to full licensing.

2.2. Ontario

Boase and Tasca (1998) conducted an interim evaluation of the Ontario program using a simple pre–post comparison group design. They found that the overall collision rate per 10,000 licensed novice drivers in 1995 (program group) was 31% lower than the rate observed for 1993 novice drivers (comparison group). The overall collision rate declined for

Table 1
Graduated driver licensing evaluations in Canada

Province	Graduated driver licensing date	Authors	Target group(s) examined	Results	
				% Reduction	Measures
Nova Scotia	1994	Mayhew et al., 2001	Drivers of age 16	−37	Number of crashes
				−31	Number of injury crashes
				−24	Per capita crash rate
				−34	Per capita casualty crash rate
			All novice drivers	−19	Per-driver crash rate
			Age 16	−22	
			Ages 17–24	−21	
			Age 25+	−43	
Ontario	1994	Boase & Tasca, 1998	All novice drivers	−31	Per-driver crash rate
			Ages 16–19	31	
			Ages 20–24	−42	
			Ages 25–34	−38	
			Ages 35–44	−37	
			Ages 45–54	−24	
			Ages 55+	−19	
			All novice drivers	−24	Per-driver casualty crash rate
Quebec	1997	Bouchard et al., 2000	All novice drivers	−5	Number of fatalities
				−14	Number of injuries
				−7	Per-driver fatality rate
				−17	Per-driver injury rate

all age groups of novice drivers: a 31% reduction among those aged 16–19 years; a 42% reduction among those 20–24 years old; a 38% reduction among those 25–34 years old; a 37% reduction among those 35–44 years old; a 24% reduction among those 45–54 years old; and a 19% reduction among novice drivers aged 55 years and over.

The effects of the alcohol, night, and freeway restrictions in Ontario were also examined and found to be effective: reductions were observed in alcohol-related collisions (a 27% decline), collisions between midnight and 5 a.m. (a 62% decline), and collisions on freeways (a 61% decline). By contrast, the "time discount" for driver education was not found to be associated with a reduction of collision involvement—drivers with certificates from approved driving schools had an overall collision rate that was 44% higher than novices without this certificate.

2.3. Quebec

The graduated driver licensing program implemented in Quebec in 1997 was also shown to be effective (Bouchard, Dussault, Simard, Gendreau, & Lemire, 2000). They found, after adjusting for changes in deaths and injuries among the control group, a 5% reduction in fatalities and a 14% reduction in injuries attributable to the new program. The per-driver fatality rate declined by 7% and the injury rate by 17%. Their analyses also showed that alcohol-related fatalities and injuries declined by 9%.

In the United States, evaluations have been conducted on graduated licensing programs implemented in Florida in 1996, in North Carolina in 1997, in Michigan in 1997, in Ohio in 1997, and in California in 1998. All have found safety benefits and the key findings are displayed in Table 2. All of these programs include a night restriction in the intermediate stage, ranging from 9:00 p.m.–5:00 a.m. in North Carolina, to 1 a.m.–5 a.m. in Ohio. The program in California also includes a restriction on teen passengers—no passengers younger than 20 years old can be transported by someone with a graduated license during the first 6 months of the intermediate stage, unless they are supervised by a 25-year-old driver.

In addition, the "partial" graduated licensing programs introduced in Kentucky in 1996 and in Connecticut in 1997 have also proven effective in reducing the crash involvement of teen drivers. Neither of these programs has an intermediate stage but both have an extended learner stage with a mandatory 6-month holding period.

2.4. California

In California, the Automobile Club reported that the number of fatal and at-fault injury crashes among 16-year-old drivers declined by 23% following implementation of the graduated licensing program in 1998; at-fault noninjury collisions of 16-year-olds declined by 17% over this period. Teen passenger deaths and injuries in vehicles driven by 16-year-old drivers also declined by 40%.

2.5. Connecticut

The safety effect of the mandatory extended learner's permit, one component of graduated licensing which was implemented in Connecticut in 1997, was recently evaluated (Ulmer et al., 2001). They found that the per capita casualty

Table 2
Graduated driver licensing evaluations in the United States

State	Graduated driver licensing date	Authors	Target group(s) examined	Results	
				% Reduction	Measures
California	1998	Automobile Club of Southern California, 2000	Drivers of age 16	−23	Number of casualty at-fault crashes
				−17	Number of noninjury at-fault crashes
				−40	Number of teen passenger deaths/injuries
Connecticut	1997	Ulmer et al., 1997	Drivers of age 16	−22	Per capita casualty crash rate
Florida	1996	Ulmer et al., 2000	Drivers of ages 15–17	−9	Per capita casualty crash rate
			Age 15	−19	
			Age 16	−11	
			Age 17	−7	
Kentucky	1996	Agent et al., 2001	Drivers age 16	−33	Number of crashes
				−34	Number of fatal crashes
				−28	Number of injury crashes
				−32	Per-driver crash rate
Michigan	1997	Shope et al., 2001	Drivers of age 16	−25	Per capita crash rate
				−24	Per capita injury crash rate
North Carolina	1997	Foss et al., 2001	Drivers of age 16	−23	Per capita crash rate
				−57	Per capita fatal crash rate
				−28	Per capita injury crash rate
				−23	Per capita noninjury crash rate
				−19	Per-driver crash rate
Ohio	1999	Department of Public Safety, 2001	Drivers of ages 16–17	−60	Per capita crash rate
				−69	Per capita fatal crash rate
				−59	Per capita injury crash rate
				−60	Per capita noninjury crash rate
				−23	Per-driver crash rate
				−24	Per-driver fatal crash rate
				−21	Per-driver injury crash rate
				−23	Per-driver noninjury crash rate

crash rate among 16-year-old drivers declined by 22% relative to the rate among 25- to 54-year-old drivers, a statistically significant change.

2.6. Florida

The per capita casualty crash rates among 15- to 17-year-old drivers before the implementation of the Florida graduated licensing program were compared to those after the program was in place, relative to the experience of 15- to 17-year-old drivers in Alabama over a similar time frame (Ulmer, Preusser, Williams, Ferguson, & Farmer, 2000). The authors found that there was a significant 9% reduction in the casualty involvement rate of 15- to 17-year-old drivers in Florida during 1997, the first full year of graduated licensing. The greatest reduction occurred among 15-year-olds (a 19% reduction), followed by 16-year-olds (an 11% reduction) and then 17-year-olds (a 7% reduction). There were no significant changes for any of the age groups in Alabama, the comparison state. (See also McCartt, Leaf, Farmer, Ferguson, & Williams, 2001 for related data on the effects of the program on attitudes and behaviours.)

Further comparisons of the actual and projected casualty crash involvements among 15- to 17-year-olds revealed that nighttime (11:00 p.m.–6:00 a.m.) crash involvements declined more than daytime crashes (17% and 7%, respectively).

2.7. Kentucky

Agent et al. (2001) evaluated the impact of the partial graduated licensing program implemented in Kentucky in 1996. They compared the number of collisions as well as the per-driver collision rates of 16-year-olds, older teens, and adults, in periods before and after the new law. To control for the effects of changes in the number of drivers, the authors compared per-driver crash rates for the various age groups. The per-driver collision rate for 16-year-old drivers after the introduction of graduated driver licensing was 32% lower than it was prior to its introduction. Similar reductions were not observed among older control groups.

Of some importance, the lower per-driver crash rates among 16-year-olds were due to an 83% decrease in the number of their collisions occurring during the first 6 months after their 16th birthday (i.e., when they were in

the extended learner stage of the new program). By contrast, drivers in the intermediate stage (i.e., those aged 16.5–17 years) actually had a 3% increase in the number of crashes following graduated driver licensing. They also found no long-term impact of the program for 17- and 18-year-old drivers.

The authors conclude that there was no long-term reduction in crash rates for teens driving under the graduated licensing program but they also emphasized that Kentucky has only a partial graduated licensing program and there is a need to upgrade it by limiting the number and age of passengers, limiting unsupervised nighttime driving (after 9 or 10 p.m.), and requiring teens to be violation-free for a period of time before being allowed to graduate to the next license stage. They indicate that such improvements might yield a longer-term safety impact, a suggestion that is certainly consistent with those in the IIHS/TIRF "blueprint" discussed earlier.

2.8. Michigan

The graduated driver licensing program implemented in Michigan in 1997 is also under evaluation (Elliott & Shope, 2003; Shope, Molnar, Elliott, & Waller, 2001). They have recently reported initial findings from their ongoing study. They found that, after adjusting for population-wide trends, the overall per capita collision rate of 16-year-old drivers declined significantly by 25% between 1996 and 1999. There were also significant reductions over this period in nonfatal injury crashes (a 24% reduction) as well as in crashes occurring at night (a 53% reduction between midnight and 5 a.m.), during the evening (a 21% reduction between 9 p.m. and 12 a.m.), and during the day (a 24% reduction between 5 a.m. and 9 p.m.). Although the per capita fatal crash rate also declined from 1996 to 1999, this difference was not statistically significant.

2.9. North Carolina

In a preliminary evaluation of the graduated licensing program implemented in North Carolina in 1997, Foss, Feaganes, and Rodgman (2001) reported that the per capita crash rate of 16-year-old drivers declined by 23% (or by 27% adjusting for the overall crash trend among drivers of age 25–54 years). Per capita crash rates declined for all levels of severity among 16-year-old drivers after the new program was implemented—fatal crashes by 57%, injury crashes by 28%, and noninjury crashes by 23%. Reductions were also observed for nighttime crashes (a 43% reduction between 9 p.m. and 5 a.m.) and daytime crashes (a decrease of 20%).

2.10. Ohio

The unpublished preliminary evaluation of the graduated licensing program implemented in Ohio in 1997 found that, after adjusting for changes in the crash rates of the control group (drivers of age 25–54 years), both the per capita and per-driver crash rates of teens licensed under the new program were lower than those of teens licensed under the old program (Department of Public Safety, 2001). The overall per-driver crash rate of teen drivers in the program, relative to drivers' age of 25–54 years, was 23% lower than the rate for teen drivers not in the program. Similar reductions were observed for collisions of all severities—fatal (a decrease of 24%), injury (a 21% decrease), and property damage only (a decrease of 23%)—as well as for alcohol-related collisions (a 27% decrease in the alcohol-related crash rate).

2.11. Summary

Evidence that graduated licensing does have safety benefits is growing. Indeed, every evaluation conducted to date has reported positive benefits with crash reductions ranging from 4% to over 60%. The magnitude of the crash reductions has varied considerably for two primary reasons. First, although jurisdictions have adopted some version of graduated driver licensing, the specific features of their programs also differ. Given the diversity of programs, it is not surprising that the magnitude of the crash reductions has also varied. Second, studies used a variety of research designs and analytic procedures to evaluate the safety effectiveness of graduated driver licensing, so findings from one study are not directly comparable to another.

Taken together, however, the consistent direction of the findings and the significant positive effects found in studies that have used sophisticated and solid research designs underscore that graduated driver licensing is an effective safety program. Importantly, the evaluations in Canada, where graduated licensing applies to all beginners, also demonstrate that safety benefits extend to novice drivers of all ages, not just young ones.

Although studies have consistently demonstrated that graduated licensing has significant safety benefits, less is known regarding the reasons why this is so (i.e., whether it leads to safer driving, or whether the benefits are attributable to delays in licensing and reductions in the amount being driven), especially during the extended period of supervised driving (i.e., the learner stage). Research also needs to be conducted to examine the relative contribution of each stage of the program (i.e., the learner and intermediate levels), as well as the longer-term impact of the program into full licensing. Importantly, ongoing studies in Michigan, North Carolina, Nova Scotia, and Ontario are currently attempting to address these issues more directly than has been the case in previous investigations.

3. Future directions

As noted earlier, the evaluations conducted to date consistently show that graduated licensing is associated

with significant and meaningful reductions in collisions. At the same time, it is evident that the reductions are by no means uniform, and at this point, we do not know how much of the variability is attributable to differences in the evaluation methodologies, to the sites where the studies have been conducted, or to fundamental differences in the programs themselves. This needs to be determined.

If most of the variability is determined by methodological factors, it suggests that the structure and contents of the program are relatively unimportant. On the other hand, if most of the variability is attributable to program differences, there is a need to know which features contribute most to collision reductions. This is one of several major questions about graduated licensing that still needs to be addressed. A few of these are outlined below as research needs and opportunities.

First, it is not clear why or how graduated licensing works (i.e., what the mechanisms are that produce the reductions in collisions). Does graduated licensing actually provide opportunities for—and produce—improvements in driving skills? Or, does it simply allow the beneficial effects of maturation to occur by delaying the time to full licensure? Or, are the reductions in collisions unrelated to experience or age and determined more by changes in exposure—quantitative, qualitative, or both?

Second, it is not entirely clear with whom the program works best. There is a substantial body of evidence (e.g., Mayhew & Simpson, 1990a, 1990b) that collision rates decline with increases in experience, even among older drivers, so it is not surprising that evaluations have found that graduated licensing is effective with new drivers of all ages. But, the Unites States is the only country (with the exception of New Jersey and Maryland) that applies graduated licensing just to young drivers (those under the age of 18 years). The New Zealand program now applies to drivers of all ages (although the conditions vary as a function of age), and all programs in the Canadian provinces apply to new drivers, regardless of age. Jurisdictions need to examine the age distribution of their new driver population to determine if the graduated licensing program should apply to all beginners, not just those who are young. In addition, there is some evidence that both males and females benefit from graduated licensing but the relationship between other person-centered characteristics and outcomes has yet to be determined. Such information might help refine the structure and content of the program.

Third, it is not yet clear which features of the program contribute to the observed reductions in collisions. Does the empirical evidence support the need for both the lengthier learner and a provisional stage? A partial answer to this question has been provided by the findings from a recent study (Mayhew et al., in press, 2002) cited earlier which found that most of the crash reductions occur during the learner stage. As well, it is not yet clear which of the many restrictions imposed on drivers during the learner and/or intermediate stages of graduated licensing are the most cost-effective—passenger restrictions, seat belt use requirements, night curfew?

Answers to some of these questions are explored in subsequent papers in this symposium, but it is evident from them that not all the answers are available as yet. However, they are essential for the design of a system that maximizes the potential for reducing collisions, deaths, and injuries. Such answers will hopefully evolve over time through carefully designed studies and will help guide a process of continuous system improvements that maximize the loss reduction potential of graduated licensing.

At the same time, it seems reasonable that graduated licensing cannot be expected to eradicate collisions among all those covered by the system. The fact that evaluations have found significant reductions in the range of 4–60% is evidence of this. It is critical that other countermeasures not be overlooked simply because of enthusiasm for graduated licensing. The causes of collisions and their resolution are too complex to be eliminated by a single measure.

References

Agent, K. R., Steenbergen, L., Pigman, J., G., Kidd, P. S., McCoy, C., & Pollack, S. H. (2001). *Impact of the partial graduated driver's license program on teen motor vehicle crashes in Kentucky.* Transportation Research Record, 1779. Traffic Safety 2001. Washington, D.C.: Transportation Research Board.

Automobile Club of Southern California. (2000). *California passenger deaths and injuries drop as graduated driver license law marks second anniversary.* News release.

Begg, D. J., Stephanson, S., Alsop, J., & Langley, J. (2001, December). *Impact of graduated driver licensing restriction on crashes involving young drivers in New Zealand* (5 pp.). Dunedin, New Zealand: Otago University, Injury Prevention Research Unit; Dunedin, New Zealand: Otago University Medical School, Department of Preventive and Social Medicine. Injury prevention (pp. 292–296), vol. 7, no. 4. Sponsor: Health Research Council of New Zealand. UMTRI-62598.

Boase, P., & Tasca, L. (1998). *Graduated licensing system evaluation: interim report*. Toronto, Ontario: Safety Policy Branch, Ontario Ministry of Transportation.

Bouchard, J., Dussault, C., Simard, R., Gendreau, M., & Lemire, A. M. (2000). The Quebec graduated licensing system for novice drivers: a two-year evaluation of the 1997 reform. *Proceedings of the 15th International Conference on Alcohol, Drugs, and Traffic Safety, T-2000, Stockholm, Sweden.*

Boughton, C., Carrick, C., & Noonan, G. (1987). Development of graduated licensing in Australia. In T. Benjamin (Ed.), *Young drivers impaired by alcohol and other drugs* (pp. 353–359). London, UK: Royal Society of Medicine Services.

Coppin, R. S. (1977). *Driver licence and driver improvement program. A national review.* Australia: Department of Transport.

Croke, A., & Wilson, W. B. (1977a). *Model provisional (graduated) licensing of young novice drivers*. Washington, DC: National Highway Traffic Safety Administration.

Croke, A., & Wilson, W. B. (1977b). *Model for provisional (graduated) licensing of young novice drivers*. Contract no. DOT-HS-6-01384. Springfield, VA: Technical Information Service.

Department of Public Safety (2001). An Evaluation of Ohio's Graduated Driver License Law. Columbus.

Eavy, P., Edwards, M., & Lee-Gosselin, M. (1987). *Group interviews for probationary drivers with low violation levels: an evaluation of the traffic safety impact*. Lansing, MI: Michigan Department of State.

Elliott, M. R., & Shope, J. T. (2003). Use of a Bayesian changepoint model to estimate effects of graduated licensing program. *Journal of Data Science*, *1*, 43–63.

Foss, R., Feaganes, J. R., & Rodgman, E. A. (2001). Initial effects of graduated driver licensing on 16-year-old driver crashes in North Carolina. *Journal of the American Medical Association*, *286*(13), 1588–1592.

Frith, W. J., & Perkins, W. A. (1992). The New Zealand graduated driver licensing system. *National Road Safety Seminar papers, vol. 2* (pp. 256–278). Wellington, New Zealand: Land Transport.

Gorys, P., Pang, H. C., & Rosenbaum, R. M. (1983). *Preliminary evaluation of the probationary driver program in Ontario—a study of the first year driving records of new drivers*. Toronto, Ontario: Ministry of Transportation and Communications.

Hagge, R. A., & Marsh, W. C. (1986). *An evaluation of the traffic safety impact of provisional licensing: interim report*. Sacramento, CA: Department of Motor Vehicles. Research report no. CAL-DMV-RSS-86-108.

Haworth, N. (1994). *Young driver research program: evaluation of Australian graduated licensing scheme*. Canberra, ACT: Federal Office of Road Safety.

Jones, B. (1994). The effectiveness of provisional licensing in Oregon: an analysis of traffic safety benefits. *Journal of Safety Research*, *25*, 33–46.

Langley, J. D., Wagenaar, A. C., & Begg, D. J. (1996). An evaluation of the New Zealand graduated driver licensing system. *Accident Analysis and Prevention*, *28*, 139–146.

Lynam, D., & Twisk, D. (1995). *Car driver training and licensing systems in Europe*. Crowthorne, Berkshire: Transport Research Laboratory.

Mayhew, D. R. (1996). Licensing systems for controlling the risk of young motorists. In H. Simpson (Ed.), *New to the road: reducing the risks for young motorists* (pp. 79–85). Los Angeles, CA: UCLA.

Mayhew, D. R. (2001). Safety effectiveness of graduated driver licensing in Canada and the United States. *Paper presented at the Novice Driver Conference, Wolfsburg, Germany, November 2001*.

Mayhew, D. R. (2003). The learner's permit. *Journal of Safety Research*, *34*(1), 33–41.

Mayhew, D. R., & Simpson, H. M. (1990a). *New to the road. Young drivers and novice drivers: similar problems and solutions?* Ottawa, Ontario: Traffic Injury Research Foundation.

Mayhew, D. R., & Simpson, H. M. (1990b). *Young drivers and novice drivers: similar problems and solutions?* Ottawa, Canada: Traffic Injury Research Foundation of Canada.

Mayhew, D. R., & Simpson, H. M. (1995). *The role of driving experience: implications for the training and licensing of new drivers*. Toronto, Ontario: Insurance Bureau of Canada.

Mayhew, D. R., Simpson, H. M., & Donelson, A. C. (1985). Young driver accidents: In search of solutions. Ottawa, Ontario: Traffic Injury Research Foundation.

Mayhew, D. R., Simpson, H. M., Groseillers, M., & Williams, A. F. (2001). Impact of the graduated driver licensing program in Nova Scotia. *Journal of Crash Prevention and Injury Control*, *2*(3), 179–192.

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

Mayhew, D. R., Simpson, H. M., Williams, A. F., & Desmond, K. (2002). *Specific and long-term effects of Nova Scotia's graduated licensing program*. Arlington, VA: Insurance Institute for Highway Safety.

McCartt, A. T., Leaf, W. A., Farmer, C. M., Ferguson, S. A., & Williams, A. F. (2001). Effects of Florida's graduated licensing program on the behaviors and attitudes of teenagers. *Journal of Safety Research*, *32*, 119–131.

McKnight, A. J. (1986). Interventions in teenage drunk driving. *Alcohol, Drugs and Driving*, *2*(1), 7.

McKnight, A. J., Hyle, P., & Albrecht, L. (1983). *Youth license control demonstration project. National Highway Traffic Safety Administration report*. Report no. DOT-HS-7-01765. Springfield, VA: National Technical Information Service.

McKnight, A. J., Tippetts, A. S., & Marques, P. R. (1990). *Provisional driver license system for follow-up evaluation of Maryland youth license control demonstration project*. Washington, DC: National Highway Traffic Safety Administration.

Preusser, D. F., Zador, P. L., & Williams, A. F. (1993). The effect of city curfew ordinances on teenage motor vehicle fatalities. *Accident Analysis and Prevention*, *25*, 641–645.

Preusser, D. F., Williams, A. F., Zador, P. L., & Blomberg, R. D. (1984). The effect of curfew laws on motor vehicle crashes. *Law and Policy Quarterly*, *6*, 115–128.

Rosenbaum, R., Hemsley, G., & Duncan, D. (1985). Ontario's probationary driver program: continuing evaluation. *Compte-Rendus de la Ivieme Conférence Canadienne Multidisciplinaire sur la Sécurité Routiere, Montréal, Québec, May 26–28.*

Shope, J. T., Molnar, L. J., Elliott, M. R., & Waller, P. F. (2001). Graduated driver licensing in Michigan: early impact on motor vehicle crashes among 16-year-old drivers. *Journal of the American Medical Association*, *286*(13), 1598–1599.

Simpson, H. M., & Mayhew, D. R. (1992). *Reducing the risks for new drivers: a graduated licensing system for British Columbia*. Ottawa, Ontario: Traffic Injury Research Foundation.

Ulmer, R. G., Williams, A. F., & Preusser, D. F. (1997). Crash involvements of 16-year-old drivers. *Journal of Safety Research*, *28*, 97–103.

Ulmer, R. G., Preusser, D. F., Williams, A. F., Ferguson, S. A., & Farmer, C. M. (2000). Effect of Florida's graduated licensing program on the crash rate of teenage drivers. *Accident Analysis and Prevention*, *32*(4), 527–532.

Ulmer, R. G., Ferguson, S. A., Williams, A. F., & Preusser, D. F. (2001). Teenage crash reduction associated with delayed licensure in Connecticut. *Journal of Safety Research*, *32*, 31–41.

Waller, P. F. (1975). *Education for driving. An exercise in self delusion*. Chapel Hill, NC: Highway Safety Research Center.

Waller, P. P. (1974). The changing task of driver licensing. *Future role of driver licensing in highway safety.* Washington, DC: Transportation Research Board.

Warren, R. A., & Simpson, H. M. (1976). *The young driver paradox*. Ottawa, Ontario: Traffic Injury Research Foundation.

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

Williams, A., Lund, A., & Preusser, D. C. (1985). Night driving curfews in New York and Louisiana: results of a questionnaire survey. *Accident Analysis and Prevention*, *17*(6), 461–466.