Aging School Bus Drivers: Is Mandatory Retirement Appropriate?

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Abstract

There exists very little evidence to determine whether aging school bus drivers pose an increased safety risk with advancing age since few drivers have continued to work beyond age 65 in those jurisdictions that do not have mandatory retirement policies. Consequently, there have not been opportunities where direct data are available to empirically show how safety risk might change as school bus drivers advance in age beyond traditional retirement limits. This creates a knowledge void that is problematic as a recent trend shows an increasing number of drivers who wish to continue to drive beyond the traditional age of retirement.

The objective of this paper is to interpret past findings and illustrate how safety levels typically change in concert with advancing age among the general population of drivers. While school bus drivers are a subset of the general population, evidence is drawn from a recent study of older commercial truck drivers to show that similar trends exist even among professional drivers. Finally, a discussion is presented that associates the extraordinary tasks involved while driving a school bus with decreased capabilities commonly found among aging drivers. The paper is written in the context of a recent Human Rights hearing in New Brunswick which effectively resulted in the removal of mandatory retirement for school bus drivers at age 65.

Résumé

Il y a un manque évidence qui existe pour déterminer si l'âge d`un conducteur d'autobus a une corrélation avec un risque de sécurité élevé, pour la raison qu'il n`y a pas beaucoup de conducteur passer l'âge de 65 ans dans les juridictions qui ont une limite sur l'âge de retraite. En conséquences, il n`y a pas eu beaucoup d'opportunité pour collecter les données nécessaire pour représenter expérimentalement si le risque de sécurité élève avec une augmentation d'âge des conducteurs. Le problème associé avec ceci est qu`il y a une augmentation dans le nombre de conducteur qui veulent continuer de travailler passer l'âge traditionnelle de retraite. Les risques associés avec ceci ne sont pas évidents.

Cette dissertation a pour but d`interpréter les recherches précédentes pour voir si l'âge des conducteurs a une influence sur le niveau de sécurité dans la population général. Les conducteurs d'autobus sont seulement une fraction de la population générale. Basé sur une dissertation précédente concernant des conducteurs de camion commercial plus âgé, il est évident qu'il y a une tendance similaire chez les conducteurs de camion professionnel et l'augmentation d'âge. En conclusion, cette dissertation discute les tâches associées avec la conduction d'un autobus et le diminue de capacité associée avec l'augmentation d'âge chez les conducteurs. Cette dissertation a été rédigée dans le cadre d'un des droits de l'Hommes au Nouveau-Brunswick et a effectivement enlevée l'obligation de retraite pour les conducteurs d'autobus scolaire à l'âge de 65 ans.

INTRODUCTION

In February of 2010, The New Brunswick Labour and Employment Board issued a decision in response to a Human Rights Act complaint that effectively rendered the Department of Education's policy of mandatory retirement at age 65 discriminatory [1]. Consequently, the position that a driver must be under the age of 65 is a *bona fide* occupational qualification (BFOQ) was rejected by the Board's decision. While the case for mandatory retirement failed within the legal framework in this jurisdiction, a number of issues arose as a result of the testimony given at this hearing.

Although mandatory retirement of school bus drivers was present in a number of jurisdictions just a few years ago, the current landscape in basically all licensing jurisdictions in Canada essentially sees an accelerated rate of medical testing requirements with increasing age. The frequency typically becomes an annual requirement after the age of 65. Some jurisdictions also require increased educational/written and road testing after the age of 65. It is discussed later that there is a broad consensus among researchers that there currently is not an effective means to screen those drivers who pose an elevated safety risk associated with aging.

Strictly from a road safety perspective, important questions have been raised that need to be addressed by researchers in order to provide an objective basis to determine whether age-based mandatory retirement for school bus and other commercial drivers is warranted. This paper reviews some of the key issues that we currently understand and outlines the deficiencies that need to be addressed going forward.

STUDY OBJECTIVE

The objective of this paper is to interpret past findings and illustrate how safety levels typically change in concert with advancing age among the general population of drivers. While school bus drivers are a subset of the general population, evidence is drawn from a recent study of older commercial truck drivers to show that similar trends exist even among professional drivers. Finally, a discussion is presented that associates the extraordinary tasks involved while driving a school bus with decreased capabilities commonly found among aging drivers.

CAVEATS WHEN STUDYING ELDERLY DRIVERS

1. The reader must understand that there is no such thing as a "safe" driver; conversely, there is no such thing as an "unsafe" driver. There are only varying levels of risk that can be associated with different drivers as a result of their skills, behaviours, knowledge, cognition, physical capabilities and attitudes. It is impossible to identify a threshold (or even a metric) beyond which society would consider a particular or group of drivers to be unsafe. At best, one can only contrast the safety levels of different groups of drivers. Given the empirical evidence, it cannot be disputed that with advancing age, in general, drivers exhibit worsening safety performance when they drive. In the context of older school bus drivers, perhaps the most important question is how much of an elevated risk is tolerable from society's perspective.

2. Many road safety studies tend to delineate drivers by age groups for various comparisons. Often those over 65 years are grouped together into a single cohort (usually due to limited data or small sample sizes). We know from more focused studies that seniors are a very

heterogeneous group with varying capabilities and performance. In the context of senior drivers, it is not appropriate to rely on analyses that group all those over 65 together.

3. Road safety analyses that develop relationships for different age groups essentially report on 'group averages'. All groups have a degree of heterogeneity where some drivers perform better and some perform worse than the average values presented. To associate any individual with the performance characteristics of a group average would be inappropriate; however, our ability to delineate drivers of varying capabilities through testing remains problematic.

4. Many road safety studies of motor vehicle collisions are centered specifically on the analysis of accidents involving "fatalities". This is a reflection of the richer information that exists specifically for collisions where a fatality resulted. Interpreting plots of fatal collision rates in the context of older drivers can be misleading due to what is known as "frailty bias" [2-5]. Seniors are more likely to be fatality injured in a similar collision than younger people simply due to their increased frailty. As a consequence, even if they are involved in a similar number of collisions, older drivers tend to be over-represented in 'fatal' collision rates. The OECD [6] also cautions that "fatalities represent only a relatively small proportion of the total road safety burden and provide an inadequate indicator of total crash risk, especially for older drivers".

If the interest of the reader centers on a driver's likelihood or risk of being in an accident, rather than crash outcome or consequence, then data dealing solely with "fatal accidents" should be disregarded or at least interpreted with caution. More meaningful insight can be gained by looking at records that include all accident severities (property damage only, personal injury, and fatal).

INTERPRETING THE DATA

There are many different ways to express the collision experience of different age groups for comparative purposes. Accident or crash involvement may be measured in several different ways including simply counting the number of crashes (frequency) for different age groups. A simple frequency does not provide the insight that can be gained by an accident *rate* which can be determined in a number of different ways including [7,5]:

- Crashes per capita,
- Crashes per licensed driver,
- Crashes per vehicle miles driven, and
- Crashes based on the proportion of drivers at fault.

A very different perspective is gained for older driver crashes depending on how the data are calculated. For example, crash rates based on the numbers of licensed drivers, show that older drivers have fewer crashes than do younger drivers; however, based on miles driven, drivers over age 75 have the highest crash rate of any age group – even teenagers [8].

It is crucial that the data be properly expressed depending on the required perspective or exact question that is being asked. For example, if the question was:

"Do senior drivers, as a group, pose a significant safety risk to the motoring public?"

…..then the collision data for all levels of accident severity should be presented as a simple frequency versus age group plot. The literature is very consistent in the finding that, overall, the

issue of senior driver safety is a relatively small component of the motor vehicle collision population. Hence, from a public policy perspective, targeting other age groups or subpopulations would likely prove to be a more efficient use of safety promotion or license regulation. However, one factor that creates a strong undercurrent is the ever increasing proportion of seniors due to the demographic shifts associated with aging baby-boomers. For example, Statistics Canada [9] projects that the proportion of people aged 65 and older will increase from 13.7% in 2006 to 23.7% by 2031. As more of our population enters the older age groups, the proportion of seniors involved in collisions will also rise likely leading to a shift in the collision patterns.

What the above perspective does not recognize is that the population of older drivers is relatively small and it would therefore be expected that they would represent a small proportion of overall motor vehicle collisions. A different perspective of accident data would be required from an insurance company, for example, who would be more interested in the response to the following question:

"On average, how likely is each older driver to be involved in a collision for any given year?"

There are many data plots which provide insight to this question by dividing the collision frequency of each age group by the respective populations of drivers to yield an annual collision rate "per person. By expressing the collision rate on a per capita basis it has been shown that the elderly experience slightly elevated patterns with advancing age but, nevertheless, fair reasonably well compared to middle-aged and younger groups. Again, the pattern of these plots is very consistent throughout the literature.

The above relationships do not reflect the fact that, as a whole, seniors drive appreciably less than other age groups so fair comparisons are not made between age groups of relative risk levels on a mile-per-mile basis. Although the study is somewhat dated at this point, Hildebrand and Wilson [10] found that among New Brunswick drivers, those between 30 and 60 years of age average about 20,000 km. per year. This exposure drops to an average of about 15,000 km. for those in their early 60s, and then to around 10-11,000 km. for those 65 to 80 years. This rate then shows a steep and steady decline for those beyond 80 years. Those in their late 80's and 90's were found to drive less than 4,500 km. on average per year. Many other studies have quantified similar steady decreases in annual mileage driven as drivers advance beyond 60 years of age [3,11-13].

If one is interested in understanding the relative safety levels/performance of different age groups then it is important to ***normalize for exposure***. In other words, collision rates need to be developed that reflect differing levels of driving that are associated with each age group being compared. In other words, someone who drives 30,000 kilometres in a year would be *exposed* to more instances of collision risk than another who only drives 7,000 kilometres during the same time-frame. Importantly, from the **perspective of the issue of aging school bus drivers**, an appropriate question would be to ask:

"When they drive, are seniors more likely to be involved in a collision?"

The answer to this question would better reflect the potential risk associated with different drivers operating similar fixed-distance bus routes. To address the above question, it is important to look at analyses that have developed collision rates that include a measure of exposure. Typically, these analyses determine rates expressed as collisions**/**(million-vehicle-kilometre), or collisions/mvk where the denominator includes an age group's total driving

exposure (by taking the group's population multiplied by an estimate of their average annual mileage driven per person).

The results of analyses that have developed collision rates (per mvk) plotted by age group have consistently resulted in what are referred to as "U-shaped" plots. As shown in Figure 1, collision rates are comparatively high for the youngest and oldest age groups thereby yielding a U-shape. By including mileage driven per person, one can then compare accident risk of different age groups. The over-representation of younger and older groups is a universal relationship that is consistent in the literature. The data in Figure 1 are presented to illustrate the general shape of the relationship has been found to be consistent despite changes in study date and location.

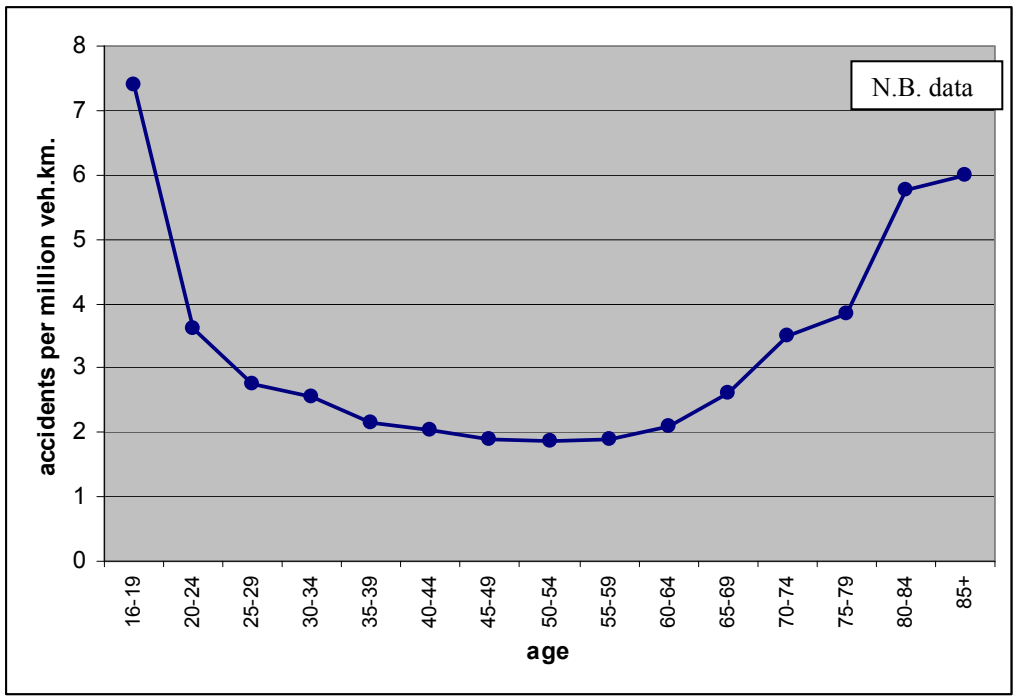

Figure 1: Crash Involvement Rates –per mile basis (New Brunswick data)
[source: Myrick, 2001]

The data in Figure 1 are generally consistent with the summary statements by expert witness Dr. Patricia Waller in the Human Rights Panel Decision [14]. Dr. Waller indicated that regarding collision rates "the decline starts with the late 50's and initially the elevation is relatively slow, but it goes up at an accelerating rate, so eventually when you are getting up into the late 70's and 80's, and if anything it is higher than with teenage drivers. The data is very consistent."

It is clear that on a mile-per-mile basis, on average, senior drivers experience increasing safety risk levels as age increases. This finding is also universal among the literature. Perhaps just as important to the issue of aging school bus drivers is:

"……at what point does the risk become unacceptable?"

As previously noted, there cannot be a definitive line drawn that separates acceptable risk from unacceptable. A reasonable judgment needs to be made that considers the increasing risk levels associated with each advancing age group.

Some authors have interpreted data such as that depicted in Figure 1 above by noting that there isn't a "significant" increase in safety risk until age 'x'. The term 'significant' is typically taken as a subjective opinion on behalf of the author (i.e., without association to any statistical meaning). It is clear that beginning when drivers enter late 50s or early 60s, the relative safety performance begins to worsen. The incremental change increases with advancing age. Since one cannot define a threshold beyond which the safety performance or risk is no longer acceptable then it is necessary to simply review the trends and relative performances of adjacent age groups to assist in developing policy.

Another way to help put into perspective the deterioration of safety performances of age groups, is to express the collision rate plots in terms of "relative risk" or indexing the rates to the safest cohort for comparative purposes. The data in Figure 2 are presented to illustrate the *relative* safety performance of different age groups based on Myrick's [13] work in New Brunswick. Consistent with the recommendations of Loughran and Seabury [40], the data are derived from relative collision rates of all accidents in general, rather than using fatalities only. They noted that "the ratio of accidents in general to VMT is likely to facilitate a much better estimate of the relative riskiness of older drivers than is the ratio of fatalities to VMT".

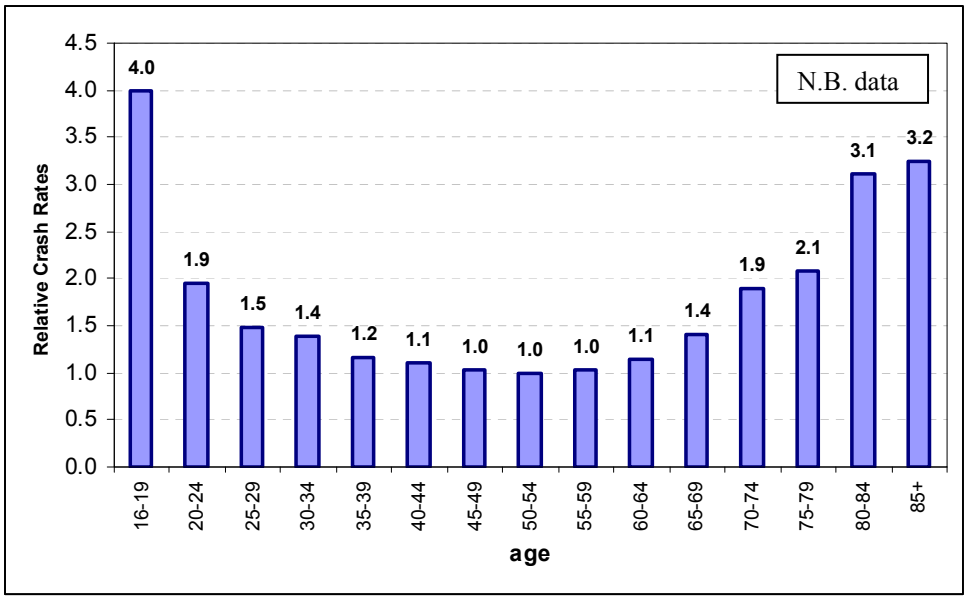

Figure 2: Relative Crash Rates for All Accident Severities (New Brunswick Data) [source: Myrick, 2001]

The data presented in Figure 2 indicate that New Brunswick drivers aged 60-64 are 1.1 times more likely to be in an accident than those between 45-59 years of age. Similarly, those aged 65-70 are 1.4 times more likely to be in a crash compared with those who are middle-aged. In other words, compared to middle-aged drivers, **there is 30% more chance that those in their late 60s will be in a collision than those in their early 60s given equal miles driven.** Those aged 70-74 are 90% more likely than middle-aged, and so on. These data were found to yield similar relative factors as those found by Fitten [15] using 2002 California data when his data is indexed in a similar manner.

EXPLANING EXPOSURE

Figures 1 and 2 above provide a means to compare the safety risk associated with different age groups while normalizing for the amount that each group drives on average. This is essentially a way to account for differing levels of being "exposed" to the risk of an accident. While mileage driven is a quantifiable proxy for exposure, there are other variables that are not included. For example, a mile driven in a heavily congested urban area exposes a driver to a greater chance of being in a collision than if they were to accumulate that mile on a divided highway in a rural setting. Further, differences when driving including weather, lighting condition, pavement condition, speed, traffic volumes, traffic control (signals, stop signs, etc.), road classification etc. all impact the risk of being involved in a collision.

In order to compare collision rates between different age groups it would be ideal if the collision frequencies could be normalized to include not only mileage driven, but under what conditions. Unfortunately, researchers have not reached a point where all exposure variables can be included for such comparisons. It is, however, important to note that senior drivers, on average, tend to engage in ***self-regulation*** for a number of reasons which largely results in a lowered risk of exposure given the choices that they make.

Findings from a literature review undertaken by Molnar and Eby [16] found that several studies indicated that older drivers self-regulate by reducing their driving exposure (e.g., taking fewer trips and/or driving shorter distances). They also found evidence that, in general, older drivers self-regulate by avoiding specific driving situations such as driving at night, in poor weather (rain, fog, snow, etc.), in heavy traffic or during peak traffic periods, and making left turns. Many studies beyond the Molnar and Eby review confirm these findings [13, 17-21] summarized an extensive literature review of older driver adaptations with the following compensations:

- Reduce operating speed
- Reduce number of kilometres driven
- Reduce highway driving/increase urban driving
- Avoid peak hours
- Avoid limited access highways
- Do not drive at night
- Carry fewer passengers
- Avoid driving in ice/snowy conditions
- Drive familiar routes
- Avoid driving in unfamiliar cities
- Avoid complex intersections
- Increased scrutiny of surroundings
- Reduce attentional load (e.g., know the route, turn off radio)
- Avoid making quick maneuvers

It is conceded that despite self-regulation, hazardous situations cannot be completely avoided including shopping centers which Ossenbruggen *et al.* [41] have been shown to be almost twice as risky for crash involvement as a typical village site.

It is interesting that many of these self-adaptations are not possible in the context of school bus drivers. Rates (or the extent) of self-reported avoidance were found to vary widely among the different studies reviewed. Furthermore, mixed results are also found with regard to the association between self-regulation by older drivers and the specific functional declines they may be experiencing.

The net result of the trend among seniors to self-regulate is that the kilometres that they do drive, are generally less risky than those of younger drivers. Consequently, the U-shaped plots would likely tend to underestimate the collision rates among seniors if all facets of exposure could be considered. It is important to note that school bus drivers are not afforded the opportunity to self-regulate.

A final issue related to exposure that needs to be addressed is that some researchers are promoting "low mileage bias" as perhaps a partial explanation for the over-representation of senior drivers in mileage-based collision rates [12, 22]. Some have generalized that drivers who exhibit low annual mileages would intuitively do most of their driving in urban environments. Conversely, higher mileage drivers would tend to drive proportionately more on rural or freeway type facilities (which have lower overall safety risks compared to urban streets). They argue that since seniors, on average, exhibit lower mileages then most of their driving must be in urban environments exposing them to riskier situations. These arguments neglect the robust information that does exist that documents the propensity of seniors to self-regulate or modify their driving patterns that coincide with less risky exposure. Further, in the context of New Brunswick where nearly half of the drivers live in rural areas, Hildebrand and Myrick [19] undertook analyses that found rural-based senior drivers actually perform worse than their urban counterparts.

AGING COMMERCIAL DRIVERS

Perhaps a criticism of the above comparisons is that they involve different age groups representing all drivers from the general population and that the expected safety performance of professional school bus drivers cannot be inferred from these data. Although there are no recent studies that have examined the performance of school bus drivers, Hildebrand and Morrison [23-24] completed an extensive analysis of collisions among older commercial truck drivers in New Brunswick. The following sections summarize the results from this study with the premise that truck driver duties may be more closely related to those of school bus drivers than the general driving public.

The study's overall goal was to develop a better understanding of the safety issues surrounding elderly commercial drivers in New Brunswick. To achieve this, an examination of the collision involvement of older commercial truck drivers was conducted. Eleven years (1993-2003) of all police-reported accidents were extracted from the New Brunswick Department of Transportation's collision database. Only collisions involving heavy commercial trucks (trucks over 4500kg, truck tractors, and truck tractors with towed units) were used for this study resulting in a total of 7,880 heavy vehicle collisions described in this dataset for the 11-year period. Within this dataset, 282 collisions were associated with drivers aged 61-70, while 48 involved those over 70 years of age. It is important to note that these values are not a sample; rather, they represent the entire population of commercial truck collisions over this 11-year period.

These data were then combined with driver exposure estimates from the 1999 National Roadside Study. Estimates of driver kilometres were needed to normalize collision data to allow comparisons between age groups. The 1999 National Roadside Study (NRS) estimates were used for this purpose. The NRS involved a total of 238 data collection sites (DCS) spread across the 25,200 km of highways that make up the main components of the Canadian network used by the trucking industry, referred to as the Study Highway System (SHS). The analyses yielded comparisons between the safety of older and younger commercial truck driver age groups.

It should be noted that Matteson [25] found that in 2002 in the United States drivers of heavy trucks over the age of 65 years only represented 2.9 percent of a fatal truck collisions. While this could initially indicate that this cohort of commercial drivers is not a safety risk, the data do not reflect the collision rates 'per driver' nor do they include exposure variables.

The data depicted in Figure 3 are based on the New Brunswick study and show that a U-shaped plot consistent in shape with those for the general driving population results. The highest accident rates for commercial drivers also occur in the youngest and oldest age groups. In this figure, the collision rates are expressed in relative terms, so it is seen that drivers aged 61-70 are 1.57 times more likely to be in a collision than those aged 41-50. Collision experience sky-rockets for those older than 70 years of age who were shown to be over 7 times more likely to be in a collision than those 41-50 years old. When compared to a "mean" collision rate (for all age groups collectively), the rates for the 61-70 year old drivers were 1.4 times higher, while drivers over 70 years old experienced rates 6.3 times higher.

The collision rates for New Brunswick commercial truck drivers were plotted against those found by Myrick [13] for all categories of New Brunswick drivers. Both sets of data are plotted in Figure 4, allowing the following observations:

- Collision rates among commercial truck drivers were approximately equivalent to those of general drivers for those younger than 60 years of age.
- Collision rates of the older drivers (61 years old and over) were higher among commercial truck drivers versus general drivers.
- The average collision rate for commercial truck drivers in the age range of 61-70 years old was 36% higher than for general drivers.
- The average collision rate for all commercial truck drivers over 70 years old was found to be 243% higher than for general drivers.

These data indicate that aging seems to have a more detrimental impact on the driving performance of commercial truck drivers than for general drivers. There are likely many reasons for this disparity including the increased driver load, complexity of the driving task, and inability to self-regulate. It is not unreasonable to assume that school bus drivers would experience an acceleration of relative collision risk in line with those depicted in Figures 2 and 3.

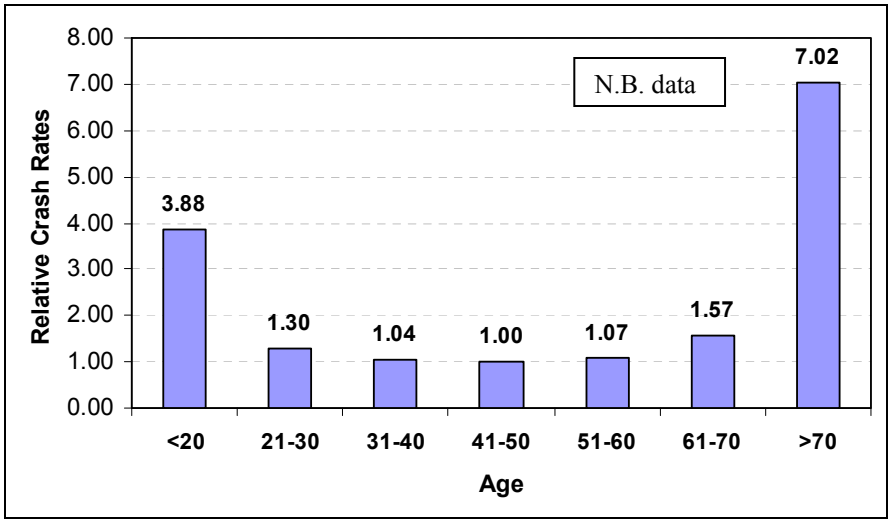

Figure 3: Relative Crash Rates for Commercial Truck Driver Accidents
[source: Hildebrand and Morrison, 2006; Morrison 2006]

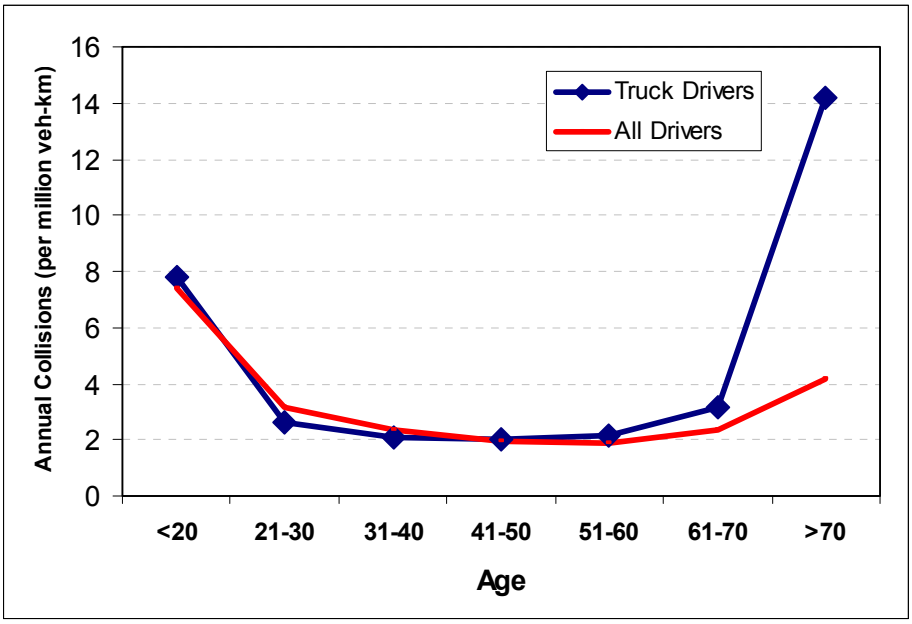

Figure 4: Comparison of Collision Rates of General Drivers to Commercial Truck Drivers (New Brunswick Data)
[source: Hildebrand and Morrison, 2006; Myrick 2001]

ACCIDENT RESPONSIBILITY

While it is clear that as drivers age beyond about 60 years they are increasingly at-risk of being involved in a collision, however, one also needs to understand how they share responsibility for having caused the crash. Again, the literature is consistent in showing that as we advance with age, the propensity to have caused the accident increases dramatically.

The data in Figure 5 illustrate the typical shape of accident responsibility versus age group. Rothe [26] assigned accident responsibility through examination of police and insurance adjuster statements for a 2-year dataset covering 88,000 collisions in British Columbia. He noted that the results are robust since the smallest sample size for any point on the plot is 118 and that most had over a thousand observations. Assigning accident responsibility often involves some subjectivity, however, Rothe notes that all data are based on the observations of at least two people (police and insurance) and are represented by statistically significant sample sizes. The data illustrate that there is an exponential looking relationship beyond age 65. Rothe also notes that these data are consistent with other findings such as McKelvey *et al.* [27] as well as Verhaegen *et al.* [28].

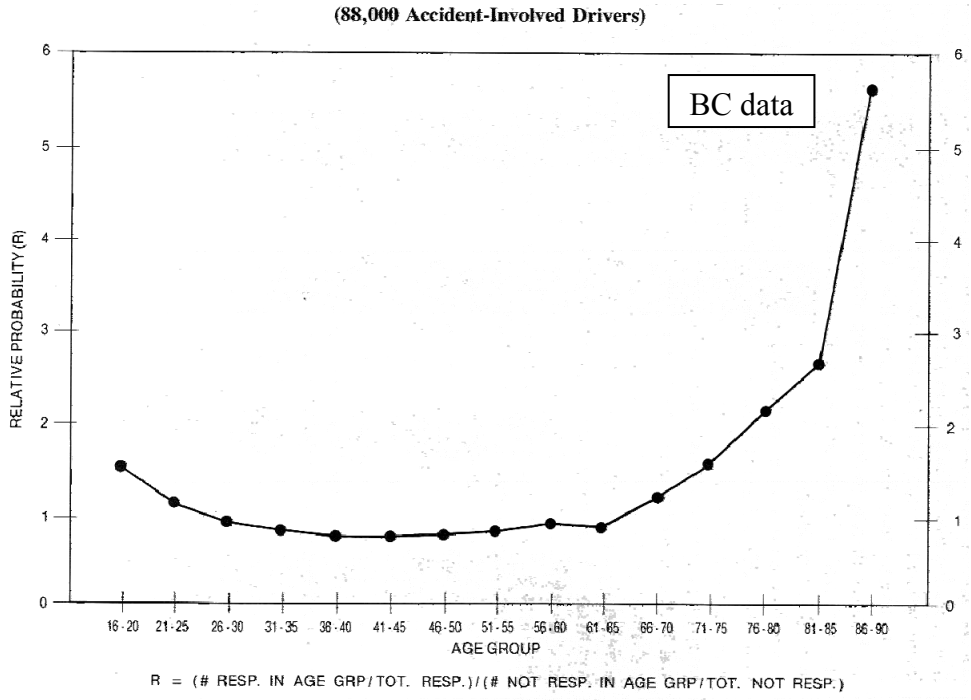

Figure 5: Relative Probability of Accident Responsibility by Age
[source: Rothe, 1990]

SCHOOL BUS DRIVERS

There has been very limited research that has directly addressed the issue of older school bus drivers. The few studies that do exist are typically dated, present vague results, or are based on very small sample sizes so results are difficult to interpret. Nevertheless, the findings seem consistent with those relationships described for general drivers documented in Figure 1 above.

Julian Waller refers to a 1970s study undertaken in the State of Iowa where school bus drivers were allowed to drive until age 70 if they passed a semi-annual medical examination [14]. Waller notes that “the increase in crash rates for older school bus drivers changes appreciably for the worse at around age 55 or 60 and continues to get progressively worse as age increases”.

A study by McMichael [29] examined North Carolina school bus accidents by driver age, however, since the study focus was on younger drivers, all older drivers were grouped into an ‘over 55’ group which prevents detailed interpretation.

A study undertaken by the New York State Department of Motor Vehicles (1979) examined the driving records of school bus drivers. The authors concluded that “in general, school bus drivers less than thirty and over sixty-five years of age have a disproportionately large number of accidents, compared to school bus drivers in the intervening age groups”. No further details are known.

In the context of seniors driving school buses there are a number of studies of accident characteristics whose results are particularly problematic given the need to drive on fixed routes and the slower/longer turning characteristics of a school bus.

Studies of elderly driver crash patterns consistently find a strong over-representation of intersection related accidents where they have failed to yield the right-of-way. The OECD [30] notes that "a greater proportion of older drivers' crashes occur at intersections, where typically the older driver is turning against oncoming traffic with right-of-way on the main road". Bowles [31] notes that one-third of all deaths that occur at intersections are the elderly and half of those die while attempting a left-turn. These findings are reinforced by Myrick [13] who found that in New Brunswick the proportion of 'turning left' and 'failure to yield right-of-way' collisions increase considerably beyond age 55 years. Poor vision and judgment have been attributed to these errors [32].

A further finding is that there is a sizable increase in the proportion of accidents where driver inattention was listed as a contributing factor beginning at about age 65. Considering older school bus drivers, the need to divide their attention between driving and managing children may prove to be particularly problematic as age increases.

Finally, Myrick [13] found that seniors have a disproportionate number of collisions that occur as they are pulling into traffic from a stop. Again, in the context of school bus drivers, this is a frequent maneuver related to picking up/dropping off children that cannot be avoided or self-regulated.

Dr. Patricia Waller identified the following factors that make school bus operation more demanding than operating a personal vehicle [14]:

- Bus is longer and more difficult to maneuver and control
- Starting and stopping to unload children (a maneuver that accounts for the most fatalities)
- Moving in and out of traffic during peak traffic periods
- Operate on a fixed schedule
- Out-of-town activities on unfamiliar roads
- Concurrent management and responsibility for monitoring children
- Driver must maintain vigilance in the presence of distractions

In summary, many of the known problem areas for senior drivers as a whole cannot be avoided by school bus drivers who are unable to modify their driving habits in order to adapt to age-related conditions. The higher level of task load and required diligence could result in even higher collision rates for senior school bus drivers than senior drivers in general.

LIMITS OF OLDER DRIVIER TESTING

There is consensus in the literature that it is not aging itself that leads to poorer driving performance; rather, it is the increased onset of medical conditions (associated with ageing) that elevates risk. Cognitive status, visual ability, and physical ability have all been shown to play a major role in a driver's ability to drive safely. Safety implications are often extremely difficult to assess since there are typically the presence of more than one condition in varying degrees of severity. Dobbs [33] identifies the following medical conditions as 'red flags' for increased crash risk:

- Visual impairments/illnesses
- Hearing
- Cardiovascular disease

- Cerebrovascular disease
- Peripheral vascular diseases
- Diseases of the nervous system
- Respiratory diseases
- Metabolic diseases
- Renal diseases
- Musculoskeletal disabilities
- Psychiatric disease
- Medication/drugs

The linkage between ageing and increased accident involvement is largely explained by changes in medical conditions. Stutts and Wilkins [34] summarized much of the research in this area by noting:

"As a group, older drivers have poorer visual acuity, reduced nighttime vision, poorer depth perception, and greater sensitivity to glare; they have reduced muscle strength, decreased flexibility of the neck and trunk, and slower reaction times; they are also less able to divide their attention among tasks, filter out important stimuli, and make quick judgements".

Regulation 10(1) of New Brunswick Regulation 2001-51 under the Education Act [35] requires school bus drivers "where the person is between sixty and sixty-five years of age, the person must successfully pass, each year, during the month of the person's birthday, (i) a medical examination by a medical practitioner or a medical examination prescribed by the Minister of Public Safety, and (ii) a driver's examination conducted under the authority of the Minister of Public Safety". The intent is to screen out those drivers where a medical impairment would preclude the safe operation of the school bus. Unfortunately, such a screening process has globally been found to be largely ineffective at reducing accidents as noted below.

A common complaint among the medical profession is that they either do not have specific tests that they can undertake relative to driving ability in a consultative environment or that the tests take too long to administer [32].

Fitten [15] noted that:

"There is no single screening procedure or test with sufficient technical efficacy that can reliably and economically separate safe senior drivers from those that are clearly more at risk for serious road crashes. Given the nature of driving, the most common disorders with high potential impact on driving safely are those of the eye, the brain and the musculoskeletal system. These are quite diverse, and it is unlikely that any single test could identify all deficits in facilities important to driving. Even standard, state-sponsored driving tests may be inadequate in identifying many older drivers with important cognitive deficits".

It is interesting that even vision testing is not found to have a strong relationship with increased accident risk. Owsley [36] noted that "while acuity is the most frequently tested aspect of vision. Its association with crash risk is weak and cannot effectively identify high-risk older drivers".

Canadian-based research by Bedard *et al.* [37] has confirmed that it is not currently possible to develop a means to screen those drivers who will perform poorly going forward. They noted that their "analyses demonstrated that it is not possible to predict accurately who would have a poor driving performance".

Following an extensive review of age-based, on-road and off-road assessment programs from many countries Whelan *et al.* [2] conclude that the bulk of current evidence cannot provide a direct link between a test outcome and eventual crash risk. While some of the screening tests developed have been evaluated against on-road driving, they are rarely, if ever, validated against crash involvement [32]. Regarding age-based mandatory assessment programs, they noted that "there is little evidence to support the continued existence of assessment programs of the type used by licensing authorities as a condition for continued licensing."

Whelan *et al.* noted that following an assessment "authorities need to be able to justify their decisions in terms of demonstrable and quantified crash risk". They point out that the Canadian-based DriveABLE™ In-Office Test has been shown to accurately predict the results of the DriveABLE™ Road Test; however, a demonstrably strong connection between the road test and potential crash outcome has yet to be made.

Hakamies-Blomqvist *et al.* [4] described general age-based screening of fitness to drive as a 'Jack-in-the-box' safety measure, liable to emerge in specific situations but lacking any demonstrable safety benefits. A major reason for this ineffectiveness was:

"While certain drivers undoubtedly have higher risk of accident than others, and in some cases for age-related reasons (such as dementing illnesses whose incidence grows with age), it is difficult to find correlations between single functional measures and risk, even the most carefully done studies …. end up with correlations so low that they cannot be used as decision criteria" (p. 59).

A working group of members from the Organization for Economic Co-operation and Development (OECD) undertook a review of policies among member countries and strongly opposed programs in place by licensing authorities as they were ineffective at identifying at-risk drivers [30]. They were unable to demonstrate any crash reduction benefits when compared to jurisdictions with no regular assessment programs.

A recent study undertaken by the Monash University Accident Research Centre [38] compared the accident experience of two Australian states that have different relicensing policies for older drivers. In Victoria there is no age-based assessment required for re-licensing, while in New South Wales (NSW) drivers aged 80 years and older are required to provide annual medical certificates and from age 85, are required to pass on-road driving tests. The comparison of accident experiences between the two different states found that

"…there were no statistically significant differences across the two jurisdictions. These findings collectively suggested that age-based mandatory assessment programs do not have demonstrable safety benefits, in terms of either total fatalities or other road user fatalities—thereby broadly confirming the findings from previous research based on older driver crash involvement."

A number of jurisdictions offer driver refresher or retraining courses which target elderly drivers. Some are classroom based while others provide on-road refresher training. Examples include the Canadian Safety Council's 55-Alive/Mature Driving program (adopted from the AARP program) and the Safe Driving for Mature Operators program developed by the American Automobile Association. The main criticism of these programs is that most do not yield measurable (statistically significant) benefits. Even when a program can be shown to yield improved skill test (written or road) scores, there is no evidence to indicate the drivers go on to experience a reduction in crash involvement [2, 39, 14].

Although much effort has gone into the deployment and development of testing and screening programs geared toward senior drivers, it is unfortunate that, to date, there has not been a system that is shown to be an effective tool to delineate those drivers who will pose a substantially greater safety risk in the future. The myriad and varying degrees of age-related impairments result in a very complex condition that some drivers are able to negotiate while others find it much more difficult to adapt.

DISCUSSION OF RESULTS

The following items highlight some of the key points raised in this paper:

- When studying the safety-related impacts of aging on a target group of drivers (*e.g.*, school bus drivers) it is important to consider exposure and to include all severities of collisions (not just fatalities) in the analyses.
- All empirical evidence indicates that, on a per-mile basis, older drivers are less safe than middle-aged drivers and that their relative risk to crash will increasingly worsen with advancing age.
- Despite degrees of self-regulation and a lack of engagement of high risk behaviour, older drivers have relatively high crash rates that progressively increase with age.
- General drivers in New Brunswick aged 65-69 are approximately 30% more likely to be in a collision than those in their early 60s (on a per-mile basis). This crash risk level is approximately equaled by those in their late 20s or early 30s.
- General drivers in New Brunswick aged 70-74 are approximately 80% more likely to be in a collision than those in their early 60s (on a per-mile basis). This risk level is only exceeded by teenagers and drivers that are even older.
- Commercial truck drivers in their 60s are approximately 50% more likely to be in a collision than those in their 50s (on a per-mile basis). The only other age groups that have a higher relative crash risk are teenagers and those over 70 years of age.
- In New Brunswick, the average collision rate (per-mile basis) for commercial truck drivers aged 61-70 was found to be 36% higher than for general drivers. Comparative rates for all younger age groups are approximately equal. This suggests that a higher driver work load associated with operating a commercial truck is more problematic for older drivers.
- School bus drivers have a higher task load than general drivers and are unable to self-regulate or adapt their driving patterns to reduce higher risk exposure. Both are key issues in the context of advancing age.
- Collisions involving intersections, left-turns, and starting in traffic are over-represented by senior drivers. These maneuvers cannot be self-regulated by school bus drivers.
- Driver inattention is an accident cause that is much more prevalent among older drivers. This may prove particularly problematic among school bus drivers who must divide their attention between the driving task and monitoring passengers.
- The literature consistently finds that there are no known procedures that have been proven to reliably screen older drivers that pose elevated safety risks.

It is clear that safety risk slowly begins to increase beginning for those in their late 50s and early 60s. Furthermore, the *rate* of deterioration accelerates with advancing age. These are

observations for populations as a whole and, of course, individuals will be affected to varying degrees. While an individual may be perfectly competent to operate a school bus beyond the traditional age of retirement, as a group, drivers can be expected to be more often involved in a collision and most often at-fault. The additional demands beyond traditional driving that school bus drivers face are likely to be particularly challenging in the face of age-related conditions. It is clear that there exists an age-related deterioration in driving skills that should be exaggerated in the context of a high-demand environment such as driving a school bus. It is now up to the research community to develop sufficient direct evidence to either support or reject the notion that some upper age threshold should be incorporated into a *bona fide* occupational qualification.

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