

The challenge of safe driving among elderly drivers

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The challenge of ageing has two key aspects with regard to driving: mobility and safety. It is necessary for elderly adults to preserve independent mobility and activity; however, physical frailty and cognitive limitations have negative effects on their safety. Therefore, the issue of driving, and more specifically, the fostering of safe driving of old people, is crucial, especially due the increasing number of elderly people holding a driving license. The purpose of this Letter is to point out the complexity of elderly driving and to suggest countermeasures by acknowledging that obtaining the correct balance between safety and mobility of older drivers is a complicated and sensitive task. To address this issue, the authors suggest accommodating their driving behaviour and patterns, in light of the deteriorating driving skills, by integrating social and policy procedures and use of emerging technologies. Policy steps to support elderly drivers and their loved ones by gradually controlling driving of elderly population when this becomes risky to them may serve as a desired countermeasure according to a proved tool such as technology. Utilisation of advanced technologies can help to monitor travel and driver behaviour and ability to make the necessary alterations, based on elderly driving skills.

1. Introduction: The number of elderly adults (ages 65 and above) in Israel, similar to other places, is gradually increasing over the years [1–3]. The elderly accounted for less than 5% of the Israel population in 1960. However, according to population forecasts, adults aged 65 and above are expected to constitute 12% of the population in 2020 and to 14% in 2030 [4]. In line with this trend, the number of elderly drivers is expected to significantly increase. Furthermore, the share of driving license holders among elderly adults worldwide is higher than ever and is expected to further increase as driving became an integral part of mobility, and a key issue for health and well-being of elderly adults [2, 3, 5, 6].

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The social dilemma of driving is complex. Driving allows the elders to manage an active life, maintain social ties, and contributes to their self-confidence. Studies have shown that cessation of driving in old age may be very costly; it accelerates dependency, depression, decline in physical functioning and social interactions, even when alternative transport modes are available [7–9]. However, driving is a complex activity that requires skills and adequate functioning of vision, cognition, and mobility ability. Age-related changes in these human factors can make driving unsafe and intensify the severity of the injuries [2, 6, 10, 11].

This Letter sheds light on the complexity of elderly driving and suggests potential policy and technology countermeasures, which may contribute to promote safe driving among elderly. The purpose is to address the key problem – how to obtain the balance between safety and mobility of older drivers by integrating social and policy procedures and use of emerging technologies in order to promote elderly safe driving. In the following section, we review travel and driver behaviour of elderly and refer to their casualty. Then we present a number of policy and technology countermeasures that may contribute to achieve the goal. Finally, we discuss and conclude.

2. Travel and driver behaviour of the elderly: The statistics and studies are unclear regarding whether the rate of car crashes is higher for elderly drivers in comparison to other age groups. In Israel, the rate of fatality and severe injury in road crashes among age group 65 and above is meaningfully higher than their share in the population, especially when travel mileage (relatively low for elderly drivers) is taken into consideration [1, 12]. For example, in 2011, it was almost double – 19% compared to 10% [12]. However, more than half were pedestrians. This trend remains consistent over the years and reflects the safety problem of elderly as vulnerable road users. This data is in line with the international literature which indicates that older adults represent a much larger proportion of passengers and mainly pedestrian fatalities in road crashes [13].

There seems to be no indication that elderly drivers' involvement in fatal and severe road crashes is higher than other age groups and the literature is ambiguous about this issue [3]. In the Netherlands, Israel, and in the US, for example, a comparison of drivers' injury rate by age group shows the well-recognised U-shape; i.e. the highest for the youngest age group, then a decline which is followed by an increase for the oldest [14, 15]. However, in the US, e.g. the fatal crash involvement rate for drivers 70 and older has declined since peaking in the mid-1990s due to decreases in crash involvement and in the risk of dying in the crashes that occurred. The trend in fatal crash involvement rates has been recently slowed but not reversed [15]. Nevertheless, it should be noted that compared relative collision rates of older drivers to those of other age groups are complicated; the comparatively greater fatality rates of older drivers can be accounted for by their greater frailty and lower resilience to injury [16].

Along with these trends, findings clearly suggest that there are changes in driving behaviour as people become older. The literature shows a decline in the annual mileage travelled, more daytime travel, and more urban and local travel, in surroundings that are considered less cognitively and visually demanding, in a manner which is perceived as 'self-restricted driving' [3, 14, 16, 17]. Findings have indicated that many old Israelis are conscientious drivers. That is, when their confidence in their driving abilities decreases, they take the initiative and either drive less under certain conditions

such as night, heavy traffic, long distances, bad weather and other difficult road and traffic conditions, or voluntarily do not renew their driving license [5]. These changes in travel behaviour may also bias the elderly drivers' rate of involvement in road crashes but, as will be further discussed, do not diminish the extent of the problem and need to be controlled.

There is some criticism on whether an age-based licensing screening criterion is necessary since older drivers are not over-involved in crashes once their driving frequency and fragility are controlled. Performance tests do not differentiate mental and physical disabilities [18] and the cost-benefit ratio of vision and medical testing for elderly drivers is less than 1.0 as only 0.3% of crashes of drivers aged 75 and above is caused by these conditions [19].

Dementia deserves a special emphasis because it presents a significant challenge to driving safety. With progressive dementia, patients ultimately lose the ability to drive safely and the ability to be aware of this. Furthermore, drivers coping with Alzheimers' disease have been found to have a 2.5–4.7 increased risk for involvement in motor vehicle collisions when compared to healthy older adults [20]. Therefore, dementia patients may be more likely than drivers with visual or motor deficits (who tend to self-restrict their driving to accommodate their declining abilities) to drive even when it is highly unsafe for them to be on the road [21]. Fitness to drive studies in older adults with dementia indicates that 90% may be able to pass a road test, whereas 40% may fail at a mild level of cognitive impairment [22]. Individuals with mild cognitive impairments or early dementia can benefit from being evaluated by a driving rehabilitation specialist. However, individuals with moderate to severe dementia can benefit from driving retirement. Assessing when these decisions and transitions should be made are complex and demand professional guidance [23, 24].

Some studies show that older drivers tend to self-regulate and assess their driving behaviour while taking into account their driving environment and their perceived physical and mental capacity to drive. However, this is not optimal as many drivers tend to overestimate or underestimate their abilities [25, 26]. While no substitute for professional assessment, self-assessment may help create a constructive discussion between older drivers and their family, and may also provide useful feedback on their driving and mobility abilities. Therefore, creating a better understanding of actual capabilities and driving behaviour is needed [16].

3. Policy implication: In most US states, licensing requirements are identical for all age groups and the passing criteria are based only on functional performance [27]. While screening and assessments made by the licensing authority were found to be effective in identifying impaired drivers, functional capacity screening significantly predicted driving impairment risk among elderly drivers [28]. In-person renewals and vision tests for older drivers in particular, can contribute to reducing traffic injury [29]. For example, in California, a law requiring drivers above the age of 80 to pass a vision test before license renewal has decreased fatality in this age group by 17%. However, there has been criticism as commonly used vision screening for license renewal does not explain many unsafe driving issues [30].

Similar practice applies to the Israeli case: currently the authorities either renew older driving licenses based on a rapid eye examination and a physician's short report every five years for drivers aged 70–80 and every two years for drivers above the age of 80 [31]. The Israeli law requires physicians to report to the authorities all patients who suffer from medical conditions that could possibly impact their ability to drive safely but does not determine driving competence. The Israel State Comptroller [32] reported that only 5% of the physicians reported patients whom they identified as suffering from a deterioration of skills that could result in dangerous and incompetent driving.

Programs, such as training courses, community outreach and media campaigns may enable older drivers' independent mobility

through driving while increasing their own safety and of those around them. Studies found that even basic driving training is essential among older drivers who comprehend significantly less road signs [33] and thus many organisations offer refresher courses aimed at older drivers [19]. However, while these courses improve awareness to impairment and driving behaviour and increase self-regulatory behaviour, they do not reduce crash rates [34, 35].

4. Technology implication: Technology is evolving rapidly. Recent advances in information technology and embedded intelligent systems are offering new ways to improve driver performance [2]. New advanced systems range from monitoring systems (which document actual driving performance with emphasis on unsafe events such as: speeding, hard braking etc.), through warning systems (which warn on potential risks such as: close following, lane keeping, fatigue detection or blind-spot detection), to systems that actually interfere with driving (such as adaptive cruise control (ACC), emergency stopping, and parking assistance).

However, drivers need to learn these systems, to get used to them and to adjust their driving accordingly [2]. For the foreseeable future, even automated vehicle technologies, will continue to rely on a 'responsible' driver to oversee the technology and be capable of resuming control and having the foresight to make many strategic operational decisions [7].

Older drivers in particular are more susceptible to confusion and uncertainty regarding how to react to automated systems because their established behaviour patterns are often difficult to modify without appropriate orientation and education [36]. The successful deployment and adoption of these systems will play an important role in the successful transition of elderly drivers towards vehicles equipped with such systems.

With recent improvements in virtual reality (VR) technology, driving simulators seem to offer a promising alternative to on-road methods of driving assessment and training [37]. Lee *et al.* [38] argue that low cost driving simulators, made possible by the current advances in personal computer technology, have better face validity than traditional psychometric tests. In addition, these simulators have been found to be a safe and cost-effective means of testing performance under different driving situations. No doubt, the use of cognitive and physical training may promote healthy aging and benefit their driving ability [39]. Moreover, although simulators are not perfect surrogates for the on-road setting, research findings have indicated that people's performance in a simulator is similar to their performance on the road [40].

It is critical, therefore, that technology will be developed to suit a broad spectrum of populations, according to universal design principles, accessible to older people, people without disabilities, and people with disabilities. In addition, society has to take into account that proper implementation will need training. A process of adaptation may be necessary in order to establish realistic driver expectations and mental capabilities contributing to effective and safe use of systems. In essence, technological advances may only succeed if drivers can successfully acquire the skills necessary for successful operation [7, 14].

5. Discussion and conclusion: The challenge of ageing has two key aspects in regard to transportation: mobility and safety. It is necessary for elderly adults to preserve independent mobility and activity; however, physical frailty and cognitive limitations have negative effects on their safety. Furthermore, there are differential effects of these medical conditions on functional abilities which are required for safe driving such as hazard perception and reaction time [16, 41]. Therefore, the issue of driving, and more specifically, the fostering of safe driving of old people, is crucial, especially due the increasing number of elderly people holding a driving license. Elderly drivers do not always recognise nor accept the deterioration of their driving skills, and

their environment struggles with the debate between keeping their mobility and freedom versus the risk they pose mainly to themselves but also to the society.

It seems that obtaining the correct dose of balance between safety and mobility of older drivers is a complicated and sensitive task. This may be supported by integrating the use of emerging technologies for improving driver behaviour with social and policy procedures to better control driving by elderly population. A gradually adjustment of elderly driving, which often occurs naturally, may be promoted and improved by adapting appropriate technology and policy. This requires innovative thinking, that could be relevant to elderly drivers before and while their driving skills begin to deteriorate, and will accompany them throughout their aging process.

Utilisation of advanced technologies can help to monitor travel and driver behaviour and make the necessary alterations, based on elderly driving skills, and warn them when their driving become risky at certain situations. For example, Mobileye is a type of technology which includes forward collision warning, headway warning, lane keeping warning and pedestrians alerts. A recent study found Mobileye a valid and reliable evidence based tool, and the main predictor of car accidents involvement [42]. This technology can be implemented with monitoring capabilities, which can also utilise closed-circuit feedback. Such technologies that provide drivers with the ability to compensate for some of their cognitive decline may also slow down the age-related cognitive decline.

While laws have been passed to ensure new drivers, regardless of age, get the support, skills and experience they need to handle the complex task of driving by having them accompanied by experienced drivers for some period (Israeli Graduated Driver Licensing program – GDL), there is no such process regarding elderly drivers. Building a mirror-image of GDL to the older drivers, recognizing this age group as high-risk target population, may be beneficial. That is, a process that will gradually restrict elderly driving when their driving skills deteriorate to a risky level and at the same time provide them with the supporting technology systems to monitor, detect and assess the need to actually accept and reduce their driving. Similar to the important role that parents play in GDL – there is a need of professionals such as occupational therapists who are driver rehabilitation specialists to be part of the process. Driver rehabilitation specialists work with people of all ages and abilities, as assessors of driving fitness, as well as exploring alternative transportation solutions for drivers found unsuitable for driving. Thus help older drivers and their families master the challenges of diminishing driving skills.

GDL programs are widely implemented and studied, mostly in the US and Canada. Unlike many intervention programs, their effectiveness have been proven in numerous studies which show that adopting GDL laws will lead to substantial decreases of crashes of the relevant age groups – anywhere between 20 and 50% [43].

To conclude, an integrated and applicable procedure of advanced technologies and policy steps to support elderly drivers and their close circle to cope with the complexity of elderly driving may serve as a desired countermeasure. This process should be available to decision makers and individuals and accords further exploration and evaluation.

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