ARTICLE

Young driver challenges

Frank P. McKenna on psychology's contribution to evidence-based approaches to reducing crash risk

It is clear that young people have the highest crash involvement of any group. What are the direct and indirect factors associated with these high crash rates? How do biological, personality, fatigue and experiential factors affect risky driving behaviours? And what potential countermeasures can be deployed?

question

Why are young people more vulnerable to risky situations?"

resources

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The public health benefits of road safety education for teenagers: www.road-safety.org.uk/research/completed-research/think-piece-by-frank-mckenna/

Education in road safety: Are we getting it right? www.racfoundation.org/research/safety/education-in-road-safety

In starting one of my lectures I often pose the charming question 'If you are going to die in the next few months, what is going to kill you?' The uncomfortable answer is road accidents. Below the age of 40, road accidents kill more people than any other factor (WHO, 2004). While the casualties are decreasing in high-income countries it is forecast that worldwide traffic deaths will increase substantially (Kopits & Cropper, 2003). It is common knowledge that young drivers are at high risk. In considering the issues surrounding the vulnerability of young people to road accidents we will consider some developmental processes that may be implicated in the high risk of young people; we will consider how low levels of experience affect crash risk; and finally we will consider remedial measures.

Developmental

Around the world the age at which young people have been licensed to drive has varied between 14 and 18, with most countries opting for a period in later adolescence between age 16 and 18. Adolescence is a period in which there is a wide range of biological and social changes, some of which may be relevant to the risks that young people take or the risk to which they are exposed.

We know, for example, that the dopamine system is changing across adolescence. Ernst and Spear (2009) have hypothesised that changes in the dopamine system may mean adolescents become very sensitive to potentially rewarding stimuli. It is clear that sensation seeking peaks in adolescence (Waylen & McKenna, 2008) and is associated with risky behaviour (Roberti, 2004).

There are other personality factors that may be relevant to risky behaviour. For example, one of the big five factors of personality, Agreeableness, declines across adolescence (Allik et al., 2004). This may be important for a number of reasons. First, we know that low levels of Agreeableness are associated with both occupational and traffic accidents (Clarke & Robertson, 2005). Second, during adolescence there is an obvious reduction in adult supervision, which in turn means that the opportunity for Agreeableness to be expressed may be changing dramatically. For example, in the UK the opportunity to express levels of Agreeableness through use of a vehicle changes radically as a function of the legal age for driver licensing.

We might speculate on the mechanism by which low levels of Agreeableness are associated with crash involvement. One plausible route is through antisocial behaviour in general and driving violations in particular. Driving violations have a long history of association with accidents. For example, Gerbers and Peck (2003) found that those drivers who have a traffic violation have a higher subsequent accident rate. In the 1990s a group of Manchester psychologists attempted to show how violations might differ from other forms of human error. They showed that errors, lapses and violations were separate factors (Reason et al., 1990). Their focus has been on the violation factor, which they have shown to be related to crash involvement (Parker et al., 1995). A range of violations, such as drink driving, are clearly important. Young people have a greater crash risk at all blood alcohol levels (Mayhew et al., 1986). The usual explanation for this is that young people are inexperienced in drinking, inexperienced in driving and inexperienced in drinking and driving.

Antisocial tendencies in general have been shown to be related to crash involvement (West et al., 1993). A fairly

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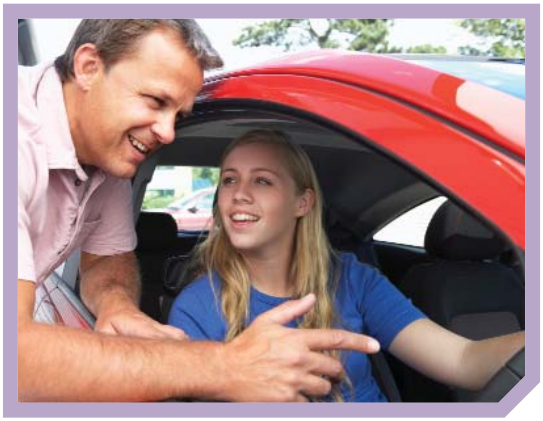
crude but important measure of antisocial tendencies is criminal involvement, which peaks about age 17 (Moffit, 1993). This, of course, just happens to be the age at which we allow young people unsupervised access to cars.

One final personality factor worth considering is impulsivity. While we might consider that there may be substantial overlap between impulsivity and sensation seeking, a number of authors note not only that they are conceptually different but also that they have different developmental trajectories. For example, it has been proposed and observed that while sensation seeking increases across adolescence, reaches a peak and then decreases, the pattern for impulsivity is quite different, starting high and decreasing into early adulthood (Steinberg et al., 2008). High levels of impulsivity have been shown to be associated with accident involvement (Freeman, 2008).

Another factor that changes across adolescence is sleep patterns. There is a reliable delay in the onset of sleep across adolescence. Both changes in the psychosocial environment and in the regulatory factors underlying sleep may be involved. Two factors are generally regarded as important in sleep regulation – a homeostatic and a circadian mechanism. The homeostatic mechanism responds to sleep need such that as wakefulness is prolonged there is an increase in sleep need and as sleep is prolonged there is a decrease in sleep need. The circadian rhythm is a biological process of roughly 24 hours duration that operates largely independent of the prior number of hours of sleep and wakefulness. The expressed concern is that while there is a delay in sleep onset there is, for a variety of social constraints, no delay in sleep offset, so young people may have insufficient sleep (Carskadon et al., 2004). At the Loughborough Sleep Research Centre they have been investigating the relationship between sleep and performance in general and accident involvement in particular. They find that about 16 per cent of all accidents are sleep-related and that a substantial proportion of sleep-related accidents involve people under the age of 30 (Horne & Reyner, 1995). The age-related effect may in part be due to an exposure effect, since a significant proportion of young people may be driving at a point when their biological clocks are telling them they should be asleep. There is also some evidence that young people may be more susceptible to performance decrements following sleep disruption (Philip et al., 2004), with the latest research finding that young male and female participants struggled more than older participants to maintain safe driving performance in the simulator after a short five-hour sleep (Filtness et al., 2012).



Young male and female participants struggled more than older participants to maintain safe driving performance in the simulator after a short five-hour sleep

From a developmental perspective the high crash risk of young people emerges from a combination of an increase in reward sensitivity, combined with low impulse control, higher levels of antisocial tendencies and exposure to sleep challenge. The one factor that I would add is the dramatic change in social controls across adolescence. The amount of adult supervision and relevance of adult social norms changes dramatically across adolescence. Changes in factors such as sensation seeking may produce a change in the drive for risk taking, and changes in the social controls may change the opportunity and exposure to high-risk situations.

Experience issues

It is quite clear that new drivers by definition lack experience. It is also quite clear that as drivers gain experience the crash rate decreases. Indeed, it has been shown that the decrease in crash rate is rapid in the first few months of driving.

The fact that there is such a rapid change in crash risk across the first few months of driving for both younger and older drivers suggests that while slowly changing factors such as personality may have an important role to play they are unlikely to account for the whole picture. Indeed, when age-related factors are compared to experience-related factors, the general conclusion has been that, while both make an independent contribution, experience may have a larger role (McCartt et al., 2008). Herein lies a paradox: we need experience to reduce crash risk yet in the process we are exposed to high crash risk. We will see later that there are ways out of this paradox.

In examining the blameworthiness of young drivers it has been found that 75 per cent of young drivers were at fault in the accidents that they experienced (Braitman et al., 2008). The types of accidents were largely run off the road, rear end, and right-of-way violations. The factors involved in these accidents were found to be failures of detection, speeding and loss of control.

Although the term 'experience' has

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been used here, this term may be too passive for the process that is involved. We are not good at learning from passive experience: see the classic example of poor retention for frequently experienced common objects such as coins, demonstrated by Nickerson and Adams (1979). Young people may have very considerable experience of traffic as passengers, but this does not leave them safe. Is control of the vehicle the key factor? There are reasons to doubt this explanation. For example, younger people are more efficient at learning the control skills to pass the driving test but less effective at subsequently staying alive. A key issue for researchers is to identify the factors responsible for the rapid reduction in crash risk in the first few months of driving. In examining one line of thought at the University of Reading we have developed methods of measuring drivers' ability to detect hazards, showing that new drivers are relatively slow to detect hazards but improvements come with training and experience (McKenna & Crick, 1994, 1997). This work became the basis for the Hazard Perception Test which is now used as part of driver licensing.

Young drivers are susceptible to all the major risk factors, such as speeding, drink driving and night-time driving

Countermeasures

While there has been a great deal of research outlining the nature of the challenges faced by young drivers, there has been less research work devoted to reducing the crash risk of young drivers. There has been no shortage of interventions, but a very small percentage have two key features: being based on research and evaluated.

Driver training\education

One commonsense countermeasure is the introduction of driver training and education. The commonsense nature of this countermeasure might be indexed by the proliferation of these interventions and the fact that they command public support (Mayhew, 2007). Driver training and education are there to ensure that young drivers are prepared for the risks that they face. If they were successful then there would be no increased risk for young drivers. Against that criterion, driver training and education universally fail.

What is profoundly problematic is that for decades numerous researchers have found no evidence to support these interventions (e.g. Brown et al., 1987; Christie, 2001; Ker et al., 2005; Mayhew et al., 1998; Mayhew & Simpson, 2002). Indeed there has been some suggestion that some of these interventions may in fact increase the crash risk (Roberts & Kwan, 2001; Williams, 2006).

There may be a number of reasons why driver training\education has no obvious benefits. For the present purposes the following points are worth noting:

- Despite their popularity there is little evidence to support driver training\education.
- In the past the absence of evidence appears to have had no impact on the number of subsequent interventions.
- The design of the interventions (even when evaluated) are often based neither on evidence nor formal knowledge.

It might be hoped that the changing culture surrounding the importance of evidence may produce some changes in the future.

Graduated licensing

The key idea behind graduated licensing is that learning should proceed following a few simple principles. For example, learning should proceed from simple to complex and should progress from low-risk conditions to high-risk conditions. In the same way that a pilot may graduate from flying a small plane to flying a

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jumbo jet, so the young driver would proceed through graduated steps. Does driver licensing in the UK violate these simple proposals by having too much of a step change between safe supervised driving and unsafe unsupervised driving? The key risk conditions that have been identified are night-time driving and driving with young passengers. It has been shown that when graduated licensing is introduced and new drivers graduate from driving in daylight conditions with no peer passengers to driving at night with peer passengers, then there is a significant reduction in crash risk (Chen et al., 2006).

Driver experience

The challenge for interventions based on experience is, as noted before, that while we need experience to reduce crash risk the process itself exposes us to high crash risk. What is needed to solve this problem is a method of gaining experience at low risk. Swedish researchers have examined one such method. They noted that while young drivers were being supervised, they were at low risk. What parameters of practice might we manipulate?

The first obvious factor is the amount of practice. We know that learning proceeds as a nonlinear function of practice, being rapid at first and decreasing as practice continues. Whether the precise function is a power or exponential function has been a matter of debate (Heathcote et al., 2000). The other parameter that might be worth considering is 'massed' versus 'distributed' practice. When practice is continuous with no or few separate learning episodes it is considered to be massed, and when there are many separate learning episodes then it is said to be distributed. The advantages of distributed practice has been known for some time (Cepeda et al., 2006). From these two parameters an intervention should increase the amount of practice and do so in separate learning episodes over an extended period of time. An intervention in Sweden appears to have these characteristics. By retaining their licensing age of 18 and extending the learning period, their goal was to increase the amount of safe supervised experience over an extended period of time. It was shown that this intervention could produce a 40 per cent accident reduction (Gregersen et al., 2000).

Electronic Stability Programme (ESP)

Given that loss of control is a feature of young driver crash involvement, it would be predicted that any factor that aids control would be a benefit. By checking the consistency of the steering input with the direction of travel, ESP detects discrepancies and by applying braking individually to the wheels and in some cases controlling engine power ESP is designed explicitly to regain control. While it has been shown that this intervention reduces crash risk (Scully & Newstead, 2008) one clear, but as yet untested, prediction is that this measure should differentially benefit young drivers.

General countermeasures

Given that young drivers are susceptible to all the major risk factors, such as speeding, drink driving and night-time driving, then it follows that young drivers should benefit from countermeasures designed to affect any of these measures. For example, speed-control measures either implemented in the vehicle or externally via automated speed cameras should produce a benefit.

The main interventions for alcohol involve deterrence. One important challenge for many countries is not just to invest in sufficient resources to deter drink driving but also to determine what level of alcohol should be defined as illegal. What criteria should be used to determine a legal limit? Two criteria present themselves. The first is an elevated crash risk. On this basis one might choose a level of 0.05 per cent since it is known that crash risk begins to increase beyond this level (Zador et al., 2000). An alternative criterion might be .02 per cent since it is known that at this level performance is affected (Moskowitz & Fiorentino, 2000). We might note that there is no rational defence of the current UK legal limit of 0.08 per cent.

As the crashworthiness of vehicles improves we would expect young drivers to benefit but to benefit to a lesser extent than older drivers, because safety innovations start with new vehicles that young drivers cannot afford. Those who are in greatest need are least likely to benefit. That said, within a given budget, advice might be provided on those vehicles with superior crashworthiness.

Conclusion

The crash rate of young drivers presents many challenges. For society, it is a significant public health challenge. For researchers, the challenge is to provide a more detailed understanding of the rapid reduction in crash risk that happens in the first few months of driving and how to instil this knowledge into effective interventions.

For psychologists there is also a professional challenge. To what extent should we take a lead in trying to stop the proliferation of road safety interventions that are based neither on theory nor formal knowledge and remain unevaluated? To what extent is it our responsibility to encourage authorities to implement only interventions that are based on sound theory and evidence?

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