Identification of Risky Young Drivers

by

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October 2011
EXECUTIVE SUMMARY

This report discusses issues relevant to the identification of risky young drivers before they obtain a driver licence. This could provide an opportunity to intervene before drivers obtain a licence, with the aim of reducing their tendency to engage in risk-taking behaviours and therefore reducing their risk of crash involvement or injury.

This report is structured in a way that ensures that the risky driving issue can be linked to the broader research literature. It includes sections that:

- Set the context by discussing the young driver issues, risky (or hoon) driving behaviour, and the relationship between risky (hoon) behaviours and safety outcomes.
- Focus on the broader issues relevant to problem behaviours, the developmental transitions through adolescence and into early adulthood, and the prediction of antisocial developmental transitions.
- Draw the road safety and developmental issues together and discusses the possibility of predicting risky driving behaviour before licensing.
- Make some cautionary comments about the identification of potential risky drivers based on information collected earlier in life.
- Draw some conclusions.

This report was therefore concerned with the possibility that young adults likely to engage in problem driving behaviours (sometimes referred to as ‘hoon’ behaviours) could be identified before they obtain a driver licence. Key conclusions resulting from this approach were as follows:

- The average risk of crash involvement is higher for young and novice drivers than for older and experienced drivers. This is consistent across jurisdictions and occurs due to the effects of inexperience on the application of cognitive skills to the driving task in complex situations, motivational factors, the effect of peers, and broader lifestyle factors across the young driver population.
- Within the elevation of crash risk that occurs across young drivers there is some amount of variability that allows for the identification of subgroups of drivers that have a higher-than-average level of crash involvement.
- Patterns of unsafe driving behaviour amongst some young drivers increase their risk of crash involvement compared to the average elevated crash risk for young drivers. Patterns of risky driving behaviour appear to be part of a broader pattern of problem behaviours.
- Developmental outcomes in young adulthood can be understood in terms of trajectories that describe the development of patterns of behaviour.
  - Developmental trajectories are useful here because the aim is to assess the possible identification of adolescents who will go on to develop risk-taking patterns of driving behaviour.
  - Trajectory-based research has identified two trajectories that are relevant here:
• Life-course-persistent antisocial behaviour where problem behaviours commence during childhood and persist at high levels.
• Adolescence-limited antisocial behaviour where problem behaviours commence during adolescence and peak before declining in late adolescence and into early adulthood.

- The behavioural problems associated with the persistent and limited antisocial behaviour trajectories in early adulthood are likely to differ.
  • The life-course-persistent antisocial behaviour group is more likely to display aggressive driving behaviours in addition to defiant, rule-breaking driving behaviours, and their problem behaviours are likely to persist into adulthood.
  • The adolescence-limited antisocial trajectory group are likely to limit their problem or risky driving behaviours to rule-breaking, sensation-seeking behaviours and are likely to desist from these behaviours as they deal with the transition into early adulthood.

- Young people with life-course-persistent antisocial are likely to exhibit the most-severe problem behaviours, are unlikely to desist in these behaviour patterns during early adulthood, and are affected by factors that are difficult to influence such as guilt and callousness.
- Temperament problems and related neurological deficits may have a causal role in persistent antisocial behaviours.

• Antisocial behaviour patterns occur in the context of a range of developmental and psychological factors.
  • The interactions between different patterns of problem behaviour suggest that identification of future risk-related driving behaviours can draw on a broad range of potential predictor behaviours.
  • There is a level of complexity in the interaction between these different patterns of behaviour that would need to be reflected in any identification/assessment tool.

• The differences between antisocial behavioural trajectories in boys and girls imply that methods used to identify at-risk young people will need to take sex into account.

• Severe antisocial behaviours are associated with callousness and limited empathy that are likely to contribute to dangerous driving behaviour. Research concerning the development of severe antisocial patterns of behaviour and the role of callous-unemotional traits in relation to young problem drivers is relevant for two reasons.
  • Serious hoon-like, risk-related behaviours are relatively uncommon and reflect a behaviour style that is impulsive and lacking in empathy for the potential outcomes that might affect other drivers and road users.
  • Predictions are likely to be more accurate (reliable and valid) where more-severe patterns of antisocial behaviour are targeted.

• There is some supporting evidence that the relationship between developmental trajectories and young driver problem behaviours may provide the basis for identifying adolescents who have a relatively high risk of engaging in unsafe behaviours once licensed.
There is consistent research evidence supporting the predictive relationship between adolescent characteristics and behaviours and subsequent antisocial behaviour patterns in early adulthood.

- Aggressive behavioural patterns and bullying in childhood and adolescence are important, consistent predictors of antisocial and aggressive behaviour patterns in early adulthood.
- Although the diagnostic system in widespread use (APA, 2000) is limited as a predictor:
  - There is evidence that externalising disorders such as Conduct Disorder have some predictive value.
  - There is clear benefit to focusing on some specific patterns of behaviour that contribute to the diagnosis of externalising disorders – such as behavioural patterns associated with serious Conduct Disorder, some of the patterns linked to Oppositional Defiant Disorder where they are associated with subsequent Conduct Disorder in adolescents, and the impulse-related behaviours associated with Attention-Deficit/Hyperactivity Disorder.
  - Those behaviours normally linked to Antisocial Personality Disorder (and the callousness associated with psychopathy) but not normally treated in this way during adolescence are also likely to be useful as predictors of subsequent antisocial and deviant behaviours.
- Adolescent and childhood alcohol use may be a useful predictor of subsequent antisocial and deviant behaviour, in addition to other predictors relating to patterns of externalising behaviour.
- The presence of callous-unemotional traits in adolescence is a reliable predictor of similar traits in adulthood and antisocial behaviour patterns.
- The failure to develop age-appropriate levels of self-regulation and impulse control, and the presence of impulsivity are predictors of a range of problem behaviours and antisocial behaviours in young adulthood.
- The measurement of prosocial attitudes and behaviour during adolescence may provide an additional predictor for antisocial behaviour patterns during young adulthood.

- The predictive relationship between adolescent behaviours and antisocial behaviours in young adulthood has some relevance for attempting to predict problem driving behaviours because they occur in the broader context of problem behaviours.
  - Personality has limited value as a predictor of road safety outcomes. Behavioural measures are better predictors than personality measures.
  - The use of Attention-Deficit/Hyperactivity Disorder on its own as a predictor of road safety problems appears to be risky, but its use in combination with other factors may be of some value. The impulsive behaviour patterns present in some young people with this disorder appear to have greater predictive value than the attentional factors also included in the diagnostic criteria.
  - The adolescent behavioural patterns underlying externalising disorders have some value as predictors of problem driving behaviours during early adulthood, but the predictive relationship is asymmetrical. Young people with
externalising behaviour patterns are highly likely to have subsequent records as traffic offenders, but there is no reason to believe that this predictive relationship is sufficient to guarantee that most offenders will be identified based on their adolescent externalising behaviour patterns.

- Lifestyle-related factors assessed during adolescence appear to be useful predictors of risk-related driving behaviours in adulthood, much as they are effective predictors of a broader range of antisocial behaviours.

- Attitudes expressed in a survey context are poor predictors of self-reported behaviour, and are therefore most likely very poor predictors of behaviour in the real world.

- Where young drivers have a pattern of traffic offences it is likely that they will engage in risk-related problem driving behaviours and more-serious offences. This may provide an avenue for predicting problem drivers amongst licence holders, and is consistent with the use of traffic offence information for unlicensed drivers (learners and pre-learners) as predictors of antisocial behaviours in general and problem driving behaviour more specifically.

- There may be some benefits to including assessment of positive developmental factors such as prosocial measures, self-regulation, and impulse control as additional predictors of problem driving behaviours in early adulthood.

There are some broader issues that need to be considered as cautionary comments relating to research and the development and implementation of interventions targeting identified future problem drivers.

The consistent relationships between potential predictor variables and antisocial behaviours or problem driving behaviours suggest that there are patterns of adolescent behaviour that, when present, predict a high risk of the target early-adult behaviours. They do not, however, guarantee that the use of these predictors will identify the majority of young adults with problem driving behaviours. The relationships are asymmetrical in this sense, raising some concerns about the value of applying a predictive approach to the large population of adolescents.

There is some considerable uncertainty about how best to proceed in relation to intervention programs if it is agreed that it is reasonable to attempt to predict future driving behaviour based on adolescent behaviour patterns. There is a need to identify causal factors to be targeted in intervention programs and to be aware that these causal factors differ for different developmental trajectories that lead to young adult problem behaviours. There is also a need to consider the challenges associated with identification of potential offenders and the implications of these challenges for intervention programs. In particular, it is likely that it will be easier to detect predictors of subsequent behaviour problems in those adolescents who are members of the life-course persistent trajectory, who in turn are most likely to be resistant to intervention programs given the genetic/neuropsychological factors underlying their behaviour patterns.
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INTRODUCTION

This report discusses the potential identification of risky young drivers before they obtain a driver licence. This would provide an opportunity to intervene before they obtain a licence, with the aim of reducing their tendency to engage in risk-taking behaviours and therefore reducing their risk of crash involvement or injury.

This is a challenging task, but could provide an opportunity to influence crash risk before identified young people have an opportunity to harm themselves or others. The challenge is twofold. The first challenge is the development of an identification method that is both reliable and valid.

- A reliable identification system is one that is accurate in its ability to differentiate between high-risk and low-risk young adults. A reliable system would be one that produces the same outcome regardless of who is attempting to identify at-risk young people, and that consistently results in the same assessment outcome for each young person.

- A valid identification system is one that identifies at-risk young people based on the key outcome measure – in this case their risk of injury as a result of, or involvement in, a crash. Identification of young people based on some current risk-related behaviours is only valid if the identification predicts crash risk.

An identification system that is not valid and reliable will undermine the potential success of any interventions targeting identified high-risk young people. The second challenge – addressed only briefly in this report – is the development of an intervention method that modifies patterns of behaviour before they occur.

This report attempts to take a rational, structured, and evidence-based approach to discussing the potential identification of risky young drivers. Relevant, scientific evidence was drawn from a number of sources. There have been some important developments in our scientific understanding of the developmental transition to young adulthood in the last decade, and material drawn from this literature and the related research literature concerning the development of antisocial and deviant behaviours was particularly important. The breadth of research material drawn into the discussion was considered important because road safety research and program development are often disconnected from recent developments in psychology and related areas.

This report is structured in a way that ensures that the risky driving issue can be linked to the broader research literature. The next three sections set the context by discussing the young driver issues, risky (or hoon) driving behaviour, and the relationship between risky (hoon) behaviours and safety outcomes. The following three sections focus on the broader issues relevant to problem behaviours, the developmental transitions through adolescence and into early adulthood, and the prediction of antisocial developmental transitions. The seventh section draws the road safety and developmental issues together and discusses the possibility of predicting risky driving behaviour before licensing. The last section makes some cautionary comments about the identification of potential risky drivers based on information collected earlier in life.
YOUNG DRIVER SAFETY

The young and/or novice driver population is an important focus of road safety research, policy, and program development and implementation. This focus reflects a community concern about the high crash risk associated with young or novice drivers. This section of the report discusses their crash situation and the nature of the crash problem. This discussion is important because it places the young driver crash problem more clearly in the broader developmental context.

Crash statistics

International breadth of issue

The young and/or novice driver problem is an international problem. SafetyNet (2009) summarised the international problem by noting that:

- Traffic crashes result in relatively high numbers of deaths for 15-24 years olds in OECD countries and that the problem is similar in non-OECD countries when data are available.
- Young drivers have two to three times the risk across all relevant crash risk measures.
- Young driver crashes across jurisdictions are biased towards night-time, single vehicles, loss of control, and excessive speed.
- Crash risks are consistently highest when young drivers carry peer passengers and during times of the week associated with social activity.

The similarities between different countries suggest that there may be some similarities in the causal factors associated with young driver crash risk that have their effect regardless of socio-cultural differences between countries.

Crashes in Victoria

Young drivers continue to be over-represented in crashes despite the focus on this group as a road safety program target. There was a decline in the number of young people killed in Victorian crashes in the late 1980s and early 1990s, but there has been little progress in the last decade (TAC, 2011). Young drivers continue to be over-represented in crashes – 28 percent of drivers killed in 2010 were between 18 and 25 years old, but this age group holds only 14 percent of Victorian driver licences and makes up 12 percent of the Victorian population.

VicRoads (2011) notes that about 100 people are killed every year as a result of crashes involving novice drivers (18-25 years), and that the crash rate for probationary drivers (taking into account the amount of driving or exposure) is about three times the crash rate of experienced drivers. Crashes are the largest cause of fatalities for young Victorians. The TAC (2011) notes, based on the small number of young drivers killed in 2010, that common features included male drivers (86 percent), country roads, single vehicles, high speed zones, night-time and weekends.
The elevated risk associated with young or novice drivers in Victoria is similar to that reported internationally, and the driving contexts and behaviours associated with this elevated crash risk are consistent with international young driver crash patterns. The similarities suggest common underlying causal factors, but also underscore the potential value of international research concerning young drivers and the development and implementation of interventions. The similarities across jurisdictions suggest that research in other jurisdictions should be relevant to the Victorian young driver problem.

**Young driver problem**

There are some elements of the elevated crash risk associated with young drivers that are generally considered to apply across the young driver population. These factors appear to contribute to an elevated crash risk for all young drivers rather than a specific group of young drivers, although it is possible that the strength of their contribution varies across the young driver population.

**Crash risk across novices**

Although young males are strongly over-represented in serious crashes compared to females, there is clear evidence that the risk of crash involvement is higher for all young drivers when compared to older or more-experienced drivers.

The crash and exposure data discussed by Diamantopoulou et al. (1996), for example, showed that the elevated crash risk (per kilometre) for young and novice drivers held regardless of sex, age of car, number of passengers, restraint use, and time of day. There were variations across these variables suggesting that some driving contexts and behaviours were especially risky for young drivers, but it was consistently true that the crash risk for young drivers was higher than the crash risk for experienced drivers across these contexts and behaviours. This was true in Melbourne and in provincial and rural areas of the state.

It is clear, therefore, that young drivers in general have an elevated crash risk due to factors that apply in some way across the young driver population.

**Explanations for increased risk**

The common causal factors that apply across the young driver population need to be considered in relation to risky driving behaviours because they form the context in which risky behaviours occur and may interact with some unsafe driving behaviours specific to subgroups of young drivers. It is likely, for instance, that a risky driving behaviour will be riskier for an inexperienced driver because it interacts with a causal factor that underlies the general elevation in crash risk, whereas for an experienced driver the same risky driving behaviour may have less of an effect on safety outcomes.

**unlikely explanations**

Some explanations for the elevated crash risk of young drivers are not supported by research evidence, despite their attractiveness as common-sense explanations.
Identification of Risky Young Drivers

Road rule knowledge

It is sometimes suggested that imperfect knowledge of road rules contributes to crash risk for some high-risk groups of drivers. There is some evidence that awareness of road rules in specific situations might influence safety outcomes (e.g., Hatfield et al., 2007; Derby et al., 2009), but there does not appear to be any available evidence linking road rule knowledge and crash risk amongst young drivers.

Victorian crash rate data suggest that the general elevated crash risk of young drivers is not related to poor road rule knowledge. The crash risk for learner drivers is very low throughout the learner period compared to the crash risk for novice drivers who have been licensed for a very short period (VicRoads, 2011). It is unlikely that novice drivers who have very recently obtained a licence have forgotten the road rules necessary to pass their licence tests, suggesting that a lack of road rule knowledge is not a causal factor responsible for the elevated crash risk across the population of young drivers.

Car control skills

There is no evidence that the elevated crash risk of novice drivers relates to poor car control skills. Simple car control skills develop relatively quickly (Groeger & Brady, 2004), especially in the Victorian context where learners have had relatively high levels of supervised driving experience over the last decade.

Curry et al. (2011) examined the contribution of a number of causal factors to crashes involving teenaged drivers in an in-depth study of a representative sample of 795 serious crashes. They classified causal factors into four groups – recognition errors, decision errors, performance errors, and other errors. The performance error category included poor directional control and overcompensating. These specific car control errors accounted for 4.2 and 3.3 percent of crashes respectively. Car control errors therefore play a causal role in 7.5 percent of crashes involving young drivers, compared to recognition errors and decision errors which together accounted for 86 percent of crashes.

Explanations with evidence

Experience-related skill development

A key difference between novice and experienced drivers is the level of experience and the opportunity to acquire a number of experience related skills that appear to contribute to the development of safe driving. It is clear that the lack of driving experience that is common across the population of young drivers has a number of consequences in relation to the application of cognitive skills to driving. The elevated crash risk of young drivers may largely reflect the lack of opportunity to develop these skills.

These skills include:

- **Associative Learning.** This involves learning about the predictive or causal relationships between events, behaviour, and consequences. This learning is automatic, occurs without conscious involvement or awareness, is long-lasting, and has an automatic, pervasive effect on behaviour. It occurs directly as a result of experience with causal relationships. Associative learning has been applied to driving behaviour (e.g., Fuller, 1984, 1988, 1992; Harrison, 2001, 2005), with a consistent finding that the mental links between events and safe driving behaviours develop only with experience in the driving environment. It is only by experiencing the causal or predictive relationship between cues in the environment and their consequences, or between behavioural
responses to situations and their consequences, that appropriate, long-term changes in driver behaviour will occur.

- **Visual Search.** Drivers scan the road environment while driving. Scanning behaviour that is inadequate may result in a failure to detect a potential hazard. There is some evidence that visual scanning is more likely to be a consequence of automated processes or so-called bottom-up processes (where events in the environment exert more control over visual scanning than do conscious processes) than a consequence of consciously directed attention (e.g. Cole and Hughes, 1990), emphasising the importance of driving experience in developing safe visual scanning skills.

- **Psychomotor Skill Development.** Safe driving requires the development of psychomotor skills to ensure the fast, accurate translation of behavioural decisions and intentions into vehicle control actions. The psychomotor skills underlying safe vehicle control are relatively complex, but evidence is consistent in its support for experience in the development of the underlying psychomotor skills (eg. Ingvaldsen and Whiting, 1997; Masters, 2000; Savelbergh & Bootsma, 1994).

- **Automaticity.** Safe driving becomes increasingly effortless as a result of practice – most likely a result of a reduction in mental workload associated with a shift away from the need for conscious processing of information towards automated information processing with experience (Cowan, 1995). Logan (1985, 1988) notes that automated behaviours form an important component of skilled behaviour, and that automaticity can only develop with experience of the behaviour in its context.

- **Situation Awareness.** One of the key issues in cognitive psychology and human factors research is the concept of situation awareness, defined as “the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.” (Endsley, 2000). The basic, cognitive processes that underlie situation awareness (perceptual processes, associative learning, and attentional control) are a product of experience (eg. Cowan, 1995; Logan, 1985, 1988).

- **Biases, Heuristics, and Frugal Decision Making.** There are some cognitive mechanisms that reduce the workload involved in decision making without reducing the accuracy of the decision-making process. These are important for safe driving. Gigrenzer (see Gigrenzer & Todd, 1999) discusses cognitive processes that make use of information in the environment in generating adaptive or appropriate behaviours. He views biases and heuristics in cognitive processes as a consequence of the consistent relationships between events and their consequences in the natural environment. By making use of experience with these relationships in the natural environment, human decision makers are more likely to generate adaptive behaviours without having to resort to high levels of cognitive workload and a reassessment of each situation as if it were new. Similarly, Klein’s (1993, 1998) approach to decision-making in the natural environment by experienced decision makers has the decision maker basing behavioural decisions on experience in that environment with various consequences of different behaviours.

*Peers*

The Victorian graduated licensing system includes a restriction on the number of peer passengers that can be carried in the first year of driving, based on Victorian crash data that show the presence of peers results in an increase in crash risk.
Identification of Risky Young Drivers

There is evidence that the presence of peer passengers can influence safety-related decision making and risky behaviours when driving. Shepherd et al. (2011), for example, investigated the role of peer passengers in risk-related driving behaviours, noting that although there was some evidence of a link between peer passengers and safety related outcomes, there was little experimental evidence confirming that peers can influence the likelihood of risky driving behaviours. The experiments reported by Shepherd et al. used a computer driving game as a simulation with instructions encouraging safe driving performance.

In the first study, the authors reported that the presence of confederate ‘passengers’ influenced speed choices and the number of crashes in the simulated tasks. Participants who were encouraged to drive faster and not to worry about consequences by the confederates recorded higher speeds and more crashes - and those who were encouraged to take fewer risks and to drive more carefully recorded lower speeds and fewer crashes. The effects of the confederate encouragement persisted into a follow-up task where participants drove the same simulated route without ‘passengers’.

The general effect of pro-risk encouragement by confederate ‘passengers’ was confirmed in a second study in which participants were encouraged to drive as fast as possible while also having as few crashes as possible with the use of a ‘prize’ for the most skilful driver. This approach was used to mimic the tension between performance and safety in real-world driving and the results increase the relevance of the results for understanding the effect of peers on real-world driving behaviours.

The importance of experimental evidence is that it confirms that the addition of peers who are biased towards risky behaviours has an effect on young drivers and increases their risk-taking tendencies.

Driving motivation

The importance of motivational and trip-purpose factors has been noted in earlier research, and more-recent research confirms the importance of motivation as a factor that influences risky driving behaviours.

Fischer et al. (2007, 2009), for example, investigated the effect of risk-promoting computer or video racing games on risk-related behaviours and cognitions in a driving simulation task. The research was based on an awareness of the increasing popularity of risk-promoting games and evidence that access to violent and risk-promoting media content can influence cognitive and behavioural outcome measures. They noted existing evidence of a correlation between use of computer or video racing games and driving offences and crash involvement - especially amongst males.

In the first of these studies, participants played racing or non-racing computer games and then (on the following day) took part in an activity designed to measure willingness to accept risk in a range of critical traffic situations presented in video format. Participants believed the tasks were unrelated – that they had volunteered to take part in two separate studies. The results indicated that playing a racing game for thirty minutes resulted in a small but significant increase in risk taking propensity on the following day. Subsequent experiments revealed that the effect is limited to street racing games involving illegal and risky behaviours and does not occur after using racing games involving a race circuit; only occurred if the participant was actively involved in playing the game (rather than observing another participant playing the game); and is associated with a shift in self-perception towards seeing oneself as a risk-taker or rule breaker.

In another study, Moller and Gregersen (2008) found that young people who indicated that driving served some personal psychosocial function and who engaged more often in relatively
impulsive and poorly structured activities (such playing computer games and going to parties) were more likely to engage in risky driving behaviours.

Lifestyle

The view that people drive as they live is consistent with evidence that safety outcomes are related to driving lifestyle patterns. Blows et al. (2005), for example, found that drivers who engage in frequent unsafe driving behaviours that reflect an unsafe lifestyle have higher risks of injury in a car crash over the same period, and that the relationships between risky patterns of driving behaviour and crash involvement were similar for young and older drivers.

Conclusions

There is no doubt that the average risk of crash involvement is higher for young and novice drivers than for older and experienced drivers.

Evidence suggests that there are some factors that contribute to this elevated crash risk. Key issues across the young/novice driver population include the effects of inexperience on the application of cognitive skills to the driving task in complex situations, motivational factors, the effect of peers, and broader lifestyle factors across the young driver population.

The elevation of crash risk across the young driver population argues for broad interventions such as those implemented under the Victorian graduated licensing system, but differences in the effects of these underlying causal factors within the young driver population may also be important.

Young problem drivers

Evidence of a subset

In addition to the broad set of factors that contribute to an elevated crash risk across the young driver population, there is some evidence that crash risk varies within the young driver population and that this variation in crash risk is related to a number of factors that act on the individual. The evidence suggests that it is possible to identify subsets of young drivers with relatively high crash risks. There is evidence, for example, that driving is related to factors such as personality.

Ulleberg (2002) noted the role of a broad range of factors that might contribute to the high risk of crash involvement amongst younger drivers, and focused on the role that personality and related factors might play given evidence that some personality factors are associated with crash involvement in older samples. The study drew on a survey of young Norwegian drivers that included personality assessment instruments along with self-report measures relating to perceived risk, risk taking, and crash involvement.

A cluster analysis method was used to identify subgroups of young drivers based on their responses to the personality instruments and a measure of driving anger. Two of the six resulting clusters were high risk groups from a road safety perspective. Participants in one of the two high-risk clusters had high scores on normlessness and low altruism scores, combined with high levels of sensation seeking, low anxiety, and low frustration tolerance in traffic. Participants in the second high-risk group had high levels of aggression, driving anger, and anxiety, along with low scores on altruism.
Comparisons between clusters confirmed the expected relationships between personality and safety-related variables. Members of the high risk clusters had relatively high levels of speeding and rule violation, and also had relatively high risks of involvement in injury crashes. The first of the clusters noted above (risk takers with low altruism and low normative motivation) had especially poor safety records and were also had the highest levels of self-rating in relation to driving skill. Personality was therefore linked to driving behaviour and offences.

Constantinou et al. (2011) examined the role of personality as a distal causal factor in crash involvement and offence histories - where personality forms the broad context that influences behaviours with direct causal links to negative outcomes such as speeding and other types of risky driving behaviour. About 400 participants completed a series of instruments including the DBQ and measures of sensitivity to punishment and reward, sensation seeking, and impulsivity.

The results suggested that responses to the DBQ Violations scale predicted offence histories (along with driving experience), and that the Violations scale responses themselves were predicted by sensitivity to reward, disinhibition, and impulsivity. The results therefore confirmed the general prediction that personality acts through driving behaviour to predict one safety-related outcome measure (offences).

Findings such as these suggest that there are potential subgroups of young drivers, defined in terms of personality characteristics, who may have a higher risk of crash involvement than other young drivers.

The results reported by Vassallo et al. (2008), based on the Australian Temperament Project data, confirmed that it is possible to identify a group of risky drivers who engage in risky driving behaviours across different types of driving and more broadly in relation to drug and alcohol use. Their results indicate that that risky driving behaviour is part of a larger collection of problem or deviant behaviours and that it is therefore reasonable to argue that there are subgroups of young drivers who have relatively high and relatively levels of risk taking behaviour.

It is therefore likely that within the elevation of crash risk that occurs across young drivers there is some amount of variability that allows for the identification of subgroups of drivers that have a higher-than-average level of crash involvement. Understanding the characteristics of these subgroups will help inform the identification of potential high-risk young drivers.

**Characteristics of the subset**

There is some research concerning the characteristics of high-risk young drivers. This research has focused on issues such as personality and lifestyle, and will be further addressed in the context of antisocial and deviant behaviour patterns later in this report.

In the context of lifestyle characteristics, the study reported by Blows et al. (2005) (discussed later) is relevant. They reported that crash involvement was associated with risky driving behaviours such as unlicensed driving, racing for excitement, driving well over the speed limit, and traffic convictions. This suggests that there is a group of high-risk young drivers who display a pattern of risky driving behaviours.

Ulleberg’s (2002) study of the high risk of crash involvement amongst younger drivers (discussed above) focused on the role of personality and related factors. One of their groups of high-risk young drivers differed from low-risk drivers in relation to some personality variables including normlessness and low altruism, high levels of sensation seeking, low anxiety, and low
frustration tolerance in traffic. A second high-risk group had high levels of aggression, driving anger, and anxiety, and low scores on altruism.

The links between group membership and safety indicated that some personality factors are associated with risky driving behaviours such as speeding and other driving offences, and that these factors are also associated with higher risks of crash involvement.

Moller and Gregersen (2008) investigated young driver risk taking in the context of lifestyle factors and the broader problem behaviour approach (discussed later). They took the view that problem behaviours, although broadly identified as antisocial, serve a functional purpose for the young person. They then hypothesised that risky driving serves a functional purpose for risky drivers, and that an understanding of how risk taking meets the motivational needs of the young driver is essential for the development and targeting of interventions.

Their research study involved a survey of a large sample of young drivers that collected information on risky driving behaviours (such as speeding, racing, close following) and lifestyle and activity factors. Risky driving behaviours were associated with the use of driving as a status symbol or to ‘blow off steam’, along with a range of other measures. In general, young people who indicated that driving served some personal psychosocial function and who engaged more often in relatively impulsive and poorly structured activities (such playing computer games and going to parties) were more likely to engage in risky driving behaviours.

These results suggest that one way to identify high risk drivers might be to assess young people in relation to the motivational needs that are met by their driving. Those who drive to meet personal needs or social needs may be more likely to engage in risky driving behaviours.

Garrity and Demick (2001) noted evidence that there are relationships between personality traits and driving behaviours, especially in relation to thrill seeking, impulsivity, and hostility or aggression. They investigated this issue by examining the relationship between driving behaviours (assessed in an on-road driving activity) and personality and mood states using well-normed instruments.

The results suggested that the driving behaviours could be grouped into four types of behaviour - classified as responsiveness, manoeuvring, observation, and cautiousness. The relationships between driving behaviour and mood and personality measures were limited to the cautiousness behaviours. Further analysis indicated that these relationships held only for younger drivers, and then only for mood states. There was no evidence of an independent relationship between personality traits and the driving measures.

The cautiousness-related driving behaviours were related to anger-hostility, depression-dejection, fatigue-inertia, and tension-anxiety - with partial correlations ranging from .47 to .54. In each case, negative mood states were associated with lower levels of caution when driving for young adult participants.

**Conclusions**

The evidence is therefore consistent that risky driving behaviours and the risk of crash involvement are not the same across all young drivers.

Young drivers generally have a relatively high risk of crash involvement, but emphasis on this average elevation in risk masks the variation amongst young drivers and the likelihood that it may be possible to identify subgroups of riskier young drivers who could be targeted by safety-related programs. The identification and targeting of riskier young drivers is the main focus of this report.
RISK-RELATED BEHAVIOUR

Avoiding the use of ‘hoon’

The label ‘hoon’ behaviour is one of convenience that has been used to describe a range of behaviours targeted by media (eg., The Age, 2004) and by legislative change. Behaviours included under this broad definition used informally in Australia have included street racing, burnouts, excessive noise, incomplete control of a vehicle, repeat offences in some categories, and so on.

Victorian legislation targeting ‘hoon’ behaviours focuses on a broad range of behaviours:

- High level speeding offences
- Loss of traction
- Street racing
- Deliberately or recklessly entering a level crossing in the presence of an approaching train
- Refusing a police direction to stop
- Repeat disqualified or unlicensed driving offences
- Repeat drink and drunk driving offences
- Having more passengers than seatbelts in a vehicle

These offences all lead to vehicle impoundment penalties, but there is some uncertainty about their association with crash involvement. There is no evidence that all of these behaviours are necessarily associated with a higher-than-average risk of crash involvement, although the evidence cited above suggests that this is true for patterns of risk taking behaviour that include most of these offences.

The inclusion of a broad range of problem behaviours under the broad label of ‘hoon’ behaviours might be seen as a political response to some road safety and community perception issues.

The political and media-attention basis for the broad notion of ‘hoon’ behaviours argues for avoiding the term in an evidence-based discussion about predicting risky driving behaviour. Focusing on a narrower set of risky driving behaviours is better from a road safety perspective because it ensures that the behavioural problems identified and targeted are clearly associated with crash involvement. More importantly, focusing on a narrower set of risk-related behaviours increases the likelihood that the target behaviours will share underlying causal factors and may therefore be easier to predict. This report therefore focuses on risk-related driving behaviours rather than the broad collection of behaviours now and potentially included under the ‘hoon’ definition.

Risky behaviour and safety outcomes

The aim of this report is to assess the possibility of identifying potential risky drivers before they are licensed. It is therefore necessary to identify some of the driving behaviours or
patterns of driving behaviour that are associated with crash involvement. These patterns of driving behaviour will help define the behaviours that we are aiming to predict.

Blows et al. (2005) examined the relationship between habitual risky driving behaviours and crash involvement in the context of a large cohort study in New Zealand. Patterns of risky driving were assessed using self-report responses to items concerning driving behaviour frequencies over the twelve months preceding the survey. Crash involvement was assessed based on self-reported crash histories over the same period.

Crash involvement was associated with risky driving behaviours over the same period – such as unlicensed driving (2.0 times the risk if unlicensed driving occurred several times or always), racing for excitement (3.9 times the risk), driving well over the speed limit (1.9 times the risk if speeding reported several times), and traffic convictions (5.3 times the risk if three or more offences reported). The authors concluded that drivers who engage in frequent unsafe driving behaviours have between two and four times the risk of injury in a car crash over the same period, and that the relationships between risky patterns of driving behaviour and crash involvement were similar for young and older drivers.

Palk et al. (2011) reported the results of an Australian survey of young drivers that sought data concerning hoon-type driving behaviours and crash involvement, in part to investigate the potential link between risky driving behaviours and the risk of crashing. About half of young drivers reported at least one instance of hoon driving behaviour, with younger males more likely to do so than other participants. Only four percent of participants reported very high levels of hoon related behaviour, although seven percent of participants reported involvement in racing or dragging in the week preceding the survey and seventeen percent in the month preceding the survey.

The authors reported that hooning-related crash involvement was reported by about ten percent of participants and almost 20 percent of males. It was more likely to be reported by people who owned a car and by participants who had been detected speeding in the three years prior to the survey. Participants who reported involvement in street racing were also more likely to report involvement in a hooning related crash. There is therefore some evidence that hooning behaviours and crash involvement are correlated in an Australian sample of young drivers.

There is therefore some evidence that patterns of unsafe driving behaviour amongst some young drivers increase their risk of crash involvement compared to the average elevated crash risk for young drivers. This suggests that identifying young drivers who are likely to engage in risk-taking driving behaviour will result in the identification of young drivers with relatively high risks of crash involvement.
THE BROADER CONTEXT

The next sections of the report move away from a specific focus on risky driving behaviour and young drivers, and instead focus on the developmental and psychosocial context of the young problem driver issue. There is a substantial body of evidence concerning the developmental context in which risk-taking and problem behaviours occur, and it is worth considering the young problem driver issue in relation to this research.

Problem behaviour

Theory

There is a widely held view that problem behaviours tend to occur in patterns such that some people exhibit a range of problem behaviours. This perspective is that problem behaviours tend to occur together – that some individuals display a range of problem behaviours and that it is generally unusual for one problem behaviour to occur in the absence of others. Other individuals tend to be problem-free, showing positive, prosocial developmental outcomes across their behaviours. This theoretical approach was originally suggested in relation to substance use disorders and has since been successfully tested in developmental research (Jessor, 1987).

There is a tension evident in the problem behaviour theory between social or contextual explanations for problem patterns of behaviour and biological and temperament explanations. Jessor (1987) argues that the problem behaviour perspective is a ‘social-psychological’ framework and moves beyond biological or genetic considerations, but concludes that this perspective relies on accounting for behavioural patterns in terms of environment and personality without considering the role of temperament and genetics in the formation of personality and broader behavioural tendencies. The tension between psycho-developmental and temperament considerations is an issue that will be discussed later in relation to developmental trajectories and their relationship to the problem behaviour perspective.

Empirical support

There is considerable empirical support for the problem behaviour theory in relation to substance use problems (Donovan & Jessor, 1978; Jessor, 1987; Jessor et al., 1980). More-recent research has found that a broader range of problem behaviours are generally comorbid – individuals with tendencies to engage in one or more deviant or delinquent problem behaviours tend to engage in a pattern of these behaviours.

One recent study, for example, was reported by Sullivan et al. (2010). They focused on the broad problem behaviour concept and used survey data collected from adolescents (a single survey) to identify subgroups of young people based on risk taking behaviour, and then investigated the relationships between risk taking and other personal and social variables. They noted the consistency of findings in the problem behaviour area, generally supporting the notion that delinquent and deviant behaviours tend to occur together and that there is an underlying latent construct that appears to play a role in this broad behavioural tendency across different types of problem behaviours.
The authors identified four subgroups of young people in relation to risk taking. Just over one third of participants were classified as 'abstainers' - they reported few instances of risk taking behaviour across the range of behaviours measured in the survey. A similar proportion of participants were classified as 'experimenters'. This group engaged in a broad range of risk taking behaviours, but did so at low-moderate levels in general. The third and fourth groups were classified as 'high diverse risk takers' and 'non-sexually active, high diverse risk takers', comprising 22 percent and 5 percent of the sample respectively. These groups were similar in their high level of risk taking behaviour in relation to alcohol, drug use, and aggressive behaviours. They differed only in relation to their sexual behaviour - with the second group reporting no or very few sexual partners.

The groups differed in relation to other measures included in the survey. In particular, the risk-taking groups tended to be older than the 'abstainers', had parents who were less likely to know their whereabouts, ate dinner with their family less often, and reported lower levels of social support. The two high-risk groups reported higher levels of suicidal and depressive behaviour, and were more likely to report having had a diagnosis of Attention-Deficit/Hyperactivity Disorder (discussed below) at some stage.

The authors suggested that the results of this study were not entirely consistent with a single 'problem behaviour' view of deviance, and that there are subgroups of young people with slightly different patterns of deviant behaviour - especially in relation to the level and persistence of risk taking across all behaviours (low-moderate 'experimenters' compared to the high-level risk taking groups) and in relation to sexual behaviours (where there is a small group of high-level risk takers with little or no sexual risk taking). This finer-level distinction between different types of risk-related behaviour may be relevant to the prediction of risky driving behaviours.

In another recent study, Vassonyi et al. (2010) examined the relevance of the problem behaviour theory across a range of cultures, noting that the bulk of research on this view of deviant behaviour has been conducted in the USA. The authors collected data from a large group of participants in an international survey of adolescent development conducted in eight countries. The survey collected data concerning the problem behaviour syndrome and risk taking; protective factors relating to social and familial controls and to social support factors; and risk factors relating to peer and role model behaviours, opportunity to engage in risky behaviours, and psychosocial vulnerability (depressive and educational risks).

Path analyses revealed a high degree of consistency in the relationship between patterns of problem behaviour and the protective and risk factors included in the survey across the eight countries. Levels of problem behaviour were consistently low in the presence of high levels of the protective factors and were consistently high in the presence of two of the three risk factors. The relationship between the vulnerability risk factor and problem behaviour was less consistent, but still statistically significant in five of the eight countries.

The authors emphasised the importance of these findings as providing strong support for the stability of the problem behaviour theory as a description of patterns of deviant behaviour amongst adolescents across a range of cultures.

Problem behaviour theory provides an important framework for understanding patterns of deviant and antisocial behaviours that interfere with a successful transition from adolescence to adulthood. In this context, the relevance to young driver behaviour is obvious and the consistency of this pattern of antisocial behaviours across cultures supports the application of this theory to the Victorian road safety context.
Road safety outcomes and problem behaviour

There is consistent evidence that driving behaviours can be understood in the broader context of problem behaviour.

Jessor et al. (1997) noted evidence that risky driving behaviours are likely to contribute to the high risk of crash involvement amongst young drivers and suggested that risky driving behaviour may be thought of as part of a larger pattern of challenging or problem behaviours across the young person's life. They noted prior research had identified the link between risky driving behaviours and a range of norm-violating behaviours and personality characteristics that are less-strongly bound to traditional or normative values.

The authors also noted evidence that patterns of problem behaviour decline as adolescents enter adulthood and that this shift in behaviour is thought to be associated with improved role socialisation as young people take on adult roles and responsibilities. The study reported in this paper was concerned with the relationship between risky driving behaviours and socialisation as young people approach adulthood – a relationship that is consistent with the broader psychosocial approach to problem behaviour (Jessor, 1987).

The participants were involved in a longitudinal study of teenagers over three survey waves as they approached adulthood. The surveys collected data concerning a range of driving, behavioural, psychological, and social factors. Risky driving was assessed as part of the survey and incorporated responses to items relating to self-reported speeding, unsafe lane changing and overtaking, following too closely, and failure to give way or to stop at stop signs and traffic lines.

The results confirmed the expectation that unsafe driving behaviours are associated with lower levels of socialisation to adult roles. Young people were less likely to engage in unsafe driving behaviours if they had adult social roles (marriage, parenting, and employment), if they scored higher in relation to psychosocial conventionality (intolerance of deviance, religiosity, and less contact with friends that model problem behaviours), and if they scored higher in relation to behavioural conventionality (lower delinquent-type behaviours).

Jessor et al. reported that risky driving scores declined monotonically with increasing age, although this mean change was not reflected across all participants in the sample. The authors therefore investigated how patterns of change in risky driving were related to changes in the other measures included in the surveys. Their data suggested that individual patterns of risky driving were reasonably stable across the three survey waves and that it was possible to predict risky driving behaviours in the third survey wave ($R^2 = .23$) based on the risky driving behaviours and socialisation measures in the first survey wave some two years before. When changes in socialisation measures over the two-year period were considered, the largest contributor to changes in risky driving behaviour was the change in delinquent-type behaviours in that period. Where broader problem behaviours declined, there was an associated decline in risky driving behaviours. Jessor et al. take the results as indicative of the links between broader problem behaviours and driving behaviour.

Bina et al. (2006) took Jessor's 'problem behaviour' view as a starting point, placing risky driving behaviours in a broader context of psychosocial proneness or problem behaviours that result from the combined effects of risk factors and protective factors. They suggested that broader lifestyle factors that act through various life contexts and through the developmental processes influence the likelihood of patterns of problem behaviours that in turn affect the likelihood of unsafe or risky driving behaviours. They noted that there is a substantial body of evidence confirming that there are consistent relationships between the risky driving behaviours of novice drivers and broader problem behaviours and lifestyle factors.
The study reported by Bina et al. was concerned with the prevalence of risky driving behaviours and the relationship between these behaviours and a range of other measures included in a survey of a normative sample of teenagers. It should be noted that there are some concerns generalising the results of this study to the Australian context given differences in licensing requirements and the age range of participants, but the results do provide some additional data concerning the place of risky driving in the broader context of adolescent behaviour.

The results indicated that about half of the variance in risky driving behaviours could be accounted for by the combined variation in exposure, sex and age, and broader risk-taking behaviours. The strongest predictors included exposure, sex, and antisocial behaviours (mainly aggressive behaviours, theft, and dishonesty, and tobacco use). These results therefore confirm that lifestyle and risky driving behaviours are related, but more specifically it suggests that adolescent antisocial behaviours are significant predictors of patterns of risky driving behaviour amongst teenagers.

Broughton (2007) examined the relationship between traffic offences and non-traffic offences using official data and a large sample (over 52,000) of drivers sampled from the UK driver licensing database. He reported a strong relationship between motoring and non-motoring offences, with the strongest relationships (for men and women) being between serious driving offences and non-motoring offences.

The relationship held for drivers across all levels of non-motoring offences. Drivers with just one non-motoring offence had twelve (males) or twenty-six (females) times the number of serious driving offences as drivers with no non-motoring offences. Those with high numbers of non-motoring offences had very high numbers of serious driving offences, with the results suggesting a quadratic relationship between these variables. The link between non-driving and driving offences was strongest for dangerous driving and driving while disqualified - both reflecting broader deviant patterns of behaviour.

The relationship is less certain in the opposite direction - over two thirds of drivers with serious driving offences had no non-motoring offences. The results confirm the general finding elsewhere that there is a relationship between deviant or antisocial behaviour and driving offences such that people with deviant patterns of behaviour in relation to criminal offences are also likely to have deviant patterns of behaviour in relation to driving.

An analysis of data derived from the Australian Temperament Project reported by Vassallo et al. (2008) – a long-term longitudinal study that has incorporated some road safety related behavioural items in the most recent survey waves – provides Australian evidence that risky driving behaviours reflect broader patterns of problem behaviour. In their study, Vassallo et al. reported that patterns of risky driving behaviour were associated with high levels of alcohol and drug use.

Another study discussed earlier has some relevance here. Moller and Gregersen (2008) emphasised that risky driving, like problem behaviour, serves a functional purpose for the young person. They found that risky driving behaviours (such as speeding, racing, close following) were associated with lifestyle and activity factors, suggesting that risky driving behaviours are part of a larger pattern of behaviours that meet the motivational needs of young problem drivers.

At the more-extreme end in relation to driving behaviours, Leal & Watson (2011) examined the driving history of young male drivers involved in illegal racing activities identified as a result of detection for a racing-related or broader car control offences sometimes labelled as 'hoon' offences. The offenders were compared to a sample of drivers not detected for a 'hoon' offence, and the results indicated that drivers detected for a 'hoon' offence were significantly
more likely than comparison drivers to have been detected for other traffic offences. This difference was strongest for prior speeding and vehicle defect offences, but the difference was present across all offence types. They were also more likely to have had licence sanctions imposed for traffic and related offences prior to the 'hoon' offence, and were more likely to have been involved in a reported crash.

The results are consistent with the problem behaviour view of driving - that risky driving behaviours reflect a broader pattern of risky and antisocial behaviours that in this case is apparent across all types of unsafe and illegal driving behaviours detected by Police. Given the challenges of traffic law enforcement and low detection rates for traffic offences, the pattern detected here most likely reflects a strong pattern of risky driving behaviours amongst young males identified as 'hoon' drivers, and perhaps argues for the use of non-hoon offences in young drivers as the basis for predicting potential high-risk young drivers.

Patterns of risky driving behaviour appear to be part of a broader pattern of problem behaviours. The key consequence of this is that risky driving behaviours can be considered as part of a broader tendency to engage in a range of problem behaviours, and therefore that evidence concerning the underlying causal factors and mechanisms that increase the likelihood of problem behaviours in general are also likely to influence the likelihood of risky driving behaviours. This allows the broader literature concerning antisocial and deviant behaviours to be considered in a road safety context.

**Problem behaviours in a psychological context**

This section of the report discusses the psychological context in which we understand problem behaviours in general, and therefore risky driving behaviours. This psychological context is important because it helps to set the context for understanding the role of developmental processes and the transition through adolescence into adulthood in the development of problem behaviours and risky driving behaviour.

**Current taxonomy**

Problem behaviours are categorised in psychological research and practice as a way to understand patterns of behaviours that tend to occur together and that are likely to have similar underlying causes. Research in relation to the developmental challenges associated with problem behaviours draw extensively on this psychological taxonomy, and there has been some interest in understanding road safety risks in the broader context of psychological disorders.

The development of problem behaviours through childhood, adolescence, and early adulthood is best understood in relation to a number of psychological or behavioural disorders and their diagnostic criteria. Relevant behavioural disorders and their behavioural presentations are detailed in the Diagnostic and Statistical Manual (DSM-IV-TR) (APA, 2000). This material is used here as the basis for describing the behaviour patterns and disorders considered relevant for the development of patterns of problem behaviour through to early adulthood.

**Attention-deficit/hyperactivity disorder**

This group of problem behaviours include hyperactive or impulsive behaviours and inattentional behaviours that are generally present during childhood and that then persevere into and often through adolescence. In one sense it is a poorly defined group of behaviours
because it is based on two distinct patterns (hyperactivity/impulsivity and inattention) but only requires one or the other as the basis for diagnosis. This complexity is noted in relevant research, which is important given the links between Attention-Deficit/Hyperactivity Disorder and adult problem behaviours (see below).

The inattentive criteria include poor attention, poorly sustained attention, poor instruction following, limited organisational skills, distraction, and forgetfulness. The hyperactive and impulsive criteria include fidgeting, excessive activity levels, restlessness, excessive talking, difficulty waiting a turn, interrupting and intruding, and poor activity planning. Genetic factors appear to play a role given familial patterns, and prevalence is around five percent of school children – with this behavioural pattern significantly more likely amongst boys.

There is a high level of comorbidity with Oppositional Defiant Disorder and Conduct Disorder. Unsurprisingly in this report’s context, there is consistent evidence that Attention-Deficit/Hyperactivity Disorder is associated with relatively high injury rates.

**Oppositional defiant disorder**

This disorder groups together behaviours that are negativistic and defiant. The criteria include (but are not limited to) patterns of hostility and defiance over at least a six month period that include loss of temper, arguments with adults, refusal to comply with requests and rules, annoying others and easily being annoyed, and blaming others for mistakes. It is generally first diagnosed in childhood and the defining behaviours are usually apparent in early childhood.

Oppositional Defiant Disorder is more common amongst boys until puberty, after which the prevalence similar for boys and girls. Between 12 and 16 percent of children meet the criteria and therefore have a pattern of behaviour that does not sit comfortably with rule-based behaviour. Oppositional Defiant Disorder specifically excludes more-serious aggressive patterns of behaviour (see Conduct Disorder below), but there is a tendency for children with this Oppositional Defiant Disorder pattern of behaviour to progress as they mature to develop more-serious behaviours that meet the criteria for Conduct Disorder. This developmental tendency is of some importance for the development of problem behaviours as children transition through adolescence.

There are familial patterns in this behavioural pattern that suggest some level of parental involvement in the development of oppositional behaviours, and/or possibly an inherited component.

The pattern of behaviours underlying Oppositional Defiant Disorder include some behaviours that are relevant to antisocial and deviant patterns of behaviour that are likely to underlie the patterns of high-risk driving behaviour sometimes described as ‘hoon’ behaviours. The criteria for Oppositional Defiant Disorder incorporate behaviours that are stubborn, resistant to rules and direction, persistent limit testing, and an unwillingness to take responsibility for behavioural problems or their consequences.

**Conduct disorder**

This disorder incorporates a pattern of behaviours that are similar to those included in Oppositional Defiant Disorder, but the behaviours are more serious in terms of their relationship with the rights of others and the rules and norms of society. Conduct Disorder is used as a diagnostic category where there is a persistent pattern of behaviours over a 12-month period that includes aggression, the destruction of property, deceit or theft, or serious rule violation. The aggressive behaviours used to identify Conduct Disorder are generally
displays of physical aggression involving bullying, initiation of fights, use of a weapon, physical cruelty, or forced sexual behaviour. The rule violations include behaviours such as running away from home or failing to attend school.

Conduct Disorder can be diagnosed in childhood, but is more commonly diagnosed in early adolescence. It is rare for Conduct Disorder to appear after 16 years of age, and early development of this pattern of behaviour is often preceded by the pattern of behaviours that underlie Oppositional Defiant Disorder.

It is relatively common for young people with this Conduct Disorder pattern of problem behaviours to continue to have behavioural problems in adulthood, and the problem behaviours are sometimes associated with a callous and unemotional pattern of interactions with others and a failure to demonstrate remorse for the consequences of behaviour. The progression between Oppositional Defiant Disorder, Conduct Disorder, and subsequent adult problems such as Antisocial Personality Disorder will be discussed later in the report because it is critical for attempting to predict patterns of problem behaviour in early adulthood.

The prevalence of the Conduct Disorder pattern of behaviour is relatively low compared to the prevalence of Oppositional Defiant Disorder – with estimates between 1 and 10 percent of the population. Prevalence is higher amongst males. Familial patterns and twin studies have suggested a combination of situational and genetic factors underlying Conduct Disorder.

Antisocial personality disorder

The behaviours grouped together under this diagnosis are similar to those that underlie Conduct Disorder, but it is generally applied only during adulthood (although Taylor et al. (2007) suggest an alternative view – this is discussed later). The pattern of behaviours underlying Antisocial Personality Disorder reflects a persistent disregard for and violation of other people’s rights. Key behaviours include antisocial and illegal behaviour, deceit, impulsivity, aggressiveness demonstrated through physical assaults and fights, disregard for safety, irresponsible behaviours in relation to work and personal finances, and a lack of remorse.

The pattern of behaviours underlying Antisocial Personality Disorder is linked to low empathy and a high level of callousness in relation to the rights of others. More-extreme expression of these behaviours and associated strong self-esteem and callous disregard for others are characteristics of psychopathy in a forensic context (see below). The broader pattern of behaviours associated with Antisocial Personality Disorder includes poor-quality, unsustainable relationships with others, poor parenting and personal finance skills, and a chronic history of problem behaviours that result in frequent interactions with law enforcement.

These behaviours are more common in males, with about 3 percent of males considered to meet the diagnostic criteria for Antisocial Personality Disorder. It is a chronic problem, but problem behaviours associated with the disorder do tend to desist in mid-adulthood. There is a strong familial pattern suggestive of parenting and genetic influences.

Antisocial Personality Disorder is classed as a personality disorder rather than a behavioural or emotional disorder because it is a chronic pattern of behaviours, cognitions, and emotions that is resilient in the face of intervention. Personality disorders are chronic and reflect the pattern of inner experience and behaviour that deviates from social and cultural norms. Conduct Disorder and Oppositional Defiant Disorder, despite their similar patterns of underlying behaviour, are not classified as personality disorders. This may reflect a general belief that it is not possible to be certain that a pattern of behaviours reflects a chronic problem during childhood and adolescence. There is some evidence (discussed later) that the patterns of...
behaviour that underlie Oppositional Defiant Disorder and Conduct Disorder are chronic and persistent in some cases and not others. As will be discussed, this is relevant for making use of childhood and adolescent patterns of behaviour to identify potential risky drivers.

Psychopathy

The DSM-IV-TR (APA, 2000) taxonomic system for behavioural disturbances does not make allowance for psychopathy. The working groups responsible for the next update of this system (DSM-5, APA (2011)) had considered a partial reversal of the decision to remove psychopathy as a disorder in DSM-III, but proposed to set out detailed criteria for Antisocial Personality Disorder that match some of the characteristics associated with psychopathy. The notion of psychopathy as a collection of severe problem behaviours is still routinely used in a forensic setting, however, and therefore has some relevance to the development of patterns of deviant and antisocial behaviours.

The original proposal in the development of DSM-5 is worth considering as a starting point for discussing psychopathy as a collection of problem behaviours. Severe behaviours include exploitation of others, arrogance, callousness, disregard for others and no guilt, limited emotional expression (anger and hostility and little else), reckless sensation seeking and impulsivity, poor motivational insight, temperamental aggression, high levels of illegal behaviour, disregard for conventional moral principles, and aggression or sadism in pursuit of personal agendas.

This pattern of behaviour is accepted in the DSM system as an extreme expression of Antisocial Personality Disorder, but in a forensic context is perceived as a specific mental disorder.

Aspects of psychopathy are relevant in relation to risky driving behaviours. Aggression, disregard for others, anger, reckless sensation seeking, and illegal behaviour are consistent with severe levels of risk-related driving behaviours or ‘hoon’ behaviours.

Hoon behaviour in a taxonomic context

Given the broad suggestion that driving behaviour and safety outcomes reflect general characteristics of drivers’ lives, it may be reasonable to focus on the relationship between psychological characteristics that contribute to behavioural disorders and driving/safety consequences.

Elonheimo et al. (2007), for example, investigated the relationship between crime and psychiatric disorders amongst young males using crime data from the Finnish police register and psychiatric diagnosis data from the national military service register. Unlike data used in other studies, the data sets used here are population-based and are therefore unbiased by self-selection or institutional restrictions. The study was part of a longitudinal study of a sample of ten percent of Finnish children born in 1981.

Ten percent of the sample had a psychiatric disorder (current or prior) recorded in their national service data. This ten percent of young men accounted for fifty percent of the crime recorded for the sample, and all crime types were associated with one or more psychiatric diagnoses.

Traffic offences and drink driving offences were associated with Antisocial Personality Disorder and substance abuse disorders. Forty-two percent of young people with Antisocial Personality Disorder and 42 percent of young people with substance use disorders had traffic offences,
and 26 percent of young people with Antisocial Personality Disorder and 33 percent of people with substance abuse disorders had one or more drink driving offences. The relationships were strongest for repeat offenders.

There has been a focus on the relationship between alcohol use disorders and drink driving. Although alcohol use disorders are less likely to be relevant to young driver issues in Victoria, this relationship confirms the general conclusion that driving problems reflect broader patterns of problem behaviours.

Furr-Holden et al. (2011), for example, reported the results of an alcohol use disorder survey conducted at sampling locations across the USA which aimed to investigate the prevalence of alcohol use disorders in the normal driving population at night on the weekend.

Participants were recruited at random from the traffic stream at each of 60 sampling locations by Police, with the resulting sample consisting of 4,616 drivers of non-commercial vehicles who were current drinkers. Interviews were conducted on Friday and Saturday nights, and participants also provided a saliva sample to assess alcohol level at the time of the survey. The survey incorporated a standardised tool to assess the presence of alcohol use disorders, using criteria derived from the DSM-IV-TR (APA, 2000).

The sample was divided into four groups based on their responses to the assessment tool – normative drinkers (75 percent of the alcohol-using sample) were those who were not classified as having an alcohol use disorder; dependent drinkers (7 percent), abusive drinkers (7 percent), and heavy drinkers (11 percent). High BACs while driving were more likely amongst those classified as heavy drinkers, suggesting a link between problem driving behaviour and the broader pattern of alcohol use outside the driving context.

The role of aggression-related problem behaviours in driving offences has also been investigated, again with a focus on the possibility that problem driving behaviours reflect a broader pattern of problem behaviours. Galovski et al. (2002) examined the relationship between aggressive driving and a number of psychological conditions in two small samples (one court-referred, the other self-referred) of driving offenders, with a specific interest in the relationship between aggressive driving and Intermittent Explosive Disorder (APA, 2000). Aggressive driving was operationally defined to include offences that might be classified as road-rage, reckless driving, and combinations of traffic offences detected at the same time.

The authors noted other research suggesting that Intermittent Explosive Disorder may best be thought of as an affective disorder due to the high level of comorbidity with current and lifetime mood and anxiety disorders. The two clinical samples were compared to a control sample recruited through local advertisements. Participants were assessed using standard structured interviews for Axis I and Axis II behavioural disorders.

Axis I and II disorders were significantly more likely amongst the two offender samples, with court-referred and self-referred participants being about two times more likely than the control participants to have a current or prior Axis I disorder, and about six times more likely to have a current or prior Axis II disorder. The disorders that were over-represented amongst the offenders were past or current alcohol or drug related disorders, Intermittent Explosive Disorder, and Antisocial Personality Disorder.

The study conducted by Jesser et al. (1997) discussed earlier also has some relevance to the relationship between risky driving behaviours and broader behavioural disorders. The Jesser et al. study involved a longitudinal survey of teenagers and collected data concerning a range of problem behaviours. Amongst other things, they reported that the delinquent-type behaviours that appeared to have a strong relationship to unsafe driving behaviour were consistent with some of the criteria used to diagnose a number of antisocial disorders such as
Conduct Disorder and Antisocial Personality Disorder. This included items relating to behaviours such as shoplifting, stealing, lying, starting fights, and damaging property. Jessor’s results therefore suggest that there is a relationship between risky driving and the pattern of problem behaviours that underlie externalising disorders such as Conduct Disorder and Antisocial Personality Disorder.

The link between risky driving behaviour and crash risk and broader patterns of problem behaviour appears to extend to links between safety-related behaviours and the patterns of problem behaviour that are used as the basis for diagnosing behavioural disorders such as Conduct Disorder and Antisocial Personality Disorder. This has some important consequences for the possibility of predicting risky driving behaviour prior to licensing. It indicates that research concerning the development of diagnosable behavioural disorders has some relevance to understanding the development of risky driving behaviours, and it suggests some potential avenues for predicting problem driving behaviours based on recognised behavioural criteria for these disorders. These issues are investigated below.
DEVELOPMENTAL PSYCHOLOGY

Problem behaviours, including problem driving behaviours, occur in the broader life context of the developmental challenges and transitions that lead to early adulthood. These developmental issues are therefore relevant to unsafe driving outcomes, particularly given the focus of this report on the possibility that early adult driving behaviours may be predictable based on adolescent patterns of behaviour.

Transitions and trajectories

Developmental psychology has traditionally considered growth from infancy through to adulthood in terms of a series of stages, where within each stage people generally share a number of characteristics and developmental challenges. The transitions within and between stages occur more or less successfully depending on the interaction between the characteristics and challenges associated with each stage and the person’s context in relation to peers, schools, and family (Gutman & Eccles, 2007).

Recent improvements in research and analysis methods have changed the focus of developmental research in a way that has decreased the emphasis on the characteristics and challenges of average young people in and between specific stages, and that has increased the emphasis on how individual people progress along their developmental paths and how there are similarities and differences between these trajectories that involve common personal and contextual factors. The increasing focus on longitudinal data and new analysis methods has allowed tracking people as they transition through their childhood and adolescence and assessment of similar trajectories in relation to some characteristics (Nagin & Odgers, 2010).

The research transition from a focus on developmental stages towards a focus on the way individuals change over time and through development is important in relation to the development and desistance of antisocial behaviours. Moffitt’s (1993) review of this area encouraged a stronger focus on developmental trajectories. Moffitt discussed the challenges of reconciling the stability of antisocial behaviours and the less-stable increase and then decline in the prevalence of antisocial behaviours as adolescents mature into young adults. The distinction Moffitt drew between life-course-persistent antisocial behaviour and adolescence-limited antisocial behaviour was one that relied on different causal factors that are best interpreted in terms of different developmental trajectories. Life-course-persistent problems were interpreted based on neuropsychological deficits interacting with criminological contexts, while adolescence-limited problems were interpreted as a maturational deficit.

The strengths of trajectory-oriented methods are related to their focus on how individuals’ responses to developmental challenges differ based on a range of factors that have cumulative effects over their development (Nagin & Odgers, 2010). While there may be ‘typical’ developmental trajectories that account for many young people’s outcomes and that are detected in developmental-stage focused research, trajectory-based approaches allow for the likelihood that there are atypical developmental trajectories that lead to different outcomes and that may be seen only as statistical noise in stage-based research.

In the context of antisocial and deviant behaviours, or in relation to risk-taking driving behaviours that are atypical and associated with above-average elevation in crash risk, the
trajectory notion puts young adult outcomes in a developmental context where atypical outcomes are able to be assessed in relation to atypical developmental paths.

Maughan et al. (2000) noted the consistent paradox in antisocial behaviour discussed in part by Moffitt (1993). Although most antisocial adults have longstanding histories of problem behaviour commencing in childhood, the majority of children with antisocial patterns of behaviour do not progress to antisocial behaviours in adulthood. They noted the historical development of research in this area. Research before the 1990s focused on a variable-based approach where research was concerned primarily with which variables predicted later antisocial behaviours. This research was able to show that there are a number of such variables that when assessed in childhood are able to predict later offending - such as antisocial behaviours in childhood, Attention-Deficit/Hyperactivity Disorder related deficits, cognitive problems, parental patterns of antisocial and offence behaviours, and parenting.

More-recent approaches have taken the person-orientation rather than the variable-orientation and have attempted to track the development of patterns of behaviour over time in terms of developmental pathways or trajectories. These approaches have the advantage that they allow constructs that would otherwise have mainly epidemiological value (such as problem behaviour theory) to be examined more closely as children mature. The result is a more-detailed understanding of the pathways different children take as they develop antisocial and broader patterns of problem behaviour.

Tremblay (2010) presented a detailed review of recent research concerning various forms of disruptive behaviour (including Oppositional Defiant Disorder, Conduct Disorder, and aggressive behaviours) and the developmental processes and trajectories thought to contribute to disruptive behaviours in adolescence and early adulthood. He defined developmental trajectories as "statistically different courses of development over a given developmental period based on repeated assessments of intermediate problem states".

A trajectory, therefore, is a way of understanding the development of patterns of problem behaviour over the childhood and adolescent lifespan into early adulthood. The notion that developmental processes can be seen as trajectories has a number of advantages. The first is that it moves away from the notion that the average development of behavioural patterns represents the pattern across all individuals. The notion that there are different trajectories of development allows for the possibility that there are different subgroups of children and adolescents whose development progresses at different rates and towards different patterns of behaviour.

The relevance of this trajectory notion in road safety is important and reflects the tension between the notions of the young driver problem and the young problem driver. Traditional approaches to developmental processes have assumed common patterns of development, sometimes with different delays, across the population – much as the young driver problem notion accepts that the road safety problems associated with novice drivers are present across the young driver population. The more-recent notion that developmental processes differ between individuals as developmental trajectories is consistent with the young problem driver notion, where there is an acceptance that the elevated crash risk of young drivers varies between individuals according to the causal effects of a range of factors.

The trajectory notion is also valuable in its acceptance of changing patterns of behaviour over time as people transition through adolescence to young adulthood. It takes into account the changing pattern of behaviour at an individual level – where personal and contextual influences can result in stable, increasing, and decreasing patterns of problem behaviour as children mature. Regardless of the average changes with maturity, the trajectory notion assumes that individuals respond to their specific influential factors in different ways. This
notion raises the possibility that it may be possible to identify the changing pattern of problem behaviours in young people and to predict how their trajectory will influence their behaviour as young adults. This is consistent with the focus of this report – the possibility that deviant or problem driving behaviours in early adulthood may be predictable based on changing patterns of behaviour during adolescence.

The trajectory approach allows for the possibility that cumulative developmental processes and outcomes can be influenced by challenges and characteristics that are present in early childhood. One personal characteristic with developmental and success-related effects is temperament. This is the starting point for considering the possibility of identifying at-risk drivers based on earlier information.

Temperament relates to personal characteristics (or personality factors) that are thought to be innate rather than learned. It is generally thought that temperament is the result of genetic and/or prenatal factors that result in behavioural patterns that are apparent from infancy, and there is consistent research evidence that social behaviours are strongly affected by temperament (Sanson et al., 2004). The role of genetic and other biological factors, such as neurological factors, in the formation of temperament differences has been noted and there is some research at least suggesting that antisocial behaviour patterns may, in part, have neurological causal factors in some cases.

Van Lier et al. (2007), for example, noted previous research emphasising the differences between early onset antisocial behaviour and adolescent onset antisocial behaviour, and that life-course-persistent antisocial behaviour is generally associated with early onset problems and adolescent-onset antisocial behaviour tends to be transient and unrelated to early-onset patterns of behaviours. They noted that it is generally thought that neurological deficits contribute to early onset antisocial behaviour, and that these are seen in minor cognitive deficits, difficult temperament, persistent aggressive behaviour, and Attention-Deficit/Hyperactivity Disorder. Later onset antisocial behaviours are thought to relate to social and environmental factors.

The authors used data from a longitudinal study (commencing around 10 years of age) to assess the relationship between Attention-Deficit/Hyperactivity Disorder and antisocial behaviour, and reported that there was an association between the presence of Attention-Deficit/Hyperactivity Disorder symptoms (reported by teachers) and self-reported antisocial behaviours, but only for those children who reported antisocial behaviour from the beginning of the study and who were therefore judged to have childhood-onset antisocial behaviour problems. The authors argued that this result confirms the view that there are underlying, subtle neurological defects that contribute to child-onset, persistent antisocial behaviour that are not as important in adolescent-onset antisocial behaviour.

The possibility that temperament and other biological and early infancy factors influence the development of antisocial behaviours is an important consideration in considering the early prediction of problem driving behaviours – children and adolescents with behaviour patterns from early childhood that suggest temperament problems and related neurological deficits and antisocial behaviours may be an important group.
Trajectories in problem behaviours

Trajectories and the taxonomy

The taxonomic system – the Diagnostic and Statistical Manual (APA, 2000) – used in the mental health area lends itself to an understanding in terms of the notion of developmental trajectories. It was noted earlier, for example, that the DSM takes a developmental approach (in part) and allows for the progression from Oppositional Defiant Disorder to Conduct Disorder to Antisocial Personality Disorder for some young people. These trajectories in behavioural disorders reflect the trajectories in the development of the specific patterns of behaviour that underlie the diagnosis of each of the disorders.

The notion that developmental trajectories have some value in understanding the factors that influence behavioural patterns in adolescence and early adulthood is consistent with research outcomes in the last decade.

Maughan et al. (2000), for example, examined the developmental pathways or trajectories concerning aggressive and non-aggressive conduct problems amongst children and their progression to police contact and arrest. The data used were those collected as part of a large cohort study undertaken in the USA that was concerned mainly with the development of psychiatric conditions in the initial sample of 4,500 children from 9 years of age to 16 years.

Analysis of the data suggested there were three developmental trajectories in relation to aggressive conduct problems - stable-low patterns of aggressive behaviour where children entered the study with few reported conduct problems and continued with the same pattern; stable-high patterns where children had consistently high levels of conduct problems; and declining patterns where relatively high levels of conduct problems disappeared as the child matured. The stable-high and declining conduct problem groups displayed different patterns of problem behaviours, with the stable-high children generally more likely to demonstrate higher levels of cruelty and violent aggression, or higher levels of stealing and property damage - suggesting a qualitative difference between the stable-high and declining trajectories.

Outcome data were closely related to developmental trajectory. Police contact and arrest rates were dependent on trajectory, with arrest rates for juvenile crimes ranging from under one percent for children with a stable-low conduct problem trajectory to about forty percent for children with stable-high conduct problem trajectories. Children with declining patterns were between these two extremes.

Tucker et al. (2003) examined the developmental trajectories for binge drinking behaviours in a longitudinal sample of US young people assessed at 13, 15, and 18 years of age. Their results suggested four trajectories - early high bingers who reported a high level of binge drinking at 13 years of age; adolescent bingers who reported low levels at 13 years but then high levels at 14-16 years and a declining frequency of binge drinking as adulthood approached; steady increasers who reported a monotonic increase in binge drinking behaviour across the ten-year data collection period into early adulthood; and moderate stables who reported consistently lower levels of binge drinking behaviour when compared to other participants. The largest groups were the moderate stables (37 percent of the sample) and the steady increasers (16 percent).

Patterns of deviant behaviour were associated with early highs and adolescent bingers. The association between binge drinking and measures of social deviance suggest that it may be possible to identify at-risk young people through awareness of their pattern of alcohol use.
Antisocial trajectories

There is an increasingly large body of research evidence concerning the developmental trajectories involved in the development of antisocial behaviours (Nagin & Odgers, 2010; Sanson et al., 2004). The way in which antisocial and deviant behaviours develop and the causal factors that contribute to their development have some relevance to the development of risky driving behaviours such as excessive speeding, loss of control, and recidivism because these driving behaviours are best seen as reflecting broader patterns of antisocial and deviant behaviour.

Developmental trajectories have significant and long-term effects in adulthood across a range of measures. Odgers et al. (2008) investigated different trajectories of antisocial behaviours for males and females in the Dunedin Longitudinal Study, in which data were collected from childhood until participants were in their thirties. Conduct problems were measured throughout childhood and early adulthood based on DSM-IV key diagnostic criteria, and the study identified four trajectories of antisocial behaviours in males and females - early onset (life-course-persistent), adolescent-onset, childhood-limited, and low-trajectory groups.

These trajectories were consistent with other trajectory research in relation to antisocial and deviant behaviours. Early evidence emphasised the difference between early onset or lifetime-persistent trajectories and late-onset or adolescence-limited trajectories (eg. Moffitt, 1993). In the former group, antisocial and deviant behaviours are reported in childhood and remain consistent throughout childhood, adolescence and into early adulthood. In the adolescence-limited trajectories the onset of problem behaviours occurs during adolescence and then declines during early adulthood. The consequences of these trajectories differ in severity and longevity, but both are likely to have consequences for young driver behaviour given that young drivers are generally in late adolescence and early adulthood.

Externalising behaviour

The consequences of antisocial or deviant developmental trajectories are broad. Bongers et al. (2008) investigated the relationship between externalising behaviour trajectories in adolescence and social functioning in early adulthood using data derived from a longitudinal study of 1,600 people initially recruited into the study during childhood. They noted existing evidence that persistent externalising behaviours in childhood and adolescence are associated with conduct and personality problems in adulthood, but they suggested that there is a broader range of negative outcomes that could be related to childhood externalising behaviours, such as social and relationship problems.

The authors identified childhood/adolescent developmental trajectories relevant to four types of externalising behaviour - aggression, opposition, property violations, and status violations - and examined the relationship between membership in each of the trajectory groups and social functioning in adulthood.

The results indicated that variation in most of the social functioning measures was associated with the developmental trajectories associated with opposition and status violations (truancy, running away, and drug use). The outcome across these relationships was that severe, persistent patterns of externalising behaviours were associated with poorer social functioning and social outcomes in early adulthood.

The relationship between adult social functioning and childhood externalising behaviours depended on the type of externalising behaviour. Opposition related externalising behaviours were predictive of poor achievement, problematic social interactions, and intimate
relationships. Status violation trajectories were associated with alcohol and drug use, expulsion from school, and low educational attainment.

Reef et al. (2010) were also interested in the differences between externalising and internalising problems. They reported results from a 24-year longitudinal study of an initial sample of 2,600 children and parents, conducted in the Netherlands, concerning the relationship between externalising behaviour problems and subsequent adult psychopathology and behavioural problems.

Different externalising behaviour trajectories were identified for each of the four types of behaviour identified in Bongers et al. (2008), and there were predictive relationships between these trajectories and subsequent adult psychopathology. High levels of each of the externalising behaviours were associated with negative outcomes such as anxiety and depression, cognitive and attentional problems, and aggressive and rule-breaking behaviours.

The authors concluded that their data were consistent with earlier research suggesting that externalising behaviour problems in childhood are often persistent and predictive of poor outcomes in adulthood. Reef et al. drew a distinction between proactive and reactive externalising behaviours, noting that proactive externalising behaviours in childhood (aggression and property damage) are most strongly related to aggression related behavioural problems in adulthood, while the reactive externalising behaviours are more closely predictive of internalising disorders in adulthood. The implication of this result for hoon-related behaviours is that the presence of proactive externalising behaviours in childhood is likely to be a better predictor of aggressive driving behaviours than the reactive externalising behaviours.

There is increasing evidence that there are some important differences between the causal factors that underlie membership in the problem behaviour trajectories and the severity of their consequences in adulthood. The results reported by Odgers et al. (2008) indicated that participants on the life-course-persistent antisocial behaviour trajectory demonstrated a range of social, familial, and neurodevelopmental risk factors that were not present for adolescent-onset antisocial behaviours, and that male and female participants on the life-course-persistent trajectory were having a broad range of problems in their thirties - including involvement in physical violence, and mental health and economic problems. These problems were noted in the adolescent-onset trajectory members, but they were considerably less intense.

The authors emphasised the similarities in trajectories, risk factors, and long term outcomes for female and male participants. Life-course-persistent antisocial behaviour trajectories in males and females are especially similar in that these people continue to have serious behavioural problems across a broad range of areas well into adulthood without any sign of desistance.

**Genetic contributions**

The possibility that antisocial behaviours in young adulthood arise from one of two sources presents challenges for early identification and for intervention. This is particularly so given evidence that life-course-persistent problem behaviours appear to commence early in childhood and may have their roots in genetic or infancy factors. Silberg et al. (2007) started with the notion that antisocial behaviours take two forms - a persistent form starting in early childhood and an adolescent-limited form that commences later and desists in early adulthood. They suggested that the persistent form may have resulted in part from genetic factors, and that these factors may play a weaker role in the adolescence-limited pattern of
antisocial behaviours. They noted that there is evidence that the early-onset, persistent form is also associated with risk factors such as neurodevelopmental impairment and hyperactivity, and that this may point towards some level of genetic involvement. The adolescent-limited form is less likely to be associated with these individual and familial risk factors.

Silberg et al. drew on data from a twin study in the US and reported that there was a single genetic factor associated with life-course-persistent antisocial behaviour commencing in childhood and an environmental effect that contributed to the development of antisocial behaviours later, during adolescence. They noted that their methods do not preclude the possibility of an interaction effect between genetic and environmental factors in life-course-persistent antisocial behaviour, just that there is a genetic causal factor involved that does not appear to play a role in later-onset externalising problems.

The relationship between antisocial behaviour patterns and other behaviour patterns underscores the likelihood that genetic or infancy factors may play a role in the development of antisocial behaviour patterns during childhood. Van Lier et al. (2007), for example, noted the differentiation between early onset and adolescent onset antisocial behaviours, and that life-course-persistent antisocial behaviour is generally associated with early onset problems and adolescent onset antisocial behaviour tends to be transient. It is generally thought that neurological deficits contribute to early onset antisocial behaviour, and that these are seen in minor cognitive deficits, difficult temperament, persistent aggressive behaviour, and Attention-Deficit/Hyperactivity Disorder. Later onset antisocial behaviours are thought to relate to social and environmental factors.

The authors used data from a longitudinal study (commencing around 10 years of age) to assess the relationship between Attention-Deficit/Hyperactivity Disorder and antisocial behaviour, and reported that there was an association between the presence of Attention-Deficit/Hyperactivity Disorder symptoms (reported by teachers) and self-reported antisocial behaviours, but only for those children who reported antisocial behaviour from the beginning of the study and who were therefore judged to have childhood-onset antisocial behaviour problems. The authors argued that this result confirms the view that there are underlying, subtle neurological defects that contribute to child-onset, persistent antisocial behaviour that are not as important in adolescent-onset antisocial behaviour.

Although it raises some challenges for the development of intervention programs, the focus on the role of inheritance in antisocial patterns of behaviour has some important implications. Some research in this area is remarkably specific. DeLisi et al. (2009) reported the results of a study concerning the effect of an interaction between a person's father's criminal record and a differences in a specific gene that codes for dopamine reception, noting that evidence now suggests that between 40% and 80% of the variance in externalising behaviours and antisocial traits and behaviours is linked to genetic factors.

The authors examined the effect of one gene (the DRD2 gene which codes for the D2 dopamine receptor that is found in a number of brain regions) which has been linked to Antisocial Personality Disorder, Attention-Deficit/Hyperactivity Disorder, and a range of antisocial behaviour patterns. This receptor and the gene are viewed as playing a role in the effectiveness of positive outcomes or rewards.

Serious violent antisocial behaviours and contact with the police in the female adolescent sample were associated with having both a father with a criminal record and one or (more so) two DRD2 alleles associated with risk in previous research. The results were consistent with earlier research that the interaction between genotype and familial situation was critical - adolescent girls with one or two of the risky DRD2 alleles only exhibited violent delinquent behaviours if they also had a criminal father.
Aggression

The possibility that life-course-persistent antisocial behaviours have a genetic basis extends to the different patterns of antisocial behaviours that characterise the two trajectories. Life-course-persistent trajectories appear to be associated with more-severe problem behaviours during childhood and beyond. This was a key conclusion in Tremblay’s (2010) review concerning developmental processes and trajectories. The first issue relevant here was how aggressive, disruptive behaviours develop, keeping in mind that aggressive behaviours are prominent in our understanding of Oppositional Defiant Disorder and Conduct Disorder and are relevant to our understanding of the development of aggressive driving behaviours in early adulthood.

Tremblay noted that aggression meets some evolutionary requirements and is therefore a natural part of human behaviour. Prospective research with infancy-recruited cohorts indicated that aggressive behaviours first appear in early childhood, with the peak in physical aggression in children occurring between 2 and 4 years of age. The vast majority of young children use aggression and then learn to control aggression and use other methods to solve problems. Controlling aggression is therefore an early developmental challenge, and failure to meet this challenge may lead to chronic aggression for some children.

Oppositional behaviours appear in infancy (anger and associated temper tantrums) and peak across all children prior to 2 years of age. The mean peaks in crying (2 months), temper tantrums (28 months) and aggression (4 years) suggests that these behaviours develop to meet goals and then decline as the majority of children learn alternative, more-effective methods of achieving goals. Children who persist with any of these are considered as having a disruptive behaviour problem.

Chronic physical aggression then occurs in 7-11% of children who fail to develop self-control skills. Some of these children go on to develop self-control skills in adolescence and become part of a declining aggression trajectory.

These findings led Tremblay to emphasise that chronic physical aggression almost always appears during early childhood. Evidence suggests that there are four well-defined trajectories of serious violence through adolescence and early adulthood – consistently low levels of aggression (about half the population), early desisters (20%) where aggression levels decline in early adolescence, late desisters (20%) where aggression levels decline in early adulthood, and chronic (about 5%, almost all males) where aggression levels remain high, peaking around 19 years of age.

There is little evidence of a trajectory where serious physical aggression starts during adolescence. This suggests that adolescence-limited antisocial behaviours are less likely to include severe aggressive behaviours and are more likely to relate specifically to defiant and rule-breaking antisocial behaviours. Tremblay noted, given that aggression does not appear to onset after early childhood, the argument that Conduct Disorder is a development of Oppositional Defiant Disorder is most likely an artefact of poor research methods that rely on parental recall of first instances of aggressive behaviours.

The defiant disruptive behaviours that underlie Oppositional Defiant Disorder are different to the chronic aggressive behaviours that underlie severe Conduct Disorder. There are trajectories of Oppositional Defiant Disorder behaviours - high persisters (7%), high decreasers, medium decreasers, low decreasers, adolescent increasers (6%), and near-zeroes. The adolescent increasers are similar to the adolescence-limited antisocial behaviour trajectory and are unlikely to feed into a late onset Conduct Disorder group as their behavioural problems are relatively modest. The adolescence-limited antisocial or deviant behaviour
groups noted in other research are not characterised by severe levels of aggressive behaviour, emphasising the difference in cause and development between life-course-persistent problem behaviours and short-term, temporary problem behaviours.

One challenge for road safety is that the behavioural problems associated with the persistent and limited antisocial behaviour trajectories in early adulthood are likely to differ. The life-course-persistent antisocial behaviour group is more likely to display aggressive driving behaviours in addition to defiant, rule-breaking driving behaviours, and their problem behaviours are likely to persist into adulthood. The adolescence-limited antisocial trajectory group are likely to limit their problem or risky driving behaviours to rule-breaking, sensation-seeking behaviours and are likely to desist from these behaviours as they deal with the transition into early adulthood.

**Impulse control and self-regulation**

The factors that contribute to the resolution of problem behaviour patterns in adolescence-limited antisocial behaviour trajectories have been of some interest. Monahan et al. (2009) focused their attention on the role of psychological development in adolescence as a predictor of desistance from ongoing antisocial behaviour into adulthood. They noted in particular that there is significantly more research concerning the factors that are associated with the development of antisocial behaviour patterns than there is research concerning the factors associated with the decline in antisocial behaviour experienced by many in late adolescence.

Monahan et al. were interested in the role of psychological maturity in the desistance from antisocial behaviour that occurs in the adolescence-limited offender group, given that there are most likely neuropsychological and cognitive deficits amongst life-course-persistent offenders that are unlikely to benefit from broader developmental or maturational processes. The authors emphasised that the recent research into the various developmental trajectories that has identified a range of antisocial trajectories has not countered the general view derived from earlier work that many antisocial children and adolescents desist at some point in their early adulthood.

The authors focused their attention on self-control and impulse control as predictors of offending behaviours, and therefore the development of impulse control as a developmental change in late adolescence. They noted that psychological development in late adolescent is characterised by improvements in future orientation, planning, and impulse control, and that these changes are likely to underlie the decline in antisocial behaviours in early adulthood amongst adolescence-limited offenders.

Monahan et al. reported the results of a longitudinal study of 1100 US males who were recruited into the study if they had been charged with a serious offence between 14 and 17 years of age. Participants were interviewed at 6-month intervals over a three-year period and then once more after an additional year. Their results suggested three high-risk trajectories, two of which declined in late adolescence or early adulthood. Their results showed that desistance from antisocial behaviour in early adulthood was associated with improvements in impulse control and suppression of aggression. Persistent offenders showed no positive changes in these traits through the data collection period. They also showed that persistent and desisting youths did not differ in relation to psychosocial maturity through the data collection period, suggesting that the key developmental factors relating to adolescence-limited offending behaviour are related to impulse control rather than broader maturity issues. Some factors, such as future orientation, discriminated between the trajectories over the data collection period, but did not change in a way that suggested a causal role for desistance.
The primacy of impulse control as a determinant of changes in antisocial behaviours suggests that desistance in the adolescence-limited group relates primarily to the development or activation of specific neuropsychological or cognitive mechanisms during maturity into early adulthood. The authors emphasised the maturation of the cognitive control system located in the dorsolateral prefrontal and parietal cortices.

Research published at about the same time investigated the role of guilt and effortful control in inhibiting problem behaviours. Guilt and effortful control are similar to impulse control and the suppression of aggression. Kochanska et al. (2009) started with the general conclusion that developmental trajectories in disruptive behaviours reflect the action and timing of processes that lead to the inhibition of disruptive behaviours that are prevalent in early childhood as children develop into, through, and beyond adolescence.

They noted that guilt and effortful control have been emphasised as important contributors to rule-bound behaviour, and that the callous-unemotional traits thought to lead to the development of psychopathy are largely guilt-related - a lack of remorse, lack of empathy, and compromised guilt. The focus of this study was the combined effect of these factors on the development of prosocial behaviours and the interruption of disruptive trajectories.

The studies involved repeated assessment of young children's guilt responses and effortful control (delayed or interrupted impulsive behaviours) using tasks designed to promote both responses. These were compared to mothers’ ratings of disruptive conduct at around 6 years of age.

The results of the first study suggested that effortful control assessed through early childhood had a significant effect on disruptive behaviour but only for children with moderate or strong guilt responses. The second study used a larger sample and suggested that disruptive conduct was more common for children with low guilt and poor effortful control of their behaviour, that strong guilt responses were associated with low levels of disruptive behaviour, and that the difference between strong and weak effortful control of behaviour was most pronounced for low-guilt children.

The results suggest that effortful control improves behavioural outcomes for low-guilt children, but has little effect for children with high levels of guilt. They therefore underscore the importance of guilt in inhibiting disruptive behaviours.

O’Connor et al. (2011) built on the research reported by Hawkins et al. (2009) using the same data set derived from the Australian Temperament Project, with a focus on the predictive relationships between data collected throughout the longitudinal project and the positive development construct operationalised in the earlier research. This project provides important information about the protective factors that encourage positive outcomes during young adulthood, and could there provide information about an approach to assessment for risk that identifies at-risk children based on a low likelihood of positive development.

The results indicated that 27 percent of the variation in the positive development variable calculated based on survey responses during young adulthood could be accounted for by a small number of variables assessed in late childhood, early adolescence, and mid/late adolescence. Key predictors of young-adult positive development in early and mid/late adolescence included emotional control, school adjustment (and persistence measured in late childhood), positive relationships with peers, relationship with parents, and community orientation. SES was also associated with positive development, as was reactivity in late childhood (an inverse relationship).

Some of the results suggest that self-regulation is an important predictor of positive development, consistent with other research suggesting that the development of self-
regulation is an important predictor of positive outcomes throughout childhood and adolescent development.

The differentiation between life-course-persistent and adolescence-limited antisocial behaviours is important in the road safety context because there is evidence that the persistent behavioural problems (which include rule breaking and aggressive behaviours) are likely to result from causal factors that will challenge the development and implementation of interventions. These young adults are likely to exhibit the most-severe problem behaviours, are unlikely to desist in these behaviour patterns during early adulthood, and are affected by factors that are difficult to influence such as guilt and callousness. It will be important to continue to differentiate between these two groups of problem young drivers when considering identification, prediction, and intervention.

Comorbidity

Research concerning the comorbidity between different patterns of behaviour in childhood and adolescence and the range of factors that are correlated with antisocial and other problem behaviours is of some interest. The possibility that there is some level of overlap between various antisocial and problem patterns of behaviour adds some level of complexity to applying this area of research to young driver safety. Similarly, the likelihood that there are many psychosocial and contextual factors associated with antisocial and deviant behaviours raises questions about causal factors that might be relevant for predicting ongoing problems.

There is consistent evidence that the taxonomic categories in the DSM system are not independent of each other – there are high levels of comorbidity (APA, 2000). This comorbidity hints at some complex relationships between developmental trajectories that may need to be considered when developing an assessment method and when implementing intervention programs.

Van Lier et al. (2007), for example, were interested in the relationship between developmental trajectories for Conduct Disorder, Oppositional Defiant Disorder, and Attention Deficit Hyperactivity Disorder. They noted that there is consistent evidence of comorbidity across these disorders; but that the evidence concerning this is generally drawn from clinical research rather than population research and that there is some uncertainty about the developmental trajectories that may be relevant to the three disorders. Their research made use of longitudinal data from a large sample of Netherlands children/adolescents.

The authors identified developmental trajectories separately for each of the three disorders and for males and females separately. The trajectories identified for males and females were similar - there were three Conduct Disorder trajectories (called low, moderate, and adolescent peak), four Oppositional Defiant Disorder trajectories (near zero, low, moderate, and high), and four Attention-Deficit/Hyperactivity Disorder trajectories (near zero, low, moderate, and high). The smallest group in each disorder was the high or adolescent peak group - never more than five or six percent of the sample.

There was a high level of comorbidity between the high Oppositional Defiant Disorder and adolescent peak Conduct Disorder trajectories, and (more so for males) the weaker comorbidity between Attention-Deficit/Hyperactivity Disorder and Conduct Disorder was accounted for by the relationship between Oppositional Defiant Disorder and Conduct Disorder. These results are consistent with other research, emphasising the relationship between Oppositional Defiant Disorder and the development during adolescence of Conduct Disorder. The 'high Oppositional Defiant Disorder' trajectory commences in childhood at an
elevated level, suggesting that Oppositional Defiant Disorder can be seen as a precursor to the subsequent development of Conduct Disorder in some cases.

The authors suggested that the likelihood of Conduct Disorder in adolescence can be predicted in part by the presence of Oppositional Defiant Disorder or related patterns of behaviour in childhood. This is important – suggesting that relatively severe antisocial behaviours can be predicted based on less-severe antisocial behaviours in childhood. It is certainly consistent with evidence discussed earlier suggesting that some adolescents with serious antisocial and deviant patterns of behaviour were clearly engaging in problem behaviours in childhood. The focus on three disorders in the van Lier (2007) research may have limited its value, however, because it failed to identify the patterns of behaviour associated with persistent and temporary antisocial patterns of behaviour. The way in which the Oppositional Defiant Disorder and Conduct Disorder taxonomic categories incorporate broad ranges of problem behaviours may hide some of the trajectory patterns over childhood and adolescence.

The relationship between internalising and externalising behaviours in the trajectory context has been of some interest given consistent findings that there are relationships between problem behaviours and internalising problems such as depression and anxiety. In one trajectory-based study, Diamantopoulou et al. (2011) examined the co-occurrence of depression and delinquent behaviours in adolescence and their relationship with adult outcomes for male and female participants in a longitudinal study conducted in the Netherlands. The authors examined the developmental trajectories of young people in relation to delinquent patterns of behaviour and depression (separately).

Simple bivariate analyses indicated a broad range of predictive relationships between social, attentional, aggressive, depressive, and delinquent factors in adolescence and a range of behavioural problems in adulthood. Trajectory analyses suggested three trajectories for depression during adolescence for boys and girls (low, decreasing, and increasing) with girls less likely to be classified in the low trajectory group, and two trajectories for delinquency (low and high) for boys and girls.

The patterns of co-occurrence of depression and delinquency differed for boys and girls. Conditional probability estimates indicated that the likelihood of delinquency problems given membership in a particular depression trajectory was similar for boys and girls (increasing and decreasing depression trajectory membership was associated with high trajectory membership for delinquent behaviours), but the likelihood of depression problems given membership in the high or low delinquency trajectory differed for boys and girls. Boys who were members of the high delinquency trajectory were most likely to be members of the decreasing depression trajectory, while girls who were members of the high delinquency trajectory were most likely to be members of the increasing depression trajectory. These results suggest that high depression levels are always related to high levels of delinquency regardless of sex, but high delinquency levels are more likely to be related to depression for girls than for boys.

The relationships between adolescent developmental trajectories and adult outcomes were as expected, with membership in high-risk trajectories associated with poorer outcomes in adulthood across all problems. The longitudinal results suggested that boys’ membership in the increasing depression and high delinquency group was predicted by childhood aggression, and girls’ membership in the combined increasing depression and high delinquency group was predicted by childhood depression. The routes by which males and females develop delinquent and depressed characteristics appear to differ.

A more-recent study also identified some sex differences in the relationship between internalising and externalising problems. Pepler et al. (2010) identified developmental trajectories in relation to delinquent behaviours in a sample of male and female participants
(N=700) in a longitudinal study that started when participants were 10-12 years of age and collected data over a seven-year period. They reported five groups of participants with different developmental trajectories. The authors examined the relationship between internalising behavioural problems and trajectory and reported differences between male and female participants. While there were no differences in internalising problems across the trajectories for male participants, females in the three delinquent trajectories were more likely than those in the low-delinquency trajectory to report internalising problems, which is consistent with previous research on the comorbidity of depression and Conduct Disorder in female adolescents.

There is a body of research concerning the contextual factors that appear to have a relationship with the development of problem behaviours. Tremblay’s (2010) review indicated that environmental risk factors for physical aggression and disregard for rules include maternal young age, maternal antisocial behaviour in adolescence, maternal depression, and maternal low education level. Family low income is a risk factor for aggression, and maternal hostile or coercive parenting was also a risk factor. Similar patterns of risk factors have also been found for Conduct Disorder problem trajectories and Attention-Deficit/Hyperactivity Disorder, suggesting that they are predictive of externalising problems in general. There is little evidence in relation to covert disruptive behaviours such as theft.

The comorbid relationships between the range of externalising behavioural problems and other factors such as contextual factors and internalising disorders act as a double-edged sword in the current project’s context.

- The interaction between different patterns of problem behaviour suggest that identification of future risk-related driving behaviours can draw on a broad range of potential predictor behaviours, and therefore that an assessment tool may have access to a wide range of options.

- The negative consequence, however, is that there is a level of complexity in the interaction between these different patterns of behaviour that would need to be reflected in any identification/assessment tool – especially given the possibility that the causal factors that underlie some patterns of behaviour may depend on the extent to which different patterns are or are not comorbid. The different role of internalising disorders in relation to male and female young adults, for example, adds some complexity to any identification and intervention program that may exceed the available research.

Antisocial personality and psychopathy

The pattern of behaviours at the extreme end of the antisocial behaviour continuum is of considerable interest given the potential for serious consequences. Antisocial personality disorder includes behavioural symptoms that at their extreme are sometimes labelled psychopathic. Antisocial and deviant behaviours combined with some level of callousness may contribute to the worst young drivers.

The problem behaviours flagged as relevant to severe antisocial characteristics are sometimes seen from a strong developmental perspective that restricts the use of Antisocial Personality Disorder (and related terms) to adulthood. This diagnostic decision is understandable given the widespread adolescence-limited patterns of antisocial behaviour and the risk of labelling a teenager inappropriately in a way that will influence their status as they transition to adulthood, but one consequence is the application of an artificial distinction between
childhood, adolescent, and adult patterns of problem behaviour that may be quite similar in some cases.

Lynam et al. (2009) investigated the stability of psychopathy across childhood and adolescence using data derived from a US longitudinal study. They were interested in the suggestion that diagnosis of psychopathy and other personality disorders during childhood was risky due to developmental changes in personality through adolescence in particular. Against this concern they noted that there was growing evidence that psychopathy diagnosed in childhood and adolescence does have predictive value in relation to adult offending and antisocial behaviours.

Male participants were classified into high-risk and low-risk categories based on completion of a psychopathy assessment tool. Statistical modelling suggested that the two groups were stable - those boys classified as high-risk in relation to psychopathy in childhood continued to be high risk until late adolescence and the stability of categorisation was high throughout the developmental period sampled in this study. Future delinquency could be predicted by childhood (current) delinquent behaviours and by responses to the psychopathy assessment tool.

A potential factor in the development of antisocial behaviour trajectories from childhood to adulthood may be the emotional traits that seem to differentiate between severe antisocial patterns of behaviour that persevere developmentally and transient patterns in childhood and adolescence. The possibility that callousness and poor empathy are important predictors of antisocial behaviour has been addressed in a number of research studies.

Burke et al. (2007) reported an investigation of the role of callous and unemotional traits in identifying those young people with Oppositional Defiant Disorder and Conduct Disorder patterns of antisocial behaviour who might be viewed as having a life-course-persistent pattern of behavioural problems and a pattern of behaviours and traits that would be consistent with a childhood version of psychopathy or Antisocial Personality Disorder. There is evidence that callous-unemotional traits predict stable patterns of adult problem behaviour, and there is research confirming the importance of callous and unemotional traits in the development of Antisocial Personality Disorder and psychopathy.

Their results suggested that predictors of factor 1 scale scores in the Psychopathy Checklist (a measure of callous and unemotional traits in adulthood) included the presence of Conduct Disorder during adolescence, low full-scale IQ, teacher (but not parent) rated interpersonal callousness, harsh parenting and poor parental communication, low SES and living in a disadvantaged community, and prenatal tobacco exposure. Factor 2 scores (assessing antisocial lifestyle measures) was predicted by the same variables and maternal age (younger mothers were associated with higher risks) and parental ratings of interpersonal callousness. Further analysis suggested that the presence of Conduct Disorder and high ratings of interpersonal callousness together in adolescence resulted in much higher levels of psychopathy on both factors (callousness and antisocial behaviour patterns) in early adulthood.

Pardini and Loeber (2008) were interested in the development of interpersonal callousness in adolescents - an interpersonal style characterised by deceit, manipulation, grandiosity, superficial charm, poor empathy and low levels of guilt. They noted that this characteristic is thought to be stable across time and is a significant contributor to antisocial patterns of behaviour in adulthood. They noted that although there is research suggesting stability in relation to interpersonal callousness, this research has not addressed stability within individuals or the developmental trajectories relevant to this characteristic.
The authors examined developmental trajectories along with a range of causal factors such as parenting and peer-related factors using data from a longitudinal study of 500 US boys focusing on the development of delinquent behaviours. The project also collected data concerning antisocial behaviours in early adulthood. They did not, unfortunately, seek to identify specific trajectories relating to the development of or reduction in callousness.

The results suggest that there is a range of developmental trajectories, and that higher levels of callousness in childhood and adolescence were associated with antisocial personality characteristics in early adulthood. Dysfunctional communication styles between parent and child were identified as strong predictors of persistent callousness, although it is unclear whether this relationship is causal. There was no evidence that exposure to delinquent or prosocial peers influenced the development of callousness - these relationships were eliminated after controlling for Oppositional Defiant Disorder/Conduct Disorder and Attention-Deficit/Hyperactivity Disorder characteristics along with the parenting variables used in the study.

Fontaine et al. (2011) noted some recent evidence that deficits in empathy – callous-unemotional traits – are present in a subgroup of children with behavioural problems and are associated with an increased likelihood of adult disorders. The authors were interested in possible links between callous-unemotional developmental trajectories and conduct disorder trajectories, with a view to understanding the possibility that there are similarities in risk factors and outcomes.

The data were derived from a longitudinal study of twins in the UK with almost 10,000 participants and data collection from 7 to 12 years of age. Callous-unemotional traits and conduct problems (behaviours matching antisocial behaviour characteristics) were assessed by teachers. The measures all had reasonable internal consistencies, but the relatively short time frame of data collection presented a problem in the identification of trajectories - there were only three data collection points over the six year period.

The authors simplified their analysis by settling for a two-trajectory model of conduct problems (a high and a low trajectory), but identified four trajectories in relation to callous-unemotional traits - stable low, increasing, decreasing, and stable high, with the smallest groups being the stable high (five percent) and the increasing (seven percent) trajectories.

The smallest group of children were those with high levels both of conduct disorder and the callous-unemotional trait. They were about 4 percent of the sample.

There were clear links between conduct problems and the callous-unemotional trajectories. All of the low-callous-unemotional trajectory children were members of the low conduct problem group, and 95 percent of the high-callous-unemotional trajectory children were in the high conduct problem group. The decreasing and increasing trajectory children were, as might be expected, between these two extremes. Similarly, there were no high conduct problem participants in the low-callous-unemotional trajectory, and 82 percent of low conduct problem group members were members of the low-callous-unemotional trajectory group.

The authors noted that their results were asymmetrical - high levels of callous-unemotional traits in children were generally associated with high levels of conduct problems, but high levels of conduct problems were less well predictive of callous-unemotional traits. It is therefore possible to predict conduct problems based on the presence of callousness or poor affective responses, but prediction of callousness based on conduct problems is less reliable. This reflects similar results in adult psychopathology where psychopathy is highly predictive of antisocial behaviour, but antisocial behaviours do not reliably predict psychopathy. One implication of this is that early assessment in terms of conduct problems may not capture
potential serious problems in later childhood and adulthood - assessments would best incorporate measurement of callousness to improve their predictive utility.

Moran et al. (2009) noted that psychopathy is generally viewed as being composed of three dimensions - callous or unemotional personality traits, arrogant interpersonal style, and impulsivity. They cited evidence that antisocial behavioural patterns in adolescence are characterised by high or low levels of callousness, and that those young people with antisocial behaviour and high levels of callousness differ from others in relation to the roles of heritability and environment. There is some evidence that there is a strong genetic contribution to antisocial behaviours with high levels of callousness. The authors suggest that the presence of callous/unemotional traits in adolescents with antisocial behaviours may be predictive of subsequent psychopathy.

The authors draw on data derived from a study of a large sample of UK children recruited between 6 and 16 years of age and then followed up over a three year period. They reported that the presence of callous/unemotional traits was predictive of conduct problems and emotional problems three years after the first survey. They did not, unfortunately, provide data for different age groups or for a longer follow up period.

Research concerning the development of severe antisocial patterns of behaviour and the role of callous-unemotional traits in relation to young problem drivers is relevant for two reasons. Serious hoon-like, risk-related behaviours are relatively uncommon and reflect a behaviour style that is impulsive and lacking in empathy for the potential outcomes that might affect other drivers and road users. This suggests a role for callousness and impulsive/aggressive behaviours that would be consistent with the severe antisocial patterns discussed above.

The second reason for focusing on these characteristics relates to the prediction of early-adult behaviours based on adolescent characteristics. Predictions are likely to be more accurate (reliable and valid) where more-severe patterns of behaviour are targeted.

Sex differences

Some of the evidence concerning the relationship between depressive problems and antisocial behaviour patterns suggests that there are differences in the development of antisocial behaviours in females. These differences may be important in understanding how to use adolescent behaviour patterns to predict future behaviours.

Czech & Kemp (2010) reported results from a small study of Australian adolescents and young adults that indicated that earlier involvement in antisocial behaviours in adolescence were associated with more severe and persistent antisocial behaviours, and that the peak in antisocial behaviour in adolescence-limited antisocial behaviour patterns in girls was shorter and more-severe than the peak for boys.

Fontaine et al. (2009) presented a review of research concerning the developmental trajectories of adolescent girls in relation to antisocial behaviour patterns. There is relatively little empirical research concerning the development of antisocial behaviour patterns in females, but the research that is available is generally consistent with the broad findings for males - there are different developmental trajectories for antisocial behaviours with changing patterns as girls mature.

The authors reviewed 46 empirical studies that identified developmental trajectories. The results were varied, but most studies suggested patterns of antisocial behaviour that were either early or late onset, and that were either persistent or of limited duration (childhood- or adolescent-limited, for example).
The authors concluded that some females demonstrate an early onset, persistent pattern of antisocial behaviour that is associated with childhood risk factors similar to those reported for boys and that these patterns continue into adulthood; that some display adolescent-onset patterns of antisocial behaviour, with some best described as adolescent limited and showing longer-term patterns of antisocial behaviour that commence in adolescence rather than childhood; and that there are a number of alternative trajectories identified in some studies that suggest the development of antisocial behaviour in some females may involve more-complex processes than suggested in the theoretical literature.

Miller et al. (2010) confirmed similar patterns of trajectories in relation to delinquent behaviours for boys and girls through adolescence and similar predictive utility of these trajectories for young adult behaviour, but reported that girls were generally less likely to find themselves in the higher-risk trajectories. The only exception to this pattern in the sample of 750 children in this study concerned the 'increasing' trajectory, where girls and boys were equally represented in their teenage years.

The differences between antisocial behavioural trajectories in boys and girls imply that methods used to identify at-risk young people will need to take sex into account. Developmental processes that underlie the development of antisocial patterns of behaviour amongst girls appear to be more varied and complex and may involve internalising problems that are generally less involved in boys’ antisocial trajectories.

**Antisocial trajectories and hoon behaviour**

It is reasonable to assume that there is a relationship between risky (or hoon) driving behaviours and developmental trajectories related to antisocial patterns of problem behaviour, but the novelty of the trajectory notion in developmental psychology means that there has been little research conducted to assess the links between young driver safety and developmental trajectories.

An argument supporting a link between developmental trajectories and problem driving behaviour relies initially on adopting the problem behaviour notion that risky driving behaviours reflect broader behavioural patterns across multiple aspects of the young person’s life, and that these broader patterns in turn reflect developmental processes that are best understood in terms of individual trajectories.

Jessor et al. (1997) focused on the relationship between risky driving and the larger pattern of challenging or problem behaviours across the young person’s life, taking into account prior studies that suggested a link between risky driving behaviours and a range of norm-violating behaviours and personality characteristics that are less-strongly bound to traditional or normative values.

They focused on road safety outcomes in the context of improved role socialisation as young people take on adult roles and responsibilities, using data from a longitudinal study of teenagers. They collected data concerning driving, behavioural, psychological, and social factors. Unsafe driving behaviours were associated with lower levels of socialisation to adult roles, suggesting that the application of problem behaviour theory to young driver behaviour was reasonable. They found that the broader changes in patterns of delinquent behaviour across the teenager’s life were the best predictors of safety-related driving behaviours.

Similar links between broader developmental mechanisms and driving behaviour have been reported elsewhere. Keating and Halpern-Felsher (2008), for example, discussed young-adult and novice driving in the broader context of the developmental issues associated with transition to adulthood. They focused in part on self-regulation in relation to cognitive
development and suggest weaknesses in impulse control may be an important factor in young driver safety.

The potential interaction between this focus on developmental transitions in cognitive skills and the trajectory-oriented research suggesting that risky behaviours are associated with delinquent trajectories that are also influenced by self-regulation and impulse control is worth considering. There may be a subgroup of drivers who find the transition to developing adult cognitive skills more challenging as a result of their low initial baseline of impulse control.

There has been some interest in developmental issues and the relationship between risky driving and broader patterns of behaviour in the road safety area. Broughton (2007) examined the relationship between traffic offences and non-traffic offences in the UK and reported a strong relationship between motoring and non-motoring offences.

As noted earlier, drivers with just one non-motoring offence had twelve (males) or twenty-six (females) times the number of serious driving offences as drivers with no non motoring offences. Those with high numbers of non-motoring offences had very high numbers of serious driving offences, and the link between non-driving and driving offences was strongest for dangerous driving and driving while disqualified - both reflecting broader deviant patterns of behaviour.

Broughton concluded that his results confirmed a relationship between deviant or antisocial behaviour and driving offences such that people with deviant patterns of behaviour in relation to criminal offences are also likely to have deviant patterns of behaviour in relation to driving.

Shope et al. (2003) investigated the relationship between alcohol- and peer-related factors in adolescence and subsequent crash risk, using relatively simplistic models of alcohol-use trajectories during adolescence. Although the statistical methods used to identify trajectories and classify participants were simpler than other methods used in the developmental area, this study is an important initial investigation of the relationship between adolescent trends and subsequent safety outcomes.

The study was concerned with alcohol use, friends support for drinking, susceptibility to peer pressure, and tolerance of deviance as predictive measures. Each had been assessed at least twice during adolescence, and the analysis assumed that there were three possible trajectories - stable (high, medium, or low), increasing, and decreasing. Outcome variables were official offence and crash data.

The results were consistent across the four predictors and for crashes and offences - trajectories suggesting high levels of problem behaviour or contexts (alcohol use, friends support for drinking, susceptibility to peer pressure, and tolerance of deviance) were associated with poorer safety-related outcomes. The poorest safety-related outcomes in the first year and first three years of driving occurred for those participants with persistent high trajectories or increasing trajectories. The best outcomes were for those with decreasing trajectories or with persistently low trajectories on each measure.

These results suggest a clear relationship between adolescent behaviours and peer contexts and safety-related outcomes (offences and crashes), and therefore provide some support for the suggestion that it may be possible to predict problem driving outcomes during adolescence. As discussed elsewhere, however, the relationship is not a perfect relationship, limiting its value as the basis for imposing consequences on those young people with riskier behavioural patterns in adolescence.

Despite the limited research specifically concerning the relationship between developmental trajectories and young driver problem behaviours, there is some supporting evidence that this relationship may provide the basis for identifying adolescents who have a relatively high risk of
engaging in unsafe behaviours once licensed. The broader problem behaviour theory, its supporting evidence and its links to developmental trajectories provides additional supporting evidence.

Antisocial trajectories and injury risk

There is some evidence that antisocial behaviours are linked to injury risk – supporting the focus on broader patterns of antisocial behaviour in relation to young driver crash risk. Thuen & Bendixon (1996), for example, noted that adolescents engaging in antisocial and deviant patterns of behaviour also have a higher risk of accidents and injuries than other teenagers. This relationship has been shown for male and female adolescents, and the relationship between antisocial behaviour and injury risk is present in non-deviant, less seriously affected young people. The authors examined the link between antisocial behaviours and injury risk by examining risk seeking and safety seeking behaviours in a sample of early-adolescent Norwegian participants.

The results of the study confirmed that antisocial behaviour patterns were related to high levels of risk seeking behaviour and low levels of safety seeking behaviour, which are likely to contribute to the injury risk associated with antisocial and deviant characteristics. The authors placed the results in the broader context of the Problem Behaviour Theory and noted other evidence that antisocial characteristics such as unconventionality are known to be associated with risk taking behaviour such as restraint non-use.
PREDICTING ANTISOCIAL TRAJECTORIES

Evidence discussed to this point suggests that young driver safety problems can in part be seen as reflecting the broader patterns of risky and problem behaviour amongst young adults that are more common in groups of young people who engage in behaviours consistent with externalising and antisocial behavioural problems described in the DSM (APA, 2000) and that develop along developmental trajectories that result in reasonably stable patterns of behaviour. It follows that if these deviant patterns and trajectories are predictable, then it may also be possible to predict which young people will go on to engage in patterns of behaviour that are likely to include risky and problem driving behaviours. This section of the report therefore focuses on the consistency and predictability of antisocial behaviours and trajectories.

Dekovic et al. (2011) included a substantial review of relevant literature in their paper on intervention programs and identified some evidence consistent with the general view that antisocial patterns of behaviour are predictable because of their development and consistency over time. They noted:

- The stability of antisocial behaviour and the predictive utility of disruptive behaviours identified in childhood.
- The importance of a range of consistent factors that act together to increase the likelihood of antisocial behaviour in adulthood, including personal, familial, and extra-familial factors. Predictors include SES, parental education, parental stress and skill.
- The importance of aggressive behaviours in early childhood as a starting point for an antisocial developmental trajectory and the potential value of aggressive patterns of behaviour as consistent predictors of subsequent behaviours associated with this trajectory.
- Untreated early risk factors accumulate over time as children grow through childhood and adolescence, with social isolation and peer/adult rejection compounding the effects of childhood and temperamental factors. The accumulation of negative influences through developmental transitions will have a consistent effect on outcomes, meaning that these influences could assist in predicting problem behaviours in early adulthood.

The range of potential predictors of antisocial behaviours in early adulthood is quite diverse. Leschied et al. (2008) reported the results of a meta-analysis of 38 prospective studies of the relationship between potential childhood and adolescent predictors and subsequent measures of adult criminal, antisocial, and deviant behaviour. They discussed a distinction between static predictors - those that are historical and cannot be changed such as age, sex, racial group etc - and dynamic predictors that may in some cases be the target of interventions.

The authors reported that predictors were more accurate for older children. In the context of dynamic predictors, they found consistent relationships between adult deviant behaviour and early aggression, attentional problems, hyperactivity, and attention seeking. Negative approaches to parenting such as coerciveness, distance and poor connection, and conflict between parents were also consistently predictive of deviant early-adult behaviour.

Murray & Farrington (2010) reviewed the available research literature (with a focus on longitudinal studies) to assess potential risk factors that contribute to the development of and trajectories associated with Conduct Disorder. They concluded that risk factors for Conduct
Disorder and delinquent patterns of behaviour include impulsiveness, poor cognitive functioning and academic achievement, low levels of parental supervision and punitive or inconsistent parental discipline, and antisocial peers and exposure to antisocial norms.

The predictive use of childhood and adolescent developmental trajectories has been addressed in some research since the trajectory notion was first proposed. Maughan’s (2000) study outcome was consistent with the potential use of conduct problem trajectories identified in childhood and puberty as predictors of later offence behaviours. Further analysis of the trajectory classifications suggested that developmental trajectories were associated with the expected variables - including poverty, poor parental supervision, and parental criminality. Combining these variables with classification into the high-stable conduct problem trajectory may further improve the prediction of subsequent offence problems.

More recently, Gentle-Genitty (2010) reviewed ten longitudinal studies with a focus on the relationship between life course trajectories in adolescence and their consequences for antisocial and deviant behaviour in young adulthood. She was especially concerned about common predictors across the ten studies and the possibility that they might contribute to an understanding of the best approaches to intervening in problem patterns of behaviour.

Common themes through these studies included difficult parent-child relationships, neighbourhood support and context, and temperament and personality problems. The author also noted consistent evidence for roles for socioeconomic status, contact with deviant peers, and poor academic performance.

There is consistent research evidence supporting the predictive relationship between adolescent characteristics and behaviours and subsequent antisocial behaviour patterns in early adulthood.

**Externalising problem behaviours**

There is some evidence that internalising problems play a role in the development of antisocial behaviour patterns amongst girls. Koffler et al. (2011), for example, used data from a longitudinal study of about 3,000 US children to investigate the relationship between childhood depression and delinquency in late adolescence. They reported that depressive symptoms were strongly predictive of the development of delinquent and antisocial behaviour, but especially for girls. They suggested that their results are consistent with a view that early depressive symptoms and the associated negativity and irritability lead to increased levels of aggressive behaviour and minor rule breaking that then encourage contact with and relationships with other adolescents with antisocial behaviour patterns.

Despite this type of evidence, the majority of research studies in this area focus on the predictive value of externalising behaviours in predicting subsequent patterns of antisocial behaviour. Broidy et al. (2003) noted, for example, that there is longstanding evidence that delinquency and adult criminal behaviour are generally preceded by childhood behaviour problems. They were concerned about the relative importance of physical aggression during childhood compared to other childhood behaviour problems, and whether childhood aggressive behaviours are specifically predictive of adult physical violence. Aggressive behaviours are the most severe of the externalising behaviours and it would be surprising if patterns of childhood aggression are unrelated to adult aggression. The studies reported in the papers were conducted across six locations and all made use of longitudinal data sets that commenced in childhood.

The analysis applied methods designed to identify subgroups of participants with different trajectories (in this case of physical violence) across the data collection waves, and then
examined the relationship between subsequent (late teen or early adulthood) antisocial or delinquent behaviours. Multivariate methods were used to control for other potential predictors.

The results were broadly consistent across the six data sets. In every case the analyses identified a low-aggression, stable trajectory (where participants consistently displayed few externalising behaviours) and a high-aggression, stable trajectory (consistently high levels of physical aggression throughout childhood). Most data sets also indicated the presence of one or two large groups of participants characterised by moderate levels of aggression that declined over the childhood years. These results are largely consistent with other studies discussed earlier that suggest aggression declines in most children as they develop prosocial problem solving techniques.

Violent and non-violent delinquency was consistently predicted by the physical aggression trajectory, but only for boys. Multivariate analysis indicated that this relationship persisted when other conduct problems were taken into account (non-aggressive conduct problems, Oppositional Defiant Disorder, and Attention-Deficit/Hyperactivity Disorder), and that the relationship between these other conduct problems and delinquency was not consistent when physical aggression was used as a predictor. It is therefore possible to predict a higher risk of violent and nonviolent delinquency as an outcome for boys who are members of the high-stable physical aggression trajectory, but no such prediction is possible for girls. The authors also noted that there is evidence that Oppositional Defiant Disorder is predictive of non-violent delinquency independent of physical aggression.

Broidy et al. therefore showed that physical aggression is a key predictor of delinquent behaviours whether or not they involve aggression, and that this is less likely to be so for females. This is consistent with the Kofler et al. (2011) results noted above that suggest that antisocial behaviour amongst girls is related to adolescent depression rather than physical aggression.

A number of negative outcomes can be predicted based on earlier patterns of externalising problem behaviour. Bongers et al. (2008) demonstrated that the relationship between adult social functioning and childhood externalising behaviours depended on the type of externalising behaviour. Opposition-related externalising behaviours were predictive of poor achievement, problematic social interactions, and intimate relationships. Status violation trajectories were associated with alcohol and drug use, expulsion from school, and low educational attainment.

Reef et al.’s (2010a, 2010b) results, based on a 24-year longitudinal study in the Netherlands concerning the relationship between externalising behaviour problems and subsequent adult psychopathology and behavioural problems, are consistent with earlier research suggesting that externalising behaviour problems in childhood are persistent and predictive of a broad range of poor outcomes in adulthood. Externalising behaviours involving oppositional and status violation patterns were associated with a broader range of psychopathologies in adulthood than the aggressive and property-violation behaviours, and is was noted above that proactive externalising behaviours in childhood (aggression and property damage) are most strongly related to aggression related behavioural problems in adulthood. The presence of proactive externalising behaviours in childhood may be a better predictor of aggressive driving behaviours than the reactive problem behaviours.

The role of aggressive behaviours as a predictor of subsequent delinquent and deviant behaviours in late adolescence and early adulthood has been investigated in relation to bullying behaviours. Hemphill et al. (2011) reported the results of a study of young people recruited in childhood, specifically focusing on the relationship between bullying (perpetration
and victimisation) in years 7 and 10 and psychosocial outcomes in year 11. Experiences of bullying in year 7 were not associated with poorer outcomes in year 11, but experiences of bullying in year 10 were. Young people who engaged in bullying in year 10 were more twice as likely to engage in theft and violent behaviour, and were more likely to report binge drinking in year 11. These results controlled for the predictive role of factors such as impulsivity, attentional problems, family history, school performance, parental monitoring, peer involvement, etc.

The results suggest that after controlling for known predictors of problem behaviours in late adolescence, self-reported perpetration of bullying behaviours in year 10 was an additional predictor of antisocial behavioural outcomes in the following year. This may be an important additional measure for identifying at-risk young people during their school years. Bullying behaviour is an observable behaviour in a school context, and the results of this study provide a clear indication that students who perpetrate bullying in year 10 have a higher risk of subsequent problems.

In another Australian study, Renda et al. (2011) examined the relationship between bullying behaviour in adolescence and subsequent patterns of antisocial behaviour in late adolescence and adulthood, using data from the Australian Temperament Project. This research built on earlier studies that have identified bullying behaviour as a predictor of problem outcomes and the broader view that bullying is part of a pattern of antisocial behaviours in adolescence.

Bullying behaviour at age 13-14 years (most likely reflecting the antisocial behaviour of people with persistent patterns of problem behaviour) was associated with moderate increases in the risk of antisocial patterns of behaviour in early adulthood and contact with the Police or Courts (measured at 19-20 years of age). These relationships were stronger for males than for females.

The authors suggested that bullying behaviour in early adolescence is therefore a potential predictor of subsequent antisocial and deviant behaviours in early adulthood.

Data collected in a US longitudinal study led to similar conclusions. Kim et al. (2011) investigated the relationship between bullying in grade 5 and a range of problem behaviours at 21 years of age. They assessed violence, alcohol use, and marijuana use as outcome variables, and included bullying, family factors, antisocial peer association, racial group, sex, income, and impulsivity as variables (with the last four used as covariates to control for known risk factors).

Childhood bullying was a significant predictor of violence and substance abuse after controlling for the other potential predictors, suggesting that children who engage in bullying behaviour are significantly more likely to engage in adult antisocial behaviours. Childhood bullying is therefore a potential predictor that could be used to help target interventions.

Jiang et al. (2011) investigated the relationship between official offence data for adolescents and young adults and assessment data collected during late childhood, with a particular focus on bullying behaviour and its relationship with subsequent offences. They found that bullies had almost twice the risk of criminal offending than non-bullies up to their eighteenth birthday, and that this relationship persisted when other predictors were taken into account. The difference became stronger as adolescents approached the transition to early adulthood.

The authors suggested that this outcome argues for early identification of children engaged in bullying behaviours and the implementation of interventions to reduce the likelihood of ongoing bullying behaviour. It is not clear, however, that this relationship is necessarily a causal relationship. It is possible that the development of bullying and the later development of criminal behaviour together reflect underlying behavioural patterns or personality factors.
In a substantial review, Ttofi et al. (2011) reported the results of a meta-analysis of 28 investigations of the relationship between childhood bullying and subsequent adult criminal behaviour. They reported consistent results indicating a strong relationship between bullying and criminal behaviour - the likelihood of criminal behaviour in early adulthood for bullies was 2.5 times the risk of criminal behaviour for non-bullies. When a range of other predictors was taken into account, there was still 1.8 times the risk of criminal behaviour in young adulthood.

They noted that the ability to predict criminal behaviour was highest when bullying behaviours were recorded in later adolescence. Given the strong relationship between bullying and subsequent criminal behaviour, the authors recommend anti-bullying programs and the identification of at-risk children.

Aggressive behavioural patterns and bullying in childhood and adolescence are therefore important, consistent predictors of antisocial and aggressive behaviour patterns in early adulthood. In addition to predicting antisocial behaviours, it would be reasonable to expect them to predict aggressive driving behaviours specifically, along with broader risk-related driving behaviours.

The patterns of behaviour used to define specific behavioural disorders during childhood and adolescence also have some predictive utility in relation to adolescent and early adult problem behaviours, although some of this research suggests that the behavioural patterns used as the basis for diagnosing specific disorders may be too narrow when used to predict subsequent behaviour patterns.

The broad relationship between diagnosable problems in childhood and adolescence and subsequent patterns of delinquent and deviant behaviour has been addressed in a number of studies. Copeland et al. (2007), for example, followed a large representative sample of young people recruited in late childhood and early adolescence and ultimately collected official offence data in late adolescence and early adulthood. They were specifically concerned with the relationship between childhood psychiatric disorders and subsequent criminal behaviour, given consistent evidence that criminal offenders are much more likely to exhibit psychiatric disorders than the broader population.

Analysis indicated that minor offences as a young adult were predicted by substance use and anxiety disorders in adolescence, moderate offences were predicted by conduct disorder (marginal results) and anxiety disorders (females) and the absence of anxiety disorders and depression (males), and severe offences were predicted by anxiety, depression, and conduct disorder. Poverty and adolescent offences also predicted adult offences.

The results confirmed the over-representation of childhood and adolescent psychiatric diagnoses and subsequent criminal behaviour in early adulthood, with a focus on anxiety, depression, conduct disorder, and substance use disorders.

Burke et al. (2010) investigated the predictive utility of childhood externalising disorders in relation to adult antisocial disorders and functional impairment. They were also interested in the hierarchical approach to these disorders in DSM-IV, where it is argued that Oppositional Defiant Disorder sometimes leads to Conduct Disorder, which in turn sometimes leads to Antisocial Personality Disorder (and psychopathy) in adulthood. They investigated these issues using data from three studies.

They concluded that the hierarchical view is generally correct, although there is a group of adolescents with Conduct Disorder who did not meet the criteria for Oppositional Defiant Disorder in childhood. This most likely reflects the adolescent-limited trajectory for antisocial behaviours reported elsewhere. They also concluded that measures of interpersonal callousness during adolescence were predictive of adult Antisocial Personality Disorder, but
only for those adolescents who did not meet the criteria for Conduct Disorder. The probability of developing Antisocial Personality Disorder in their Conduct Disorder sample was uniform across all levels of interpersonal callousness. These data may relate to the importance of callousness in psychopathy rather than Antisocial Personality Disorder - this paper was limited to the less-severe antisocial characteristics associated with Antisocial Personality Disorder and did not consider the relationship between adolescent callousness and the more-severe diagnosis of psychopathy (which is not part of the DSM-IV system).

Pardini & Fite (2010) examined the predictive value of Conduct Disorder, Oppositional Defiant Disorder, Attention-Deficit/Hyperactivity Disorder, and callous-unemotional traits in relation to patterns of antisocial behaviour in adulthood based on a longitudinal community sample of about 1,500 boys recruited in childhood. They were particularly interested in the additional predictive value of Oppositional Defiant Disorder, Attention-Deficit/Hyperactivity Disorder, and callousness given the established predictive utility of Conduct Disorder in relation to antisocial and deviant behaviours in adolescence and adulthood.

The results confirmed the stability of Conduct Disorder as a predictor of antisocial and deviant behaviours in late adolescence and early adulthood, and also indicated that Oppositional Defiant Disorder and Attention-Deficit/Hyperactivity Disorder provide additional predictive value. This was especially so for Oppositional Defiant Disorder symptoms in childhood, and less so for Attention-Deficit/Hyperactivity Disorder symptoms in relation to deviant behaviours.

The results presented by van Lier et al. (2007) and discussed earlier confirmed the clinical research findings that there was a high level of comorbidity between the high Oppositional Defiant Disorder and adolescent peak Conduct Disorder trajectories, and (more so for males) the weaker comorbidity between Attention-Deficit/Hyperactivity Disorder and Conduct Disorder was accounted for by the relationship between Oppositional Defiant Disorder and Conduct Disorder. These results are consistent with other research, emphasising the relationship between Oppositional Defiant Disorder and the development during adolescence of Conduct Disorder, suggesting that Oppositional Defiant Disorder can be seen as a precursor to the subsequent development of Conduct Disorder.

Rowe et al. (2010) examined the progression from Oppositional Defiant Disorder to Conduct Disorder during adolescence and their relationship with adult outcomes. They reported that Oppositional Defiant Disorder predicts subsequent Conduct Disorder in boys (but not in girls), but that Oppositional Defiant Disorder did not always lead to Conduct Disorder. When extended into adult consequences, the results suggested that Conduct Disorder is predictive of young adult behavioural disturbance, but that Oppositional Defiant Disorder was a better predictor of emotional disturbance in young adulthood.

Another analysis of the predictive utility of externalising disorders and antisocial personality disorder was reported by Diamantopoulou et al. (2010), who examined the prediction of antisocial problems in early adulthood using childhood (parent-rated) and adolescent (self-rated) symptoms concerning Attention-Deficit/Hyperactivity Disorder, Oppositional Defiant Disorder, anxiety, depression, substance use, and conduct problems. They were specifically interested in the potential predictive validity of childhood and adolescent measures as a way to identify likely Antisocial Personality Disorder cases prior to early adulthood. They noted evidence that Antisocial Personality Disorder was related to childhood and adolescent conduct problems (Oppositional Defiant Disorder and Conduct Disorder), but that much of this research relies on diagnostic categories rather than the assessment of symptoms across a broader range of intensities than is possible when a classification approach is used.

Their longitudinal results were consistent with a model where childhood and adolescent patterns of behaviour were correlated with the subsequent development of antisocial
personality characteristics in early adulthood. Path analysis indicated that the severities of Conduct Disorder symptoms in adolescence and Oppositional Defiant Disorder symptoms in childhood were associated with antisocial personality problems in adulthood, but that there were more-complex relationships between variables with a predictive role. Key findings were:

- Most of the relationships between internalising disorders and antisocial problems are indirect and do not add significantly to the predictive utility of Oppositional Defiant Disorder and Conduct Disorder. It is possible that these internalising problems are consequences of the Oppositional Defiant Disorder and Conduct Disorder behaviour patterns and therefore do not act as additional causal agents for the development of antisocial personality problems.

- The relationship between Attention-Deficit/Hyperactivity Disorder and subsequent antisocial personality problems was also indirect and had its effect through the symptoms associated with Oppositional Defiant Disorder. This might suggest that Attention-Deficit/Hyperactivity Disorder symptoms on their own are a relatively poor predictor of antisocial problems in early adulthood, but that they do increase the likelihood of the Oppositional Defiant Disorder patterns of behaviour that are related to Conduct Disorder symptoms and then antisocial problems.

It was noted earlier that there are some restrictions on the application of more-serious patterns of behaviour to children and adolescence. The DSM system (APA, 2000), for example, does not allow for recognition of the problem behaviours associated with antisocial personality disorder in children or adolescents. Given evidence noted earlier concerning life course persistent problems characterised by callousness and poor empathy, there may be some benefits to using these persistent problems to predict subsequent adult problems.

In this context, Taylor et al. (2007) examined the construct validity of adolescence-diagnosed Antisocial Personality Disorder, with a view to understanding its potential value as a predictor of Antisocial Personality Disorder in adulthood. They noted that the rationale for restricting the diagnosis of Antisocial Personality Disorder to adults (18 years or older) is to limit the application of the disorder in cases where Conduct Disorder and broader patterns of antisocial behaviour in adolescence are time-limited to the adolescent period. They noted, however, that there is a small proportion of adolescents who have Conduct Disorder or antisocial behaviour patterns as a result of life-course-persistent patterns of deviant behaviour and that the restriction on the application of Antisocial Personality Disorder in this group may be unnecessary and counterproductive in the identification of target groups for intervention. They noted that similar concerns have not affected the potential use of the psychopathy diagnosis (antisocial behaviours with callous emotional traits) in adolescence.

The authors studied DSMIIIIR symptoms in groups diagnosed as meeting requirements for adolescent Conduct Disorder (and not a personality disorder), adolescent Antisocial Personality Disorder, and adult Antisocial Personality Disorder. The adolescent Antisocial Personality Disorder group demonstrated patterns of Conduct Disorder and Adult Antisocial Behaviour symptoms that were remarkably similar to those of adults with Antisocial Personality Disorder, and remarkably dissimilar to adolescents with Conduct Disorder. Similarly, the patterns of cognitive skills, school achievement, and peer groups were similar for adolescent and adult Antisocial Personality Disorder groups.

The authors argued that these results suggest there are some strong similarities between adolescents and adults diagnosed with Antisocial Personality Disorder, and that these similarities argue for allowing formal diagnosis of Antisocial Personality Disorder for adolescents with early-onset and most-likely persistent patterns of antisocial or deviant behaviour. This would allow more-effective identification and early intervention with young
people who are likely to have personality traits with a strong bias towards serious deviant and antisocial behaviour.

Although the diagnostic system in widespread use (APA, 2000) limits the flexibility of this taxonomic system as a predictor of antisocial behaviour patterns in early adulthood, there is still evidence that externalising disorders such as Conduct Disorder have some predictive value. There is some clear benefit, however, to focusing on some specific patterns of behaviour that contribute to the diagnosis of externalising disorders – such as behavioural patterns associated with serious Conduct Disorder, some of the patterns linked to Oppositional Defiant Disorder where they are associated with subsequent Conduct Disorder in adolescents, and the impulse-related behaviours associated with Attention-Deficit/Hyperactivity Disorder.

Those behaviours normally linked to Antisocial Personality Disorder (and the callousness associated with psychopathy) but not normally treated in this way during adolescence are also likely to be useful as predictors of subsequent antisocial and deviant behaviours.

**Alcohol**

Childhood and adolescent alcohol use are predictors of subsequent deviant and alcohol-related problem behaviours. High levels of alcohol use and early binge drinking, when considered in relation to developmental trajectories, are associated with general deviant behaviours. Tucker et al. (2003), for example, examined the developmental trajectories for binge drinking behaviours in a longitudinal sample of US young people assessed at 13, 15, and 18 years of age. Their results suggested four trajectories - early high bingers who reported a high level of binge drinking at 13 years of age; adolescent bingers who reported low levels at 13 years but then high levels at 14-16 years and a declining frequency of binge drinking as adulthood approached; steady increasers who reported a monotonic increase in binge drinking behaviour across the ten-year data collection period into early adulthood; and moderate stables who reported consistently lower levels of binge drinking behaviour when compared to other participants. The largest groups were the moderate stables (37 percent of the sample) and the steady increasers (16 percent).

Patterns of deviant behaviour were associated with early highs and adolescent bingers. The association between binge drinking and measures of social deviance suggest that it may be possible to identify at-risk young people through awareness of their pattern of alcohol use.

There is also consistent evidence that alcohol use in adolescence predicts the likelihood of alcohol use disorders and related problem behaviours in adulthood. Guttmanova et al. (2011) noted competing hypotheses about the relationship between adolescent alcohol use and subsequent alcohol use problems in adulthood. The two views investigated there were the view that any regular alcohol use in childhood or adolescence has negative consequences, and the view that there is a sensitive period in late-childhood or early adolescence during which alcohol use is particularly negative implications for adult alcohol use.

The authors used longitudinal data collected from 800 US participants recruited before entering high school. They reported results that were inconsistent with the notion of a specific period of heightened sensitivity to alcohol use and concluded that regular alcohol use before 21 years of age and any alcohol use before 18 years of age were associated with a higher likelihood of alcohol use disorder and alcohol dependence in adulthood.

Alcohol use may therefore be a useful predictor of subsequent antisocial and deviant behaviour, in addition to other predictors relating to patterns of externalising behaviour. Early commencement of alcohol use and/or early binge drinking appear to predict alcohol problems.
in adulthood and patterns of deviant behaviour – consistent with the problem behaviour theory.

Callousness

As noted earlier, interpersonal callousness is an interpersonal style with characteristics such as deceit, manipulation, grandiosity, superficial charm, poor empathy and low levels of guilt (Pardini & Loeber, 2008). Pardini and Loeber reported that higher levels of callousness in childhood and adolescence (higher trajectories) were associated with antisocial personality characteristics in early adulthood. They also noted that dysfunctional communication styles between parent and child were identified as strong predictors of persistent callousness. The potential for callous interpersonal style to predict adult antisocial behaviours is worth considering.

The value of callousness as a predictor was noted by Burke et al. (2007). In the context of the known predictive relationship between Conduct Disorder during adolescence and stable patterns of adult problem behaviour, they found that antisocial and psychopathic characteristics were better predicted using the antisocial behaviour patterns of Conduct Disorder combined with measures of interpersonal callousness. Callous and unemotional traits in adulthood were predicted by the same characteristics (rated by teachers) in adolescence and the behaviours characteristic of Conduct Disorder, along with predictors such as harsh parenting, poor parental communication, and low socioeconomic status.

The recent study into callous-unemotional traits reported by Fontaine et al. (2011) noted clear links between conduct problems and the callous-unemotional trajectories. All of their low-callous-unemotional trajectory children were members of the low conduct problem group, and 95 percent of high-callous-unemotional trajectory children were in the high conduct problem group.

Fontaine et al. (2011) noted that their results were asymmetrical - high levels of callous-unemotional traits in children were generally associated with high levels of conduct problems, but high levels of conduct problems were less well predictive of callous-unemotional traits. It is therefore possible to predict conduct problems based on the presence of callousness or poor affective responses, but prediction of callousness based on conduct problems is less reliable.

The ability to predict problem behaviours based on the presence of callous-unemotional characteristics in adolescence was also reported by Moran et al. (2009), who showed that the presence of callous/unemotional traits was predictive of conduct problems and emotional problems three years after an initial survey. This reflects similar results in adult psychopathology where psychopathy is highly predictive of antisocial behaviour, but antisocial behaviours do not reliably predict psychopathy. One implication of this is that early assessment in terms of conduct problems may not capture potential serious problems in later childhood and adulthood - assessments would best incorporate measurement of callousness to improve their predictive utility (Fontaine et al., 2011).

The study reported by Pardini & Fite (2010) and discussed earlier in relation to externalising disorders also has some relevance here in relation to callous-unemotional traits. In addition to confirming the stability of Conduct Disorder as a predictor of antisocial and deviant behaviours in late adolescence and early adulthood, they also found that callous-unemotional traits provide further improvements in prediction of serious antisocial and deviant behaviours beyond the predictive value of DSM symptoms. The authors suggest that callous-unemotional traits are an important risk factor for serious and persistent antisocial and deviant behaviours.
There is consistent evidence that the presence of callous-unemotional traits in adolescence are reliable predictors of similar traits in adulthood and are useful additional predictors of antisocial behaviour patterns when combined with the adolescent behaviours associated with Conduct Disorder.

**Self-regulation**

Self-regulation and impulse control are important developmental challenges confronted during the transition through adolescence to early adulthood. There is some evidence that self-regulation and impulse control are predictors for subsequent antisocial and deviant behaviours.

Babinski et al. (1999) examined the role of the component behaviours associated with childhood Attention-Deficit/Hyperactivity Disorder in subsequent self-reported and officially-reported adult criminal behaviour. They noted mixed evidence concerning the relationship between Attention-Deficit/Hyperactivity Disorder diagnosis and subsequent offending and argue that the broad range of diagnostic criteria relevant to Attention-Deficit/Hyperactivity Disorder and changes in these criteria over time make it difficult to identify any consistent predictive relationship between this disorder and adult behaviour. Their focus on the behavioural and attentional characteristics associated with Attention-Deficit/Hyperactivity Disorder was an attempt to overcome the problem that diagnosis with Attention-Deficit/Hyperactivity Disorder can reflect a number of patterns of behaviour and attentional processes and that one consequence of the broad range of characteristics associated with Attention-Deficit/Hyperactivity Disorder is that studies of children based on this diagnosis can overlook the comorbidity with other problem behaviours such as aggression and conduct problems.

Their results show that the behavioural characteristics associated with Attention-Deficit/Hyperactivity Disorder (hyperactivity/impulsivity and conduct problems) were independently and jointly predictive of adult criminal offending, but that the inattention characteristics associated with Attention-Deficit/Hyperactivity Disorder were not related to offending. These results applied to males and not to females. The authors concluded that hyperactivity/impulsivity contribute to the risk of adult criminal offending in addition to the often-comorbid conduct problems known to predict subsequent problem behaviours.

The implication of this finding is that any attempt to predict antisocial patterns of behaviour in adulthood using conduct problems and oppositional patterns of behaviour might be assisted by the inclusion of measures of the impulsivity associated with Attention-Deficit/Hyperactivity Disorder.

Neumann et al. (2010) examined the development of antisocial behaviours in a large sample first recruited in childhood, with a focus on the role of contextual factors and parental monitoring in the development of problem behaviours. They noted evidence that neighbourhood factors such as social and socioeconomic factors are associated with the development of antisocial behaviours in adolescence. In addition to the role of high-risk neighbourhoods, they also noted that some aspects of a child's family situation - such as having a single parent, socioeconomic status, poor parental monitoring - can play a role in the development of problem behaviours.

The authors' analyses indicated that the best predictors of the development of antisocial behaviour by age 15 were impulsivity and parental monitoring of the child's behaviour (as reported by the child). Having a single parent was associated with antisocial behaviour, both directly and mediated by parental monitoring. Although neighbourhood factors were
associated with antisocial behavioural outcomes, their association was indirect and mediated through parental monitoring and affected by other factors such as impulsivity and family structure.

These results suggest an important role for impulsivity and parental monitoring as predictors of subsequent antisocial behaviour, and suggest some potential for focusing identification programs on neighbourhoods with lower socioeconomic status and poorer informal social controls of behaviour during early adolescence.

The study reported by Kochanska et al. (2009) discussed earlier also examined the role of effort control or self-control as a predictor of subsequent problem behaviours. Effortful control has been emphasised as important contributor to rule-bound behaviour, and the results of these studies indicated that effortful control assessed through early childhood had a significant effect on disruptive behaviours and that disruptive conduct was more common for children with low guilt and poor effortful control of their behaviour. The results suggest that effortful control improves behavioural outcomes for low-guilt children, but has little effect for children with high levels of guilt.

O'Connor et al.'s (2011) Australian research drawn from the Australian Temperament Project data indicated that key predictors of young-adult positive development in early and mid/late adolescence included emotional control, school adjustment (and persistence measured in late childhood), positive relationships with peers, relationship with parents, and community orientation. Some of the results suggest that self-regulation is an important predictor of positive development, consistent with other research suggesting that the development of self-regulation is an important predictor of positive outcomes throughout childhood and adolescent development.

The failure to develop age-appropriate levels of self-regulation and impulse control, and the presence of impulsive patterns of behaviours associated with the hyperactive form of Attention-Deficit/Hyperactivity Disorder are predictors of a range of problem behaviours and antisocial behaviours in young adulthood.

**Prosocial and positive factors**

An alternative approach to predicting antisocial behaviours in late adolescence and early adulthood might involve assessing prosocial behaviours, assuming that these are predictive of young adult behavioural outcomes.

Self-esteem, for example, might be viewed as a predictor of positive outcomes. Trzesniewski et al. (2006) examined the value of adolescent self-esteem as a predictor of behavioural outcomes in adulthood, in part using objective measures of adult outcomes to limit the role of shared variance in a self-report context. They noted the broader context in which there has been considerable research on the importance of self-esteem as a predictor of a broad range of behavioural and psychological outcomes, and some contradictory discussion suggesting that self-esteem is best viewed as a consequence of social adjustment and achievements rather than a causal factor in social adjustment. The authors suggested that the state of evidence at the time of their research was unclear.

The research reported by these authors used a large scale longitudinal study to assess the value of self-esteem as a predictor of adult outcomes in a sample of about 800 participants, controlling for measures of depression, SES, childhood BMI, and intelligence (using the WISC). The results suggested that adolescent self-esteem was related to a range of mental health outcomes in adulthood (including depression, anxiety, and tobacco dependence), physical health outcomes, criminal convictions during adulthood, and economic success.
The relationship between self-esteem and criminal behaviours was present for an objective measure of criminal behaviour and held when the analysis controlled for sex, SES, and adolescent depression. The challenge is that the relationship between self-esteem and criminal outcomes is not large enough to justify the use of self-esteem as a reliable predictor of criminal behaviours - adults with low self-esteem in their teenage years were only 1.3 times more likely than high-self-esteem teens to be convicted of a crime during adulthood. While the authors emphasise the importance of the results in confirming that self-esteem is a construct with predictive validity, it is difficult to see how the results could be used as the basis for predicting problem behavioural outcomes.

As an aside, the authors also claim that their results confirm the importance of self-esteem and contradict arguments that self-esteem is an epiphenomenon that reflects childhood and teenage achievements and life context. Their argument here rests on their use of a small number of variables to control for broader factors in childhood and adolescence, but it is not clear that their study provides a sound argument against the alternative view of self-esteem given the small number of control variables they included.

Kaufmann et al. (2007) investigated the relationship between prosocial involvement (as a protective factor), antisocial peer affiliations (as a risk factor), and behaviour problems such as aggression and antisocial behaviour in a small sample of urban teenagers. Their results suggested that prosocial involvement moderated the relationship between antisocial peer affiliation and delinquent behaviours and so had a predictive effect on problem behaviour. They suggest that interventions or prevention programs targeting children or younger teenagers that focus on improving prosocial involvement might therefore be expected to reduce the behavioural contagion effects that increase the likelihood of antisocial behaviours as a result of affiliation with antisocial peers. Of some concern, however, is that while prosocial involvement did predict lower levels of antisocial behaviour, this effect was not detected for aggressive behaviours. Improved prosocial involvement may not be sufficient to reduce the risk of aggression.

Petts (2009) noted research suggesting that attachment to social institutions such as family and religion influences the likelihood of delinquent behaviour, and reported analyses of longitudinal data concerning the relationship between developmental delinquency trajectories and the social institutional context. He reported that family characteristics were associated with delinquency trajectories such that children in stable two-parent families were more likely to be members of the low-level trajectory, but there is some doubt about how these results take into account the broad range of factors likely to be associated with less-stable family structures.

The measurement of prosocial attitudes and behaviour during adolescence would be expected to provide an additional predictor for antisocial behaviour patterns during young adulthood, but there is currently insufficient research in this area to make the argument strongly.

**Temperament, inheritance, and infancy**

Longer-term prediction of young adult outcomes might be possible if the same causal factors also influence childhood behaviour.

Lahey et al. (2008) examined the relationship between infant temperament and parenting and subsequent conduct problems in childhood and late childhood based on data collected from a sample of almost 2,000 families in a longitudinal study. Maternal ratings of a range of conduct problems in childhood were associated with ratings of temperament-related behaviours (such as fussiness, activity, predictability) during infancy.
Murray et al. (2010) extended some earlier work on predicting adult criminal and antisocial behaviour by drawing on data collected in a longitudinal study that recruited participants at birth and collected data soon after birth and at five and ten years of age and then during adulthood. Their results indicated that risk factors in early childhood are predictive of adult crime and antisocial behaviour. The authors reported that conduct problems at 5 years of age predicted conduct problems at 10 years, which then predicted adult criminal behaviour.

At the more-extreme end of the antisocial continuum, Lynam et al. (2007, 2009) reported results that were taken as supporting the potential value of and the stability of assessment for psychopathy in childhood. The authors concluded that there are few age-related changes in the predictive utility of an assessment and that juvenile psychopathy is stable across adolescence. They do caution, however, that although the predictive utility of psychopathy assessment results is sufficient to draw conclusions about theoretical issues, it is not sufficiently strong enough to support the use of juvenile psychopathy assessment in a forensic context. This cautionary comment is relevant to the proposed use of assessment tools to predict future antisocial behaviours in a driving context. The stability and reliability of the assessment method may not be sufficient to justify taking preventive action targeting young people identified as being at a relatively high risk.

Li & Lerner (2011) examined developmental trajectories in relation to behavioural and emotional engagement with school, and whether problem behaviours were associated with these developmental trajectories. They identified four school-related trajectories in a sample of adolescents (data collection was limited to a four-year period) and found that delinquency was associated with school-related behavioural and emotional trajectories. Students with decreasing trajectories of behavioural and emotional engagement with their schools over the middle-school years (grade 5 to 8) had substantially and significantly higher levels of delinquency and substance abuse than students with other trajectories, and had consistently poorer levels of academic performance.

These results suggest that changing patterns of engagement with school over the early high school years could be an important flag for increasing problem behaviours and the development of antisocial patterns of behaviour. It is not possible to determine whether these patterns are persistent or adolescence-limited, but there is at least some evidence that school engagement is a potential proxy measure of an increasing risk of other problem behaviours.

Research cited here and more-detailed research such as that relating to the Australian Temperament Project suggests that there may be some level of behavioural consistency from childhood that could potentially assist in predicting patterns of problem behaviour in young adulthood. The focus on developmental trajectories suggests, however, that assessment of potential problem behaviour in early adulthood is likely to be more reliable if conducted in adolescence rather than in childhood – especially given the adolescence-limited antisocial behaviour patterns that are likely to contribute to the number of young drivers with problem behaviours that are present before these patterns desist with increasing maturity.
APPLYING PREDICTION TO RISKY YOUNG DRIVERS

Risky drivers and antisocial trajectories

The research literature reviewed above suggests that there is some potential for identification of antisocial and deviant behaviours based on adolescent measures and observations. The relevance of this to the identification of risky young drivers depends on the relationship between risky driving behaviours and broader antisocial patterns. This issue was discussed earlier, with the following key results:

- Jesser et al. (1997) placed risky driving behaviours in the broader context of the problem behaviour theory, noting that risky driving behaviours are related to crash risk and that these behaviours appear to reflect a broader pattern of problem behaviours. Their research results linked unsafe driving behaviours with lower levels of socialisation to adult roles. They then emphasised relationship in their results between broader problem behaviours and driving behaviour. Jesser et al.’s results suggest that it may be possible to predict some of the variation in risky driving based on antisocial behavioural patterns at an earlier point in time, and that changes in the level of antisocial behaviours are predictive of changes in driving behaviour.

- Shope et al. (2003) demonstrated that trajectories suggesting high levels of problem behaviour or contexts (alcohol use, friends support for drinking, susceptibility to peer pressure, and tolerance of deviance) were associated with poorer safety-related outcomes. These results suggest a clear relationship between adolescent behaviours and peer contexts and safety-related outcomes (offences and crashes), and therefore provide some support for the suggestion that it may be possible to predict problem outcomes during adolescence.

There is at least some evidence, therefore, that the predictive relationship between adolescent behaviour and later antisocial behaviour may be taken up in the young problem driver area.

Early predictors of risky driving behaviour

This section of the report discusses research findings that are specifically related to the prediction of risky driving based on adolescent and childhood behaviours. There is sufficient evidence to justify the implementation of a predictive system, with some limitations that are discussed later in the report.

Personality

The relationship between personality and road safety outcomes has been investigated with a general finding of a relationship between personality variables and driving behaviour and crash risk (eg. Elander et al., 1993; West & Hall, 1997). The consistent pattern of results is that there is a relationship between some personality factors and road safety, but the relationship is weak and therefore unlikely to be suitable for use as a way to identify risky drivers.

Research in the last decade includes a study by Ulleberg (2002), who focused on data obtained through a survey of young Norwegian drivers that included personality assessment instruments and self-reported measures of risk taking and crash involvement.
Ulleberg identified subgroups of young drivers based on their responses to the personality instruments and noted that two of the six clusters were high risk groups from a road safety perspective. Although the relationships between personality-based cluster membership and self-reported safety measures were statistically significant, measures of the effect size (here using the percentage of variability accounted for by cluster membership and therefore equivalent in meaning to the $R^2$ statistic) suggested the cluster membership accounted for relatively little variation in key measures. It accounted for twenty percent of the variation in speeding behaviour, 12 percent of the variation in rule violations, and only 3 percent of the variation in self-perceived driving skill.

The results of this study are therefore similar in many respects to the results of other studies - personality variables are related to safety-related measures, but the predictive utility of personality is poor.

More recently, Gulliver and Begg (2007) used data derived from a New Zealand longitudinal study to assess the relationship between personality data collected during adolescence with crash involvement in early adulthood. The results for male and female participants differed - perhaps in part due to the low crash risk for females. There were no significant personality-related predictors of female crash involvement. For male drivers, however, the data suggested that personality measures concerning aggression and alienation were predictive of crash involvement, and that these predictive relationships persisted after controlling for driving exposure.

The authors suggested that the results can be used to target crash prevention programs towards adolescent males with personality characteristics related to alienation, aggression, and a rejection of traditional values. These characteristics are consistent with other research concerning antisocial behaviours and patterns of deviance.

Finally, Constantinou et al.’s (2011) research concerning the role of personality in crash involvement and offence histories indicated that responses to the DBQ Violations scale (predicting offence history), and that the Violations scale was predicted by sensitivity to reward and by disinhibition and impulsivity. The authors took these results as confirming that personality acts through driving behaviour to predict one safety-related outcome measure (offences), but unfortunately the authors did not report a similar model for self-reported crash involvement.

Although the results do suggest some predictive role for personality factors in relation to traffic offences, the reliability of these personality factors as predictors is notably poor. No personality factors accounted for more than ten percent of the variation in self-reported behaviour (the Violations scale), which in turn accounted for only nine percent of the variation in offence history. This suggests that personality factors may be very minor predictors of traffic offence history.

Personality appears to have limited value as a predictor. While it is likely that patterns of behaviour are related to underlying personality traits, behaviour is also affected by a range of additional factors such as contextual, familial, and social influences with the result that the correlations between adolescent personality and adult behaviour are likely to be smaller than the correlations between observed patterns of behaviour in adolescence and young adulthood. Behavioural measures are likely to be better predictors than personality measures.

**Adolescent Disorders**

The developmental role of behavioural disorders in relation to the transition through adolescence into early adulthood antisocial disorders was discussed earlier. Adolescent
disorders appear to play an important role in the development of antisocial patterns of behaviour and may therefore be relevant to the prediction of problem driving behaviours.

There is some data concerning the relationship between Attention-Deficit/Hyperactivity Disorder and subsequent road safety problems and risky driving behaviour (Barkley et al., 2002), and some specific research about the relationship between risk taking and the underlying behavioural patterns. Woodward et al. (2000), for example, used data collected during a 21-year longitudinal study conducted in New Zealand. They were interested in the relationship between attentional data collected at 13 years of age and a range of driving outcome measures collected between 18 and 21 years of age, noting evidence that there are associations between Attention-Deficit/Hyperactivity Disorder and the risk of crash involvement. Attentional problems in early adolescence were associated with crash involvement in early adulthood (injury and non-injury), drink driving (self-reported and official offence data), driving without a licence, unregistered driving, involvement in street racing, and contact with the Police for traffic offences.

The relationship between attentional problems and street racing in early adulthood is particularly relevant to the current report. Six percent of young adults with attentional difficulty measures in the lowest fiftieth percentile reported involvement in street racing. This increased with increasing attentional problems such that 22 percent of young adults who had the worst attentional problems in their early teens (the top five percent) reported involvement in street racing.

Attentional problems were associated with other measures such as sex, parental styles characterised by emotional and punitive behaviours, and disadvantaged family backgrounds. Apart from the relationship with injury crash involvement, the inclusion of these measures as covariates accounted for much of the variation in driving related outcomes. It is not clear, however, whether these covariates are themselves in part caused by youth attentional problems. The authors concluded that attentional problems are a potential predictor for subsequent risky driving patterns.

More-recently, Thompson et al. (2007) extended earlier research concerning the relationship between Attention-Deficit/Hyperactivity Disorder and subsequent driving outcomes using a larger sample of Attention-Deficit/Hyperactivity Disorder and control participants than reported in earlier research that, unlike earlier studies, included unlicensed participants. Participants were Attention-Deficit/Hyperactivity Disorder-diagnosed children or control children who were followed over an average eight-year period. Outcome measures included self-reported driving behaviour and measures of Attention-Deficit/Hyperactivity Disorder symptom persistence into early adulthood.

The authors reported that Attention-Deficit/Hyperactivity Disorder participants were less likely to hold a driver licence and were almost four times more likely to have driven without a licence - justifying the inclusion of unlicensed participants in the study. Attention-Deficit/Hyperactivity Disorder diagnosis was correlated with the number of crashes and the number of detected traffic offences. The effects of Attention-Deficit/Hyperactivity Disorder on driving outcomes were modest but statistically significant. The effects were strongest for those participants who had persistent hyperactivity and impulsivity problems in early adulthood and with ongoing conduct-related problem behaviours.

The use of Attention-Deficit/Hyperactivity Disorder on its own as a predictor of road safety problems therefore appears to be risky, but its use in combination with other factors may be of some value. The impulsive behaviour patterns present in some young people with this disorder appear to have greater predictive value than the attentional factors also included in the diagnostic criteria.
There is evidence suggesting that adolescent externalising behaviours are associated with subsequent problem driving behaviours and difficult road safety outcomes. The study reported by Reef et al. (2010) was discussed earlier in relation to antisocial developmental trajectories. They noted that rule-breaking behaviours were associated with trajectories relating to externalising behavioural problems and in particular that proactive externalising behaviours in childhood (aggression and property damage) were most strongly related to aggression related behavioural problems in adulthood, while the reactive externalising behaviours are more closely predictive of internalising disorders in adulthood. This result suggests that the presence of proactive externalising behaviours in childhood is likely to be a better predictor of aggressive driving behaviours than the reactive externalising behaviours.

There is a strong relationship between criminal and traffic offence outcomes and earlier patterns of criminal behaviour and externalising behavioural disorders reported in a Finnish study conducted by Elonheimo et al. (2007) and discussed above. Amongst other things, the authors reported that traffic offences were associated with antisocial personality disorder. Forty-two percent of young people with antisocial personality disorder had traffic offences, and twenty-six percent of young people with antisocial personality disorder had one or more drink driving offences. The relationships were strongest for repeat offenders.

Although the data reported by Elonheimo et al. reveal a strong relationship between psychiatric disorders and unsafe or illegal driving behaviour, they also underscore the challenges associated with predicting unsafe driving behaviour based on psychological factors. A reworking of the data in their Table 2 shows that a large majority of traffic and drink drive offenders do not have a psychiatric disorder on their records - while it is possible to be reasonably certain that someone diagnosed with antisocial personality disorder is likely to engage in unsafe driving behaviour, these people still represent only a small minority of driving offenders. This reworking of the data is shown in Table 1 (below), where it is clear, for example, that over three-quarters of traffic offenders and a similar proportion of drink drivers would not be identified if psychiatric data in early adulthood were used as the basis for predicting future driving behaviour.

<table>
<thead>
<tr>
<th></th>
<th>Proportion of traffic offenders</th>
<th>Proportion of drink driving offenders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antisocial personality disorder</td>
<td>10.8%</td>
<td>13.6%</td>
</tr>
<tr>
<td>Substance use disorder</td>
<td>7.0%</td>
<td>11.4%</td>
</tr>
<tr>
<td>No diagnosed disorder</td>
<td>77.0%</td>
<td>70.0%</td>
</tr>
</tbody>
</table>

The adolescent behavioural patterns underlying externalising disorders have some value as predictors of problem driving behaviours during early adulthood, but the predictive relationship is asymmetrical. Young people with externalising behaviour patterns are highly likely to have subsequent records as traffic offenders, but there is no reason to believe that this predictive relationship is sufficient to guarantee that most offenders will be identified based on their adolescent behaviour patterns.
Adolescent Problem Behaviour and Lifestyle

If risky driving behaviours are in-part the result of a broader pattern of risk taking and problem behaviour as discussed by Jessor et al. (1997) and others more recently (eg. Bina et al., 2006; Moller and Gregersen, 2008), then the identification of adolescents with patterns of risk taking or problem behaviours might be expected to act as a predictor of future risky driving.

As noted earlier, Jessor et al.’s (1997) research suggested a relationship between risky driving behaviours and socialisation as young people approach adulthood. Risky driving behaviours such as unsafe speeding, overtaking, following, and intersection behaviours were associated with poor responses in relation to adult social roles, psychosocial conventionality, and delinquent patterns of behaviour. Jessor et al. (1997) reported that it was possible to predict risky driving behaviours in the third survey wave ($R^2 = .23$) based on the risky driving behaviours and socialisation measures in the first survey way some two years before.

Jessor et al.’s research confirmed that delinquent behaviour patterns and that were consistent with antisocial patterns and disorders (including shoplifting, stealing, lying, starting fights, and damaging property) were predictive of unsafe driving behaviour. The consistency of the relationship between risky, deviant behaviour and subsequent safety-related behaviours is important, but the statistically significant relationship is relatively weak. The results reported in their paper suggested that just under a quarter of the variability in risk taking behaviours could be predicted based on adolescent problem behaviours.

Bina et al.’s (2006) confirmation that risky driving behaviour was predictable given adolescent behaviour and demographic measures is important here. They showed that half of the variance in risky driving behaviours could be accounted for by the combined variation in exposure, sex and age, and broader risk-taking behaviours. The strongest predictors included exposure, sex, and antisocial behaviours (mainly aggressive behaviours, theft, and dishonesty, and tobacco use). Adolescent antisocial behaviours therefore appear to be important predictors of patterns of risky driving behaviour.

Similarly, but with a focus on broader motivational factors and their relationship to problem driving behaviour, Moller and Gregersen (2008) reported that young people who engaged more often in relatively impulsive and poorly structured activities (such playing computer games and going to parties) were more likely to engage in risky driving behaviours. Their results suggest that identification of risky young drivers might benefit from identification of the motivational needs that are met by their driving. Those who drive to meet personal needs or social needs may be more likely to engage in risky driving behaviours.

Two studies reported by Bingham and colleagues support the possibility that some measures during adolescence may be useful as predictors of risky driving behaviours. Bingham (2004) used longitudinal data collected from a sample of about 2,000 young people to assess the relationship between young adult risky driving behaviours and data collected during adolescence. The participants were divided into five groups based on risky driving behaviours, and the results suggested that a number of measures predicted group membership. Risky driving behaviours were associated with low levels of parental monitoring, parental permissiveness, tolerance of deviance, poor academic outcomes, and substance use problems. These measures may provide an avenue for predicting problem driving behaviours in early adulthood.

Bingham et al. (2007) examined the relationship between potential predictors and drink driving behaviour in young adults, controlling for the confounding relationship between alcohol consumption levels and drink driving. They were interested in the possibility that some
predictors might specifically be associated with drink driving even when the amount of alcohol consumed was accounted for.

The authors reported that some predictors were associated with drink driving in particular. These included a lower perception of the risk of drink driving, aggression and delinquency, and other risky driving behaviours. The relationship between aggression and delinquency and drink driving even when the level of alcohol use is accounted for is consistent with other evidence linking these psychological/behavioural characteristics with risky driving behaviours.

Consistent with the Bingham et al. finding, Zakrajsek & Shope (2006) examined the relationship between teen alcohol use and official driving records concerning drink driving, based on survey data completed through secondary school and subsequent official data. The data indicate that early exposure to alcohol use was associated with higher risks of drink driving offences in early adulthood. The earliest drinking onset group had 2.2 times the risk of an alcohol offence before 21 years of age, and those who started drinking in year 10 had 3.3 times the risk of an alcohol offence between 21 and 25 years of age. Early exposure use may be an important predictor of drink driving in early adulthood.

Methodological problems with research can sometimes interfere with drawing conclusions about the potential prediction of problem driving behaviour. Begg et al. (1999) reported data from the NZ longitudinal study of a large sample of children recruited at birth. They focused on the relationship between driving outcomes in early adulthood and lifestyle data collected during adolescence. The authors reported that the relationships between lifestyle factors in adolescence and subsequent crash involvement in early adulthood were generally weak and that they did not provide strong predictive utility.

There were some problems with this study, however. The authors relied on self-reported crash involvement rather than official crash data, arguing that this helped minimise the biases thought to be present in official data but failing to consider the problems associated with shared variance and the possibility that some participants may be more likely than others to provide incorrect reports of crash involvement. They also made use of multivariate methods but included some traffic-related behaviours as predictors that may have displaced other potential predictors.

Although the results of this study suggest some caution in the use of adolescent factors in predicting road safety consequences, some additional caution needs to be exercised in taking the results at face value.

Some recent Australian research has particular relevance to the prediction of problem driving behaviours based on developmental data. Vassallo et al. (2007) used data from the Australian Temperament Project to examine the relationship between risky driving behaviours in young adulthood and information about temperament, behavioural problems, social competence, school outcomes, and social relationships collected during childhood and adolescence. The authors identified a group of high-risk drivers based on the self-reported frequency of risky driving behaviours across a range of driving situations including speeding, fatigue, drink driving, and restraint use.

Childhood (early and late childhood) measures associated with high-risk driving included task orientation, aggression, hyperactivity, school readiness, and social cooperation. The results were all in the expected direction.

In early adolescence, subsequent high risk driving behaviour in early adulthood was associated with persistence, social cooperation, social responsibility, school adjustment, aggression, antisocial behaviour, empathy, self-control, association with antisocial peers, and the quality of the parent-child relationship.
Predictors of adult high risk driving in late adolescence included aggression, hyperactivity, antisocial behaviour, antisocial peers, parental attachment, and maladaptive coping strategies.

The results suggest that a range of variables could be used as the basis for predicting unsafe driving behaviours in early adulthood, and that it may be possible to identify at-risk people during adolescence. These results are most likely a result of the relationship between problematic developmental pathways in adolescent and subsequent deviant behaviours in adulthood, and so provide further evidence supporting identification and possible intervention at an earlier stage. These results make use of multivariate methods and do not appear to be negatively affected in the same way as other research (eg Begg et al., 1999).

It is not surprising, given the general confirmation of the problem behaviour theory, that lifestyle-related factors assessed during adolescence appear to be useful predictors of risk-related driving behaviours in adulthood, much as they are effective predictors of a broader range of antisocial behaviours.

### Adolescent Attitudes

There is little convincing evidence concerning the possibility that attitudes may be useful as predictors of subsequent problem driving behaviour. Ulleberg & Rundmo (2002) validated a measure of attitudes by comparing responses to a range of attitude scales to self-reported risky driving behaviours and crash involvement. Although the authors take the results as supporting their contention that the attitude scales are reliable and valid, their results could be taken as suggesting the opposite and leading to a conclusion that attitudes are largely unrelated to safety-related measures.

The partial correlations between each of the eleven attitude scales and self-reported crash involvement were all less than $r = .11$ - meaning that the attitude scales at best accounted for less than two percent of the variation in crash involvement. The correlations between the attitude scales and self-reported risky behaviours were higher, but were surprisingly low given the nature of the questions. Attitudes towards speeding, for example, accounted for less than twenty-five percent of the variance in self-reported speeding behaviour, despite the attitude and speeding items having been presented in the same survey and presumably participants making an effort to be internally consistent in their responses.

The results of this and related studies suggest that attitudes expressed in a survey context are surprisingly poor predictors of self-reported behaviour, and are therefore most likely very poor predictors of behaviour in the real world.

### Traffic Offences and Adolescent Crime

The problem behaviour approach (eg. Jesssor et al., 1997) suggests that people who engage in illegal behaviours in one area are likely to do so in a broader range of areas. It is therefore reasonable to assume that adolescents with patterns of rule-breaking or illegal behaviours are likely to engage in illegal traffic behaviours once old enough to drive.

This pattern was noted when Broughton’s (2007) results were discussed earlier. Broughton showed that there is a strong relationship between motoring and non-motoring offences, with the strongest relationships (for men and women) being between serious driving offences and non-motoring offences. These results were taken as suggesting that antisocial or deviant behaviours in adolescence may be an important predictor of the risk of deviant driving behaviour in late adolescence and early adulthood.
Similarly – bit with a stronger focus on traffic offences – Leal & Watson (2011) showed that drivers detected for a 'hoon' offence were significantly more likely than comparison drivers to have been detected for other traffic offences. They were also more likely to have had licence sanctions imposed for traffic and related offences prior to the 'hoon' offence, and were more likely to have been involved in a reported crash.

Leal and Watson’s results support the view that risky driving behaviours reflect a broader pattern of risky and antisocial behaviours. This result is taken as evidence for the use of non-hoon offences in young drivers as the basis for predicting potential high-risk young drivers.

Where young drivers have a pattern of traffic offences it is likely that they will engage in risk-related problem driving behaviours and more-serious offences. This may provide an avenue for predicting problem drivers amongst licence holders, and is consistent with the use of traffic offence information for unlicensed drivers (learners and pre-learners) as predictors of antisocial behaviours in general and problem driving behaviour more specifically.

**Impulse Control and Positive Development**

The developmental transition to adulthood appears to require the development of a range of skills that are apparent in late adolescence. These contribute to positive developmental outcomes and are therefore likely to contribute to a range of positive and beneficial young adult behaviours. The failure of these skills during adolescence and early adulthood, such as impulse control, may predict problem driving behaviours.

Begg & Shope (2004) used cohort data to investigate potential predictors of risky driving behaviour in early adulthood, including road racing, excessive speed, etc. Persistent high speed driving for thrills was associated with low constraint, negative emotionality, and aggressive behaviour after controlling for the large number of predictors. As noted in relation to earlier research by Begg et al. (1999), the method favoured elimination of covariates and included some car-related behaviours including crash involvement across the whole of the adolescent and adult years as potential predictors despite the likely problem associated with this use of a road safety outcome measure in early adulthood as a predictor of early adulthood behaviours.

Despite the obvious weakness in this study, the emotional and self-control variables that continued to predict fast driving suggest some added benefit in using these as potential predictors of risky driving behaviour.

This is consistent with the recent research reported by Keating and Halpern-Felsher (2008) (discussed earlier) involving the role of self-regulation and impulse control as factors relevant to the safety of young drivers. They focused on a subgroup of drivers who find the transition to developing adult cognitive skills more challenging as a result of their low initial baseline of impulse control. This suggests that delayed developmental transition resulting from limited self-regulation may be an important predictor of risk-related driving behaviour.

The focus on the development of impulse control skills and the transition to positive young adult behaviours raises the possibility that the assessment of positive development characteristics may provide an alternative approach to predicting the riskiness (or safety) of subsequent patterns of young driver behaviour.

Hawkins et al. (2009) used data derived from the longitudinal Australian Temperament Project to investigate positive development in their sample of young adults. The authors noted that at the time of their research there was some confusion about how best to describe and measure positive development, despite increasing acceptance that it is an important outcome of the developmental processes. They review evidence and theoretical papers concerning successful
outcomes in emerging adulthood, with an emphasis on developmental goals and the importance of interaction between the person and their broader context.

The ATP survey completed by 19-20 year old participants included a broad range of items concerning attributes and behaviours relevant to positive development as a young adult. These included items relating to engagement with the community, trust and tolerance of others and broader societal organisations, competence in social situations including intrapersonal factors such as self-control and responsibility, and items concerning satisfaction with life and achievement etc. The authors assumed a four-factor structure and conducted a confirmatory factor analysis to test their assumption.

The analysis generally confirmed the structure, but a five-factor structure appeared to fit the data more successfully - civic action and engagement, trust and tolerance of others, trust in authorities and organisations, social competence, and life satisfaction. Scores on these factors were then used in a second-order factor analysis that resulted in a single factor that was labelled as 'positive development'. The weakest marker of positive development was civic action and engagement, and the strongest markers were social competence and trust and tolerance of others.

The results of the study were largely exploratory, but they do provide some guidance for the assessment of positive development in young adulthood that may be useful as part of a broader assessment strategy to identify young people at risk of difficult outcomes.

The research reported by O'Connor et al. (2011) that was also based on the data set derived from the Australian Temperament Project is also consistent with this focus on the predictive value of positive development. The results of this study suggested that self-regulation is an important predictor of positive development, consistent with other research suggesting that the development of self-regulation is an important predictor of positive outcomes throughout childhood and adolescent development.

Similarly, but based on a shorter-term study, Bingham et al. (2006) used a longitudinal study of participants recruited in year 10 in the US to examine the relationship between late-adolescent characteristics and unsafe and illegal driving behaviours in early adulthood. They reported that positive psychosocial adjustment, including connections with conventional social institutions, was associated with lower offence rates.

There may be some benefits to including assessment of positive developmental factors such as prosocial measures, self-regulation, and impulse control as additional predictors of problem driving behaviours in early adulthood.
CAUTIONARY COMMENTS AND CONCLUSIONS ABOUT IDENTIFYING POTENTIAL RISKY DRIVERS

Research limitations

One of the challenges of reviewing research in this area has been the quality of research methods used to assess the relationship between problem behaviours in early adulthood and potential predictors assessed at an earlier developmental stage. Research has been constrained in part by the selection of measurement instruments (which in turn has some implications for the use of instruments to predict later driving behaviour), sample sizes and selection, and the time periods used to assess developmental issues.

Rosenbloom & Wultz (2011), for example, collected daily self-report driving data from Attention-Deficit/Hyperactivity Disorder and non-Attention-Deficit/Hyperactivity Disorder participants using a DBQ-based instrument to investigate the possibility that the attentional problems associated with Attention-Deficit/Hyperactivity Disorder might contribute to driving errors measured by the DBQ. The study used small samples (less than 20 Attention-Deficit/Hyperactivity Disorder participants) and collected data over a thirty-day period, and the instrument included only 13 DBQ-like items targeting violations and faults. Some of the items were somewhat distant from the original DBQ items, and the small number of items raises some concerns about reliability. The results suggested that Attention-Deficit/Hyperactivity Disorder males were more likely to report DBQ-like faults or errors than non-Attention-Deficit/Hyperactivity Disorder male drivers, but there were no detectable differences in reported violations.

This study is an example of the selection of a poor instrument. It has been shown in other research that there are significant differences in crash risk and offence histories between Attention-Deficit/Hyperactivity Disorder and non-Attention-Deficit/Hyperactivity Disorder drivers. The fact that these did not appear in the current study suggests that the sample size was too small and, perhaps more so, that the data collection method was not appropriate. It is unclear how Attention-Deficit/Hyperactivity Disorder participants are likely to react to self-disclosure in relation to violations and errors in the DBQ format, for example, and it is possible that the results reflect different levels of social desirability effects rather than differences (or the lack of difference) between the two groups.

This study underscores the challenges of assessing variables that may be predictive of patterns of traffic offences and crash risk. A short measurement instrument that fails to take into account the possibility of motivational influences during the assessment process is unlikely to identify drivers with a high crash risk. Identification of high-risk drivers will require a more sophisticated approach to assessment and prediction.

Wiesner & Windle (2006) examined the relationship between adolescent developmental trajectories in relation to delinquent behaviours and outcomes in early adulthood. The longitudinal sample was recruited in mid-late adolescence, limiting the value of the study as a guide to developmental trajectories. The uncertainty of the results reported in this study underscores the importance of using long time frames in longitudinal studies focusing on developmental trajectories. The authors identified what they claim to be six separate developmental trajectories for delinquent behaviours, but the data contributing to the analyses were collected over a 1.5 year period only (15.5 years to 17 years of age) and the differences between the claimed trajectories are unclear.
Van Der Vorst et al. (2009) applied the trajectory model to alcohol use during adolescence based on longitudinal data collected from families in the Netherlands. Data were collected over a relatively short time period (from 13 to 15 years) so it is not possible to draw clear conclusions about long term trajectories through to adulthood.

Finally, as noted earlier in relation to the study reported by Begg et al. (1999), these researchers relied on self-reported crash involvement rather than official crash data, failing to consider the problems associated with shared variance and the possibility that some participants may be more likely than others to provide incorrect reports of crash involvement.

**Prediction issues**

The research issues noted above flag some potential problems likely to arise in attempts to use adolescent data to predict problem driving behaviours in early adulthood. The use of appropriate assessment instruments, for example, will be critical to the reliable prediction of risk-related driving behaviours.

Assessment issues were noted by Lynam et al. (2009) in their investigation of the stability of psychopathy across childhood and adolescence given the general view that the diagnosis of psychopathy prior to adulthood was of some concern given changes in patterns of behaviour associated with developmental transitions. They found that future delinquency could be predicted by childhood (current) delinquent behaviours and by responses to the psychopathy assessment tool. Despite the positive findings, Lynam et al. caution that the predictive utility of psychopathy assessments in adolescence are not sufficiently strong enough to support the use of juvenile psychopathy assessment in a forensic context. Their conclusions suggest that the stability and reliability of the assessment method may not be sufficient to justify taking preventive action targeting young potential risk takers.

The predictive reliability issue is an underlying concern in this area. Demonstrating that it is statistically possible to predict risky driving behaviour based on adolescent problem behaviour measures does not then lead to a certain conclusion that predictions will be accurate. The extent to which this conclusion is reasonable depends on the strength of the relationship between potential predictors and target behaviours.

The key issue is the correlation between the predictors and the target behaviour. One consistent outcome in research discussed here concerning the prediction of driving behaviour and safety outcomes is that the correlations between potential predictors and outcome measures are statistically reliably but low. This general problem is apparent in relation to predictors of antisocial behaviours in general, for example, where Lynam et al. (2007) demonstrated that predictive power was relatively poor in that childhood diagnostic data accounted for only nine percent of the variation in adult diagnosis.

Similarly in relation to Australian data, O'Connor et al. (2011) showed that twenty-seven percent of the variation in the positive development variable calculated based on survey responses during young adulthood could be accounted for by a small number of variables assessed in late childhood, early adolescence, and mid/late adolescence. Although they claim that the predictors are important, they account for little of the variation in measured adult behaviour.

This is also true in relation to studies predicting young adult driving behaviour. Ulleberg’s (2002) study of personality and safety-related behaviour concluded that the relationships between personality-based cluster membership and self-reported safety measures were statistically significant, cluster membership accounted for only twenty percent of the variation
in speeding behaviour, twelve percent of the variation in rule violations, and only three percent of the variation in self-perceived driving skill.

Garrity & Demack (2001) reported relationships between personality and driving behaviour that were statistically significant, but that negative mood states (important predictors in relation to young drivers) accounted for no more than twenty-five percent of the variation in driving behaviours.

The Australian Temperament Project studies have focused on the predictive utility of developmental data in relation to subsequent young adult driving behaviour. Vassallo et al.’s (2007) study based on the Australian Temperament Project suggested that there were predictive relationships between a number of developmental measures and subsequent unsafe driving, but the relationships were generally weak rather than strong.

The difficulty here is that scientific relationships are not the same as practical usefulness. Predictors that are weakly correlated with target behaviours may improve the prediction of the target behaviour beyond simple chance, but this is unlikely to be sufficient to ensure that predicted outcomes are correct. The study reported by Elonheimo et al. (2007) and discussed earlier provides an example of this problem. They demonstrated a strong relationship between psychiatric disorders and unsafe or illegal driving behaviour, but their data (see Table 1 in this report) highlighted the risk of failing to identify all offenders – the relationships appear to be such that deviant behaviours in adolescence predict problem driving behaviours in young adulthood, but they do not identify all the young people likely to develop problem behaviours.

The reliability problem in this issue is most likely a false-negative issue – when the pattern of antisocial, externalising behaviours is used to predict problem driving behaviours it is likely that most adolescents with these problems will go on to develop problem driving behaviours, but that there is also a large group of young adults with problem driving behaviours who did not arrive through a pattern of deviant adolescent behaviour and so could not be identified in that way. The complexity of young driver behaviour suggests that this problem will apply regardless of the adolescent predictors used.

The consistent relationships between potential predictor variables and antisocial behaviours or problem driving behaviours suggest that there are patterns of adolescent behaviour that, when present, predict a high risk of the target early-adult behaviours. They do not, however, guarantee that the use of these predictors will identify the majority of young adults with problem driving behaviours. The relationships are asymmetrical in this sense, raising some concerns about the value of applying a predictive approach to the large population of adolescents.
Implications for interventions

Assuming it is possible to identify young people at risk of developing dangerous driving behaviours in the broader context of antisocial or deviant patterns of behaviour, it would be appropriate to start considering the potential benefits of interventions that target these young people and the specific issues that appear to contribute to the development or persistence of problem behaviours.

In addition to targeting a high risk group of adolescents, a successful intervention program will need to target specific factors that have a causal role in the development of problem behaviours. The behavioural patterns and personal characteristics that are used to identify high-risk adolescents are not necessarily underlying causal factors – they are likely in most cases to be covariates in the sense that they reflect the influence of the same underlying factors as the ultimate problem driving behaviour.

As a simple example, a pattern of rule violation and defiant behaviours identified in adolescents would be part of an assessment program that identifies young people at risk of subsequent problem driving behaviour. It would be tempting to develop a program that targets adolescent rule violation and defiance as an intervention, but this is unlikely to be successful because it assumes that the rule violation behaviour patterns are the cause of subsequent unsafe driving behaviours. It is more likely that some other developmental or psychosocial factors have a causal role for both the adolescent rule violations and the pattern of problem behaviours in early adulthood, and that they will continue to influence behaviours despite any intervention targeting one of their effects.

The importance of developmental factors and their causal role has been emphasised in some research studies. Monahan et al. (2009), for example, focused on developmental factors in adolescence and their relationship with desistance from or ongoing antisocial behaviour as young people transition into adulthood. They focused on the role of psychological maturity in the desistance from antisocial behaviour amongst the adolescence-limited offender group. They argue that there is little value in attempting to intervene in relation to life-course-persistent offenders given that there are neuropsychological and cognitive deficits.

Monahan et al. (2009) suggested that desistance is driven by improvements in self-control and impulse control in late adolescence. Their results showed that desistance from antisocial behaviour in early adulthood was associated with improvements in impulse control and suppression of aggression. Persistent offenders showed no positive changes in these traits through the data collection period.

The authors therefore suggested potential targets for remedial programs - a focus on encouraging the development of impulse control and suppression of aggression may increase the desistance from antisocial behaviours if it is possible to accelerate these maturational changes. Their results do suggest, however, that there is little chance of overcoming the neurological and cognitive deficits thought to contribute to lifetime-persistent problem behaviours.

One important consequence of this view of antisocial behaviours is that if interventions are developed to target underlying causes that contribute to the development of antisocial patterns or delays in desistance from antisocial behaviours, the view that some antisocial patterns relate to biological factors that interfere in the development of prosocial behaviours carries some implications for interventions. It may be possible to intervene in antisocial patterns for those young people who are members of the adolescence-limited trajectory, with
interventions targeting the developmental processes that reduce the level of antisocial behaviours before they might otherwise desist. It is less likely to intervene in relation to life-course-persistent antisocial patterns unless some other causal factors can be identified and modified. As Tremblay (2010) noted, the possibility that lifetime-persistent antisocial behaviours have a basis in neurocognitive deficits due to inherited factors has important consequences for the selection of potential interventions for this most-severely affected group of young drivers.

There has been some research activity in relation to prevention programs, with mixed results. Most recently, Dekovic et al. (2011) conducted a meta-analysis of the effects of nine early prevention programs on subsequent criminal behaviours and measures of positive development. They noted that early intervention may be preferable so to help avoid the accumulation of negative causal factors that contribute to the ongoing development of antisocial problem behaviours, but despite widespread belief that early interventions can reduce the likelihood of adult criminal behaviour, there is little relevant, quality research concerning this issue. The authors believe that the nine studies examined in their meta-analysis are the only evaluations relevant to this issue. The limitations of these studies and the small effect sizes suggest some caution needs to be applied in drawing policy-related conclusions about program effectiveness.

The meta-analysis results suggested that early prevention programs have small effects on adult criminal behaviour, and that they are more effective at reducing subsequent problem behaviour if they target at-risk and low-SES children, and if they focus on social and behavioural skills rather than academic skills or family support. The authors concluded that early intervention programs appear to have consistent effects on positive development, but that their effectiveness in relation to adult criminal behaviour is still uncertain.

An alternative approach may be to influence the contextual factors that influence developmental trajectories and transition to young adulthood, especially for those adolescents who join the adolescence-limited trajectory. For example, Bacchini et al. (2011) examined the role of exposure to violence in the community as a predictor of subsequent antisocial behaviour and internalising disorders in a sample of Italian teenagers. They reported that antisocial behaviours (in boys) and internalising disorders (depression and anxiety in girls) were associated with experiences of community violence, and that in each case the effect of community violence was moderated by the level of parental monitoring. Higher levels of parental monitoring were associated with less negative outcomes, suggesting that parenting skills and ongoing monitoring may help reduce the severity of negative outcomes for young people who experience violence and related antisocial behaviours as they grow up.

Similarly, the results discussed above reported by Bingham et al. (2006) suggesting that positive psychosocial adjustment, including connections with conventional social institutions, was associated with lower offence rates may be relevant. These results were taken by the authors as suggesting that broad psychosocial adjustment could provide an intervention during adolescence.

There is some considerable uncertainty about how best to proceed in relation to intervention programs if it is agreed that it is reasonable to attempt to predict future driving behaviour based on adolescent behaviour patterns. There is a need to identify causal factors to be targeted in intervention programs and to be aware that these causal factors differ for different developmental trajectories that lead to young adult problem behaviours. There is also a need to consider the challenges associated with identification of potential offenders and the implications of these challenges for intervention programs. In particular, it is likely that it will be easier to detect predictors of subsequent behaviour problems in those adolescents who are members of the life-course persistent trajectory, who in turn are most likely to be resistant to
intervention programs given the genetic/neuropsychological factors underlying their behaviour patterns.
CONCLUSIONS

This report was concerned with the possibility that young adults likely to engage in problem driving behaviours (sometimes referred to as ‘hoon’ behaviours) could be identified before they obtain a driver licence. The rationale used here was to start with young driver safety and the possibility that there are some young drivers with relatively higher crash risks, and then to place this issue in the broader context of problem behaviours, developmental trajectories, and evidence relating to antisocial behavioural patterns through adolescence and into early adulthood. This context was then applied to the young problem driver issue.

Key conclusions resulting from this approach were as follows:

- The average risk of crash involvement is higher for young and novice drivers than for older and experienced drivers.
  - The elevated risk associated with young or novice drivers in Victoria is similar to that reported internationally, and the driving contexts and behaviours associated with this elevated crash risk are consistent with international young driver crash patterns.
  - Key issues across the young/novice driver population include the effects of inexperience on the application of cognitive skills to the driving task in complex situations, motivational factors, the effect of peers, and broader lifestyle factors across the young driver population.
- Within the elevation of crash risk that occurs across young drivers there is some amount of variability that allows for the identification of subgroups of drivers that have a higher-than-average level of crash involvement.
- Patterns of unsafe driving behaviour amongst some young drivers increase their risk of crash involvement compared to the average elevated crash risk for young drivers.
  - Problem behaviour theory provides an important framework for understanding patterns of deviant and antisocial behaviours that interfere with a successful transition from adolescence to adulthood.
  - Patterns of risky driving behaviour appear to be part of a broader pattern of problem behaviours.
  - The key consequence of this is that risky driving behaviours can be considered as part of a broader tendency to engage in a range of problem behaviours, and therefore that the underlying causal factors and mechanisms that increase the likelihood of problem behaviours in general are also likely to influence the likelihood of risky driving behaviours.
- Developmental outcomes can be understood in terms of trajectories, based on research methods and developmental theories that focus on the development of individuals through their lifespan.
  - Developmental trajectories have particular value in the current project where the aim is to assess the possible identification of adolescents who will go on to develop risk-taking patterns of driving behaviour.
• One important outcome of trajectory-based research relates to the development of antisocial behaviours from childhood and through adolescence, where there is evidence of two trajectories:
  - Life-course-persistent antisocial behaviour where problem antisocial behaviours commence during childhood and persist at high levels throughout adolescence and adulthood.
  - Adolescence-limited antisocial behaviour where problem antisocial behaviours commence during adolescence and peak before declining in late adolescence and into early adulthood.

• One challenge for road safety is that the behavioural problems associated with the persistent and limited antisocial behaviour trajectories in early adulthood are likely to differ.
  - The life-course-persistent antisocial behaviour group is more likely to display aggressive driving behaviours in addition to defiant, rule-breaking driving behaviours, and their problem behaviours are likely to persist into adulthood.
  - The adolescence-limited antisocial trajectory group are likely to limit their problem or risky driving behaviours to rule-breaking, sensation-seeking behaviours and are likely to desist from these behaviours as they deal with the transition into early adulthood.

• The differentiation between life-course-persistent and adolescence-limited antisocial behaviours is important in the road safety context because there is evidence that the persistent behavioural problems (which include rule breaking and aggressive behaviours) are likely to result from causal factors that will challenge the development and implementation of interventions. These young adults are likely to exhibit the most-severe problem behaviours, are unlikely to desist in these behaviour patterns during early adulthood, and are affected by factors that are difficult to influence such as guilt and callousness.

• The possibility that temperament and other biological and early infancy factors influence the development of antisocial behaviours is an important consideration in considering the early prediction of problem driving behaviours – children and adolescents with behaviour patterns from early childhood that suggest temperament problems and related neurological deficits and antisocial behaviours may be an important group.

• There is strong evidence that antisocial behaviour patterns occur within the context of a range of developmental and psychological factors. These comorbid relationships between the range of externalising behavioural problems and other factors such as contextual factors and internalising disorders act as a double-edged sword in the current project’s context.

• The interaction between different patterns of problem behaviour suggest that identification of future risk-related driving behaviours can draw on a broad range of potential predictor behaviours, and therefore that an assessment tool may have access to a wide range of options.

• The negative consequence, however, is that there is a level of complexity in the interaction between these different patterns of behaviour that would need
to be reflected in any identification/assessment tool – especially given the possibility that the causal factors that underlie some patterns of behaviour may depend on the extent to which different patterns are or are not comorbid.

- The differences between antisocial behavioural trajectories in boys and girls imply that methods used to identify at-risk young people will need to take sex into account. Developmental processes that underlie the development of antisocial patterns of behaviour amongst girls appear to be more varied and complex and may involve internalising problems that are generally less involved in boys’ antisocial trajectories.

- Severe antisocial behaviours are associated with callousness and limited empathy that are likely to contribute to dangerous driving behaviour. Research concerning the development of severe antisocial patterns of behaviour and the role of callous-unemotional traits in relation to young problem drivers is relevant for two reasons.
  - Serious hoon-like, risk-related behaviours are relatively uncommon and reflect a behaviour style that is impulsive and lacking in empathy for the potential outcomes that might affect other drivers and road users. This suggests a role for callousness and impulsive/aggressive behaviours that would be consistent with the severe antisocial patterns discussed above.
  - The second reason for focusing on these characteristics relates to the prediction of early-adult behaviours based on adolescent characteristics. Predictions are likely to be more accurate (reliable and valid) where more-severe patterns of behaviour are targeted.

- Despite the limited research specifically concerning the relationship between developmental trajectories and young driver problem behaviours, there is some supporting evidence that this relationship may provide the basis for identifying adolescents who have a relatively high risk of engaging in unsafe behaviours once licensed. The broader problem behaviour theory and its supporting evidence and its links to developmental trajectories provide additional supporting evidence.

- There is consistent research evidence supporting the predictive relationship between adolescent characteristics and behaviours and subsequent antisocial behaviour patterns in early adulthood.
  - Aggressive behavioural patterns and bullying in childhood and adolescence are important, consistent predictors of antisocial and aggressive behaviour patterns in early adulthood. In addition to predicting antisocial behaviours, it would be reasonable to expect them to predict aggressive driving behaviours specifically, along with broader risk-related driving behaviours.
  - Although the diagnostic system in widespread use (APA, 2000) limits the flexibility of this taxonomic system as a predictor of antisocial behaviour patterns in early adulthood:
    - There is still evidence that externalising disorders such as Conduct Disorder have some predictive value.
    - There is some clear benefit, however, to focusing on some specific patterns of behaviour that contribute to the diagnosis of externalising disorders – such as behavioural patterns associated with serious Conduct Disorder, some of the patterns linked to Oppositional Defiant Disorder where they are associated with subsequent Conduct Disorder.
in adolescents, and the impulse-related behaviours associated with Attention-Deficit/Hyperactivity Disorder.

- Those behaviours normally linked to Antisocial Personality Disorder (and the callousness associated with psychopathy) but not normally treated in this way during adolescence are also likely to be useful as predictors of subsequent antisocial and deviant behaviours.

- Alcohol use may be a useful predictor of subsequent antisocial and deviant behaviour, in addition to other predictors relating to patterns of externalising behaviour. Early commencement of alcohol use and/or early binge drinking appear to predict alcohol problems in adulthood and patterns of deviant behaviour – consistent with the problem behaviour theory.

- There is consistent evidence that the presence of callous-unemotional traits in adolescence are reliable predictors of similar traits in adulthood and are useful additional predictors of antisocial behaviour patterns when combined with the adolescent behaviours associated with Conduct Disorder.

- The failure to develop age-appropriate levels of self-regulation and impulse control, and the presence of impulsive patterns of behaviours associated with the hyperactive form of Attention-Deficit/Hyperactivity Disorder are predictors of a range of problem behaviours and antisocial behaviours in young adulthood.

- The measurement of prosocial attitudes and behaviour during adolescence would be expected to provide an additional predictor for antisocial behaviour patterns during young adulthood, but there is currently insufficient research in this area to make the argument strongly.

- Research cited here and more-detailed research such as that relating to the Australian Temperament Project suggests that there may be some level of behavioural consistency from childhood that could potentially assist in predicting patterns of problem behaviour in young adulthood. The focus on developmental trajectories suggests, however, that assessment of potential problem behaviour in early adulthood is likely to be more reliable if conducted in adolescence rather than in childhood – especially given the adolescence-limited antisocial behaviour patterns that are likely to contribute to the number of young drivers with problem behaviours that are present before these patterns desist with increasing maturity.

- There is evidence that the predictive relationship between adolescent behaviours and antisocial behaviours in young adulthood has some relevance for attempting to predict problem driving behaviours because they occur in the broader context of problem behaviours.

- Personality appears to have limited value as a predictor. While it is likely that patterns of behaviour are related to underlying personality traits, behaviour is also affected by a range of additional factors such as contextual, familial, and social influences with the result that the correlations between adolescent personality and adult behaviour are likely to be smaller than the correlations between observed patterns of behaviour in adolescence and young adulthood. Behavioural measures are likely to be better predictors than personality measures.
• The use of Attention-Deficit/Hyperactivity Disorder on its own as a predictor of road safety problems appears to be risky, but its use in combination with other factors may be of some value. The impulsive behaviour patterns present in some young people with this disorder appear to have greater predictive value than the attentional factors also included in the diagnostic criteria.

• The adolescent behavioural patterns underlying externalising disorders have some value as predictors of problem driving behaviours during early adulthood, but the predictive relationship is asymmetrical. Young people with externalising behaviour patterns are highly likely to have subsequent records as traffic offenders, but there is no reason to believe that this predictive relationship is sufficient to guarantee that most offenders will be identified based on their adolescent behaviour patterns.

• It is not surprising, given the general confirmation of the problem behaviour theory, that lifestyle-related factors assessed during adolescence appear to be useful predictors of risk-related driving behaviours in adulthood, much as they are effective predictors of a broader range of antisocial behaviours.

• Attitudes expressed in a survey context are surprisingly poor predictors of self-reported behaviour, and are therefore most likely very poor predictors of behaviour in the real world.

• Where young drivers have a pattern of traffic offences it is likely that they will engage in risk-related problem driving behaviours and more-serious offences. This may provide an avenue for predicting problem drivers amongst licence holders, and is consistent with the use of traffic offence information for unlicensed drivers (learners and pre-learners) as predictors of antisocial behaviours in general and problem driving behaviour more specifically.

• There may be some benefits to including assessment of positive developmental factors such as prosocial measures, self-regulation, and impulse control as additional predictors of problem driving behaviours in early adulthood.

• There are some broader issues that need to be considered as cautionary comments relating to research and the development and implementation of interventions targeting identified future problem drivers.

• The consistent relationships between potential predictor variables and antisocial behaviours or problem driving behaviours suggest that there are patterns of adolescent behaviour that, when present, predict a high risk of the target early-adult behaviours. They do not, however, guarantee that the use of these predictors will identify the majority of young adults with problem driving behaviours. The relationships are asymmetrical in this sense, raising some concerns about the value of applying a predictive approach to the large population of adolescents.

• There is some considerable uncertainty about how best to proceed in relation to intervention programs if it is agreed that it is reasonable to attempt to predict future driving behaviour based on adolescent behaviour patterns. There is a need to identify causal factors to be targeted in intervention programs and to be aware that these causal factors differ for different developmental trajectories that lead to young adult problem behaviours. There is also a need to consider the challenges associated with identification
of potential offenders and the implications of these challenges for intervention programs. In particular, it is likely that it will be easier to detect predictors of subsequent behaviour problems in those adolescents who are members of the life-course persistent trajectory, who in turn are most likely to be resistant to intervention programs given the genetic/neuropsychological factors underlying their behaviour patterns.
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