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Risky driving among young Australian drivers II: Co-occurrence with other problem behaviours☆

Suzanne Vassallo[a,*], Diana Smart[a], Ann Sanson[b], Samantha Cockfield[c], Anne Harris[d], Allison McIntyre[c], Warren Harrison[e]

[a] *Australian Institute of Family Studies, 20/485 La Trobe St., Melbourne, Vic. 3000, Australia*
[b] *Department of Paediatrics, The University of Melbourne, Royal Childrens Hospital, Flemington Road, Parkville, Vic. 3052, Australia*
[c] *Transport Accident Commission of Victoria, GPO Box 2751Y, Melbourne, Vic. 3001, Australia*
[d] *Royal Automobile Club of Victoria, 550 Princes Highway, Noble Park North, Vic. 3174, Australia*
[e] *Eastern Professional Services Pty Ltd., 3 Birdwood Avenue, Ferntree Gully, Vic. 3156, Australia*

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Abstract

This study examined the co-occurrence of risky driving with a range of externalising and internalising problems among 1055 young Australian drivers participating in an ongoing, 23-year longitudinal study. This issue was examined by: (1) investigating the co-occurrence of risky driving and other problem outcomes at 19–20 years; (2) exploring the rate of single and multiple problems among high, moderate and low young risky drivers and (3) investigating connections between risky driving in early adulthood and adolescent problem behaviours. Concurrent and longitudinal associations between risky driving and both substance use (alcohol, cigarette and marijuana use, binge drinking) and antisocial behaviour were found. However, risky driving generally appeared unrelated to internalising problems (depression, anxiety) and early sexual activity. Overall, young risky drivers varied considerably in the number and types of problem behaviours exhibited, although the great majority (70%) had displayed at least one other type of problem behaviour.

Keywords: Risky driving; Problem behaviours; Externalising problems; Internalising problems; Co-occurrence; Longitudinal

1. Introduction

The overrepresentation of young drivers in motor vehicle accidents is a major public health concern (Engström et al., 2003; Harré, 2000). Young drivers' involvement in behaviours such as speeding and driving when affected by alcohol are seen as important contributors to this trend (Harré, 2000; Williams, 1998). In recent years, researchers have sought to understand the factors that contribute to the high incidence of risky driving among this age group, in the hope of being able to better target risky or unsafe driving and in turn, prevent or reduce serious injuries and fatalities.

It is increasingly recognised that many adolescent and early adult problem behaviours tend to co-occur and share common precursors (Cooper et al., 2003; Donovan and Jessor, 1985). This may also be true of risky driving. Several studies have shown that those who engage in risky driving often engage in other risky or problematic behaviours. For instance, Beirness and Simpson (1988) found that risky driving behaviours such as driving while under the influence of alcohol or drugs, failure to wear seatbelts and deliberate risk-taking when driving, were associated with cigarette, alcohol and other drug use in a sample of Canadian high school students. Likewise, Shope and Bingham (2002) found that young American adults who drove when affected by alcohol were more likely than other young adults to report problem drinking, drug use and delinquency. Similar findings have been observed in other studies employing

☆ The views expressed in this paper are those of the authors and may not reflect those of the collaborating organisations involved in this research—the Australian Institute of Family Studies, the Royal Automobile Club of Victoria, the Transport Accident Commission of Victoria and the Australian and Victorian Governments.

* Corresponding author. Tel.: +61 3 9214 7845; fax: +61 3 9214 7839.
E-mail addresses: Suzanne.Vassallo@aifs.gov.au (S. Vassallo), Diana.Smart@aifs.gov.au (D. Smart), annvs@unimelb.edu.au (A. Sanson), samantha_cockfield@tac.vic.gov.au (S. Cockfield), anne_harris@racv.com.au (A. Harris), allison_mcintyre@tac.vic.gov.au (A. McIntyre), wharrison@eastprof.com.au (W. Harrison).

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adolescent (e.g. Donovan et al., 1988) and young adult samples (e.g. Caspi et al., 1997), and among males and females (e.g. Shope and Bingham, 2002). Taken together, these findings lend support for Jessor and Jessor (1977) and Jessor (1987) influential problem behaviour theory, which proposes that problem behaviours are interrelated and reflect a basic underlying trait or propensity.

If this theory is correct, it would be anticipated that the developmental pathways to risky driving would be similar to those found for other problems, such as antisocial behaviour and substance use. Indeed, previous research has shown considerable similarity in the risk factors for risky driving, antisocial behaviour and substance use, with aspects of temperament style, behaviour problems, school adjustment, peer relationships and parent–child relationships predicting all three outcomes (Hawkins et al., 1992; Loeber and Farrington, 1998; Vassallo et al., in press).

Nevertheless, without sound research evidence, a broad behaviour syndrome should not be assumed to account for risky driving. Indeed, Willoughby et al. (2004) caution that most studies examining relationships between differing problem behaviours have found only modest associations, with intercorrelations typically ranging from 0.10 to 0.40. Thus, while problem behaviours may share some common elements with one another, these authors suggest that they should also be viewed as unique phenomena.

While there is increasing recognition that risky driving may be a manifestation of a broader risky lifestyle among some young people, research examining the co-occurrence between risky driving and more 'traditional' problem behaviours (such as substance use and antisocial behaviour) remains limited. The studies conducted have generally focused on a limited range of behaviours, and have employed North American samples. Furthermore, many previous studies have been cross-sectional. Hence, little is known about across-time relationships between risky driving and other problem behaviours. For example, do other problems precede the development of risky driving or do they emerge at the same time? This question carries important intervention implications. For instance, the presence of earlier problem behaviours might be a potential early warning sign, indicating that a young person is at risk for a range of later difficulties, including risky driving. Early intervention strategies may have value in moving young people onto more positive developmental pathways.

Furthermore, while it is recognised that problem behaviours such as antisocial behaviour and substance use tend to co-occur with risky driving, less is known about the relationship between risky driving and internalising problems such as anxiety and depression. Are young people who engage in risky driving more likely than less risky drivers to experience emotional difficulties, and if so, do these difficulties precede the onset of risky driving or emerge at the same time? Considerable research suggests that emotional problems tend to co-occur with risky or problematic behaviours such as precocious sexual activity, substance use and antisocial behaviour (Compas et al., 1998; Cooper et al., 2003). Furthermore, negative emotional states such as depression and anxiety can precipitate engagement in risky or problematic behaviour (Cooper et al., 2003). Given these findings, the relationship between emotional difficulties and risky driving would appear to warrant further investigation.

Finally, the degree of co-occurrence between risky driving and other problem behaviours may vary considerably depending upon whether the focus is on the co-occurrence of particular types of problems (e.g. the number of risky drivers who are also high alcohol users) or co-occurrence across a range of problems (i.e. the number of risky drivers who report involvement in any other type of problem behaviour). This issue has received little attention, yet may have important theoretical and practical implications.

The current study attempted to address these issues, using a longitudinal dataset to examine associations between risky driving and a range of internalising and externalising problems in adolescence and early adulthood. More specifically it aimed to: (1) investigate the co-occurrence between risky driving and other problem behaviours in early adulthood (19–20 years); (2) investigate the extent to which multiple problem behaviours are evident among risky drivers in early adulthood and (3) examine the association between problem behaviours in adolescence (13–18 years) and risky driving in early adulthood.

The study used data from the Australian Temperament Project (ATP), a longitudinal study that has followed the development of a cohort of Australian children from infancy into early adulthood. While the ATP has focused on children's psychosocial adjustment and wellbeing, information on a wide range of other personal, familial and environmental factors has also been collected (Prior et al., 2000). This included the assessment of driving behaviour at the most recent data collection in 2002, when participants were aged between 19 and 20 years.

The problem behaviours examined were: substance use (cigarette use, alcohol use, binge drinking and marijuana use), antisocial behaviour, early sexual activity, depression and anxiety. These outcomes were selected due to their prevalence among this age group, the adverse effects they may have on a young person's life, and on the basis of past research which indicated an association between these problems and risky driving and/or other types of problem behaviour. The use of illicit substances other than marijuana (such as 'ecstasy', 'speed' or heroin) was not examined as the number of participants reporting such use was too small for reliable statistical analyses to be undertaken.

2. Method

2.1. Participants

The ATP is a longitudinal community study following the psychosocial development of a large cohort of children born in the State of Victoria, Australia, between September 1982 and January 1983 (for more details see Prior et al., 2000).

The initial sample comprised 2443 infants (aged 4–8 months) and their parents, who were recruited through Maternal and Child Health Centres during a specified 2-week period in 1983. The participants were recruited from urban (1604 children) and rural (839 children) locations, selected on the advice of the Australian Bureau of Statistics to provide a representative sample

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of the State population. The sample obtained was representative of the Victorian population (Prior et al., 2000), and on available information, the broader Australian population (e.g. urban–rural proportion, parental birth place, occupational and educational levels).

Thirteen waves of data have been collected to date, via mail questionnaires. Parents, maternal and child health nurses, primary school teachers, and from the age of 11 years, the children themselves, have acted as informants.

Approximately two-thirds of the cohort is still participating. A higher proportion of the families no longer participating are from lower socio-demographic backgrounds or include parents born outside Australia. Nevertheless, there are no significant differences between the retained and no-longer-participating sub-samples on any infancy characteristics (Smart et al., 2005a,b). Hence, while the study continues to include young people with a broad range of attributes, it contains somewhat fewer families experiencing socio-economic disadvantage than at its commencement and thus slightly underestimates the effects of family disadvantage.

One thousand one hundred and thirty-five young adults (74% of the retained sample, 56% female) participated in the most recent survey wave at 19–20 years. Participants resided in the State of Victoria, Australia. In Victoria, young people are able to commence learning to drive under supervision at 16 years of age. The minimum licensing age is 18 years, with novice drivers spending the first 3 years of licensure on a probationary licence before graduating to a full licence. Most participants held a probationary licence ($n = 983$, 87%) or learner's permit ($n = 82$, 7%). Only 2% ($n = 25$) held a motorcycle licence (22 of whom also had a car licence). Additionally, 67 young people (6%) did not have a licence or a learner's permit. This paper focuses on all participants with a licence or learner's permit, giving a total of 1068 available for inclusion in later analyses.

2.2. Description of measures and group formation process

2.2.1. Risky driving

Engagement in risky driving was assessed at 19–20 years by eight items selected on the basis of research which suggests that speeding, driver fatigue, driving while under the influence of alcohol or other drugs and non-seatbelt use, place young people at increased risk of crash involvement or injury following crash involvement (e.g. Begg and Langley, 2000; Clarke et al., 2002; Engström et al., 2003; Triggs and Smith, 1996). Participants reported the number of trips in their past 10 in which they had: (1) driven up to 10 km/h above the limit, (2) driven between 10 and 25 km/h over the limit, (3) driven more than 25 km/h over the limit, (4) not worn a seatbelt (helmet) at all, (5) not worn a seatbelt (or helmet) for part of the trip, (6) driven when very tired, (7) driven when affected by alcohol and (8) driven when affected by an illegal drug. The length of these trips was not restricted or defined. This measurement approach was selected as it provided a quantified estimate of the behaviours in question and employed a time frame within most participants' recent recall.

Three risky driving groups were identified via cluster analysis (see Vassallo et al., in press, for further details). A small number of participants ($n = 13$) could not be classified and were therefore excluded at this stage, resulting in a final sample size of 1055 available for subsequent statistical analyses.

The groups formed were:

(1) a '*low*' *risky driving group* ($n = 675$, 64% of the sample, 39% male), characterised by low levels of all risky driving behaviours;
(2) a '*moderate*' *risky driving group* ($n = 306$, 29% of the sample, 50% male), characterised by intermediate levels of most risky driving behaviours;
(3) a '*high*' *risky driving group* ($n = 74$, 7% of the sample, 77% male), characterised by high levels of all unsafe driving behaviours, particularly speeding.

Group trends on the items assessing risky driving are shown in Fig. 1, and demonstrate the clear differences between groups. The validity of the cluster solution was also investigated by comparing the groups on two independent indices of risky driving: (a) rates of crash involvement and (b) detection for speeding, after controlling for driving exposure. Detection for speeding could have included a warning, fine or charge, nevertheless all types of detection indicate that speeding has occurred. While crash involvement and detection for speeding were self-reported, parental reports of the young adults' crash involvement were highly consistent with self-reports (Smart et al., 2005a,b), and an official records check revealed that of the 92 study members who had an official police record for speeding in the previous 12 months, almost all (96.7%) also self-reported that they had been apprehended for speeding (Vassallo et al., in press).

Group comparisons indicated that the high group reported having been involved in significantly more crashes than the low group ($F(2, 1032) = 3.68$, $p < 0.026$), and having been detected speeding significantly more often than both the moderate and low groups ($F(2, 1024) = 33.62$, $p < 0.001$). These results were seen as supporting the validity of the cluster groupings.

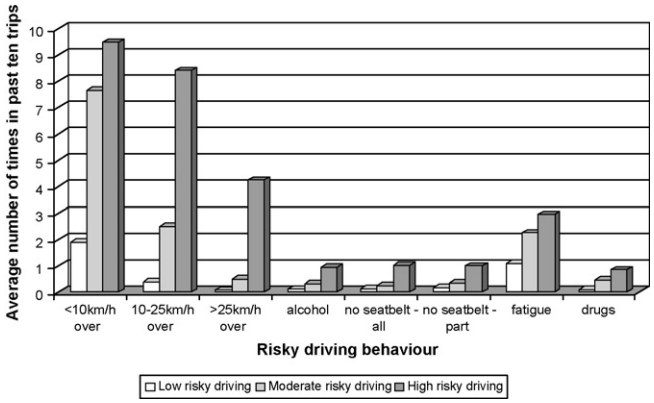

Fig. 1. Frequency of risky driving behaviours by cluster groups. *Abbreviations*: <10 km/h over, drove up to 10 km/h over the limit; 10–25 km/h over, drove between 10 and 25 km/h over the limit; >25 km/h over, drove more than 25 km/h over the limit; alcohol, drove when affected by alcohol; no seatbelt-all, did not wear a seat belt (or helmet) at all; no seatbelt-part, forgot seatbelt (or helmet) for part of the trip; fatigue, drove when very tired; drugs, drove when affected by an illegal drug.

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Table 1
Q3 Young adult groups: criteria used; group sizes and gender composition

Type and level of problem behaviour	Criteria	*n*	Percentage of ATP sample	Male (%)
Alcohol use				
Not high	Use on <10 days in past month	865	76.1	39.8
High	Use on >10 days in past month	272	23.9	57.4
Cigarette use				
Not high	Use on <16 days in past month	894	78.5	43.9
High	Use on >16 days in past month	245	21.5	45.3
Marijuana use				
Not high	Use on <5 days in past month	1038	91.4	42.9
High	Use on >5 days in past month	98	8.6	56.8
Binge drinking				
Not high	Binge drinking on <5 days in past month	834	75.1	39.9
High	Binge drinking on >5 days in past month	276	24.9	56.4
Antisocial behaviour				
Not high	<3 different types of antisocial behaviour in past year	1021	89.8	41.1
High	>3 different types of antisocial behaviour in past year	116	10.2	72.2
Depression				
Not depressed	'Normal'/'mild' depression	927	82.1	44.3
Depressed	'Moderate'/'severe'/'extremely severe' depression	202	17.9	42.6
Anxiety				
Not anxious	'Normal'/'mild' anxiety	933	82.6	44.7
Anxious	'Moderate'/'severe'/'extremely severe' anxiety	197	17.4	41.1

Note: Trends for the total ATP sample (including non-drivers) are shown in this table. As some respondents did not answer all questions, *n*'s vary slightly across the differing types of problem behaviours.

2.2.2. Substance use

Alcohol and *cigarette* use were assessed at 13–14, 15–16, 17–18 and 19–20 years by the number of days in the past month (30 days) that participants reported use of the substance. *Marijuana* use was assessed by lifetime use at 13–14 years, and the number of days of use in the past month at 15–16, 17–18 and 19–20 years. The 30-day recall methodology follows the recommendation of McLellan et al. (1992) and is consistent with other studies (e.g. Brener et al., 2002). *Binge drinking* was assessed as the number of days in the past month in which participants reported consuming seven or more drinks (if male), or five or more drinks (if female), which accords with official Australian definitions of high-risk drinking (NHMRC, 2001).

Participants' levels of use of each type of substance were classified as 'high' or 'not high'. Cut-offs were empirically derived, but informed by relevant Australian research, via consultation of the data trends and classification methods of the 1999 Victorian Adolescent Health and Wellbeing Survey (Bond et al., 2000), the 2001 and 2004 Australian National Drug Strategy Household Surveys (AIHW, 2002, 2005) and the 2002 Australian Secondary Students Smoking, Alcohol and Drugs Survey (AIHW, 2003). Differing cut-offs were used to define high substance use in early adulthood compared with adolescence, as substance use is much more prevalent among Australian youth in early adulthood and peaks around this age (Spooner et al., 2001). Furthermore, slightly different criteria were developed for each substance type to reflect the more normative nature of some forms of substance use compared with others, e.g. alcohol versus marijuana use (see Tables 1 and 2).

Thus, at 19–20 years, high *cigarette use* was defined as use on 16 or more days in the past month (i.e. at least every second day), high *alcohol use* as consumption on 10 or more days in the past month (i.e. several times a week), while for *binge drinking* and *marijuana use*, high use reflected use on 5 or more days (equivalent to weekly or more frequent use). The criteria used to form groups, the resulting group sizes and gender profiles of the early adult substance use groups are shown in Table 1.

A similar strategy was used to identify differing patterns of substance use in adolescence. Additionally, to accommodate the normative increase in substance use that occurs across adolescence (Bond et al., 2000), slightly different criteria were employed, with smaller thresholds generally used in early to mid adolescence than in late adolescence. Hence, high *alcohol use* was defined as consumption on 4 or more days in the past month at 13–14 and 15–16 years, and on 5 or more days at 17–18 years; high *cigarette use* as smoking cigarettes on 4 or more days in the past month at all adolescent survey waves; while high *marijuana use* was defined as any lifetime use at 13–14 years, and as any use in past month at 15–16 and 17–18 years.[1]

Following the dichotomisation of participants into 'high' and 'not high' groups at the three adolescent time points (13–14, 15–16 and 17–18 years), differing patterns of use from 13 to

[1] While it is acknowledged that these criteria do not reflect extremely high levels of use, for consistency across outcomes and reader ease, the terminology describing adolescent substance use as 'high' and 'not high' is retained.

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Table 2
Adolescent groups: criteria used; group sizes and gender composition

Type and pattern of problem behaviour	Criteria	*n*	Percentage of ATP sample	Male (%)
Alcohol use				
Stable low	'Not high' at all time points	644	71.6	41.1
Transient	'High' use at one time point (at 13–14 or 15–16 years and not 17–18 years)	69	7.7	40.6
Stable high	'High' use at >2 time points including 17–18 years	186	20.7	51.6
Cigarette use				
Stable low	'Not high' at all time points	780	81.3	46.3
Transient	'High' use at one time point (at 13–14 or 15–16 years and not 17–18 years)	30	3.1	20.0
Stable high	'High' use at >2 time points including 17–18 years	149	15.5	41.6
Marijuana use				
Stable low	'Not high' at all time points	831	83.9	44.2
Transient	'High' use at one time point (at 13–14 or 15–16 years and not 17–18 years)	77	7.8	37.7
Stable high	'High' use at >2 time points including 17–18 years	83	8.4	49.4
Antisocial behaviour				
Stable low	'Not high' at any adolescent time point	845	79.5	40.7
Transient	'High' antisocial behaviour at one time point (at 13–14 or 15–16 years and not 17–18 years)	88	8.3	43.2
Stable high	'High' antisocial behaviour at >2 time points including 17–18 years	130	12.2	64.6
Depression				
Stable low	'Not depressed' at all time points	952	86.0	50.6
Transient	'Depressed' at one time point (at 13–14 or 15–16 years and not 17–18 years)	84	7.6	32.1
Stable high	'Depressed' at >2 time points including 17–18 years	71	6.4	18.3
Anxiety				
Stable low	'Not anxious' at all time points	881	79.2	53.3
Transient	'Anxious' at one time point (at 13–14 or 15–16 years and not 17–18 years)	132	11.9	30.3
Stable high	'Anxious' at >2 time points including 17–18 years	100	9.0	21.0
Sexual activity				
Prior to age 16	First engaged in sexual intercourse prior to age 16	156	12.5	44.2
16 or older/never	Engaged in sexual intercourse at 16 or older age, or never	1096	87.5	45.6

Note: Trends for the total ATP sample who had data across all adolescent survey waves are shown in this table. As some respondents did not answer all questions, *n*'s vary slightly across the differing types of problem behaviours. Additionally, individuals who did not display the patterns of use identified (i.e. stable low, transient, stable high) were excluded from the relevant analysis, further contributing to the variation in *n*'s between outcomes.

18 years were identified. Three distinct patterns were established: 'stable low' (little or no use at all time points), 'transient' (high use in early- or mid-adolescence only) and 'stable high' (high use at two or more time points including late adolescence). The group sizes and gender profiles of the resulting adolescent substance use groups are shown in Table 2.

2.2.3. Antisocial behaviour

Antisocial behaviour was assessed at all survey waves using a short form of the Self-Report of Delinquency Scale (Moffitt and Silva, 1988, see Smart et al., 2005a,b; Vassallo et al., 2002 for further details). Participants reported the number of times they had engaged in differing antisocial acts (e.g. assault, theft, property damage, the sale of illegal drugs) in the past year (Cronbach alpha = 0.71 at 13–14 years, 0.77 at 15–16 years, 0.78 at 17–18 years and 0.69 at 19–20 years).

Using a criterion of involvement in three or more different types of antisocial activities in the past year to signify high antisocial behaviour, participants were classified as 'high' or 'not high' on antisocial behaviour at each survey wave (13–14, 15–16, 17–18 and 19–20 years). This cut-off corresponds with DSM-IV criteria for Conduct Disorder (American Psychiatric Association, 1994). Rates of antisocial behaviour at 19–20 years and gender profiles are shown in Table 1.

As with substance use, across-time patterns of antisocial behaviour from 13 to 18 years were next determined, leading to the formation of 'stable low', 'transient' and 'stable high' adolescent antisocial groups (see Table 2).

2.2.4. Emotional problems

Differing scales were used to obtain self-reports of internalizing problems (depression, anxiety) over the time span of early adolescence to early adulthood, to ensure that the measures tapped developmentally appropriate symptoms. For example, Weiss and Garber (2003) suggest that the development of abstract thinking capacities in adolescence may lead to differences in depressive symptoms at differing ages, as well as the way they are expressed.

Depression was assessed at 19–20 years by the seven-item depression subscale of the Depression, Anxiety and Stress Scale short form (DASS21: Lovibond and Lovibond, 1995), which asks participants to report how frequently within the past month they have experienced particular depressive symptoms using a four-point scale ranging from 'did not apply' to 'applied very

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much/most of the time' (Cronbach alpha = 0.89). At all adolescent survey waves, depression was assessed by the 13-item Short Mood and Feelings Questionnaire (SMFQ; Angold et al., 1995), with response categories of 'never or rarely', 'sometimes' or 'very often' employed (Cronbach alpha = 0.80 at 13–14 years, 0.85 at 15–16 years and 0.87 at 17–18 years).

Anxiety was assessed at 19–20 years by the seven-item anxiety subscale of the DASS21 (Lovibond and Lovibond, 1995), with the same response categories as for depression (Cronbach alpha = 0.77. At 15–16 and 17–18 years, an 11-item adaptation of the Revised Manifest Anxiety Scale (Reynolds and Richmond, 1997) was used to measure anxiety, with response categories identical to the SMFQ (Cronbach alphas = 0.84 and 0.86, respectively). At 13–14 years, adolescents' self-reports of anxiety were obtained via a five-item adaptation of the Anxiety-Withdrawal subscale of the Revised Behaviour Problem Checklist (RBPC; Quay and Peterson, 1996), using the same responses as at 15–18 years (Cronbach alpha = 0.71).

As with the other forms of problem behaviour, 'high' and 'not high' levels of depression and anxiety were identified in adolescence and early adulthood. In early adulthood, the published norms of the DASS (Lovibond and Lovibond, 1995) were used. These provide categories that differentiate normal, mild, moderate, severe and extremely severe levels. Participants whose scores fell within the 'normal' or 'mild' range on the depression scale were classified as 'not depressed', while those who scored within the 'moderate' (between the 87th and 95th percentile), 'severe' (between the 95th and 98th percentile) or 'extremely severe' (above the 98th percentile) ranges were classified as 'depressed'. The same criteria were used for the anxiety scale. Table 1 gives details of the groups formed and gender profiles.

Normative data were not available for the adolescent depression and anxiety measures, necessitating a different strategy. For depression, participants were classified as 'high' at a particular time point if they scored 11 or more on the SMFQ. This cut-off equates to five definite symptoms, which parallels the DSM-IV criteria for a major depressive episode (American Psychiatric Association, 1994). As the measure of anxiety differed at 13–14 from the two later time points, a different strategy was employed. Participants in the highest 15% of the ATP sample on anxiety at a particular survey wave were classified as 'high' at that time point, a criterion which parallels the incidence of anxiety in adolescent populations (see Vasey and Ollendick, 2000). Across-time patterns were next identified, leading to the formation of 'stable low', 'transient' and 'stable high' depression and anxiety groups (see Table 2).

2.2.5. Early sexual activity

Age at first sexual intercourse was determined by responses to two questions included at 17–18 years: 'Have you had sexual intercourse?' (yes/no) and 'If yes, how old were you when this first happened, with response categories of 'under 13', '13', '14', '15', '16', '17' and '18' years'.

Participants were classified as having first engaged in sexual intercourse '*prior to age 16*' or '*16 or older/never*' (see Table 2 for group sizes and composition). Age 16 was selected as the cut-off as it is the legal age of consent for sexual intercourse in the State of Victoria, Australia (Crimes Act, 1958).[2]

2.3. Procedure

The data were collected by mail surveys, which were mailed to all participants along with reply-paid envelopes to facilitate the return of questionnaires to the research team.

3. Results

Findings pertaining to the three issues under investigation are next presented. The co-occurrence of risky driving with other problem behaviours in early adulthood is first described, followed by an examination of single and multiple problems among differing groups of young drivers, and finally, associations between problem behaviours in adolescence and risky driving in early adulthood are reported.

3.1. Co-occurrence of problem outcomes in early adulthood (19–20 years)

Multinomial logistic regression analyses were undertaken which compared the high and low risky driving groups, and the moderate and low risky driving groups, on rates of high substance use (alcohol use, cigarette use, marijuana use, binge drinking), antisocial behaviour and internalising problems (anxiety, depression) at 19–20 years.

3.1.1. Substance use

Risky driving was significantly associated with all forms of substance use in early adulthood (alcohol use: $\chi^2(2) = 10.38$, $p < 0.01$; cigarette use: $\chi^2(2) = 22.48$, $p < 0.001$; marijuana use: $\chi^2(2) = 21.25$, $p < 0.001$ and binge drinking: $\chi^2(2) = 20.29$, $p < 0.001$). Table 3 shows the percentage of each risky driving group who engaged in high use of each substance type at 19–20 years, and demonstrates that significantly more individuals from the high risky driving group reported high cigarette use, high marijuana use and/or high binge drinking than their counterparts from the low risky driving group. Odds ratios indicated that high risky drivers were 4 times as likely as low risky drivers to engage in high marijuana use, 2.8 times as likely to engage in high cigarette use and more than twice as likely to engage in high binge drinking. While there was a significant overall association between risky driving and alcohol use, subsequent analyses comparing particular groups did not reveal significant differences.

A higher proportion of the moderate risky driving group also reported high use of all substance types than the low risky driving group. However, fewer moderate risky drivers engaged in high

[2] There are some exceptions to this law. For example, sexual activity is not considered unlawful for persons 10 years or older if: (a) their partner is no more than 2 years older than themself, (b) their partner has reasonable grounds to believe that the young person is 16 years or older or (c) the persons taking part in the act are married, or have reasonable grounds to believe that they are married (sub-sections 3 and 4 of section 45 of the Victorian Crimes Act, 1958).

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Table 3
Association between risky driving and other types of problem behaviour at 19–20 years

Type of problem behaviour	Percentage of risky driving group displaying problem behaviour			Statistical comparisons					
	Low group	Moderate group	High group	Moderate vs. low group			High vs. low group		
				Wald	OR	CI	Wald	OR	CI
High alcohol use	20.7	29.4	30.1	8.92**	1.60	1.18–2.18	3.44	1.66	0.97–2.83
High cigarette use	16.5	26.8	35.1	13.95**	1.86	1.34–2.57	14.58**	2.75	1.64–4.62
High marijuana use	5.5	12.1	18.9	12.54**	2.37	1.47–3.82	16.50**	4.01	2.05–7.82
High binge drinking	20.0	31.7	36.1	15.37**	1.86	1.36–2.53	9.59**	2.27	1.35–3.80
High antisocial behaviour	5.7	13.7	36.5	17.17**	2.65	1.67–4.21	59.26**	9.59	5.39–17.04
Depressed	15.6	19.4	21.9	2.20	1.31	0.92–1.86	1.93	1.52	0.84–2.75
Anxious	15.4	17.4	25.7	0.63	1.16	0.81–1.67	4.97*	1.90	1.08–3.33

Abbreviations: Wald, Wald's statistic; OR, odds ratios; CI, 95% confidence intervals.
* $p < 0.05$.
** $p < 0.01$.

levels of use than high risky drivers. The moderate risky driving group was found to be more than twice as likely as the low risky driving group to report high marijuana use, almost twice as likely to report high cigarette use and/or high binge drinking and 1.6 times as likely to report high alcohol use.

3.1.2. Antisocial behaviour

Antisocial behaviour was clearly associated with risky driving ($\chi^2(2) = 57.84$, $p < 0.001$), as shown in Table 3. Thirty-seven percent of the high risky driving group were highly antisocial compared with only 14% of the moderate risky driving group and 6% of the low risky driving group. High risky drivers were nine times more likely than low risky drivers to be highly antisocial and the moderate risky driving group was 2.7 times more likely to be highly antisocial than the latter group.

3.1.3. Emotional problems

While there was no significant overall association between risky driving and anxiety ($\chi^2(2) = 4.72$, ns), group comparisons revealed one significant difference between the high and low risky driving groups (Table 3), with high risky drivers almost twice as likely as low risky drivers to be anxious. There were no significant differences between the moderate and low risky driving groups on anxiety. Similarly, no significant group differences were found on rates of depression ($\chi^2(2) = 3.35$, ns).

3.2. The occurrence of single and multiple problem behaviours

The next issue addressed is whether high risky young drivers are more likely than moderate or low risky drivers to display other types of problem behaviours. As the focus is on the co-occurrence of risky driving with other problems, other types of co-occurrence (e.g. between internalising behaviour and substance use) were not examined. The problem behaviours that consistently differentiated the high and low risky driving groups, namely binge drinking, cigarette use, marijuana use and antisocial behaviour, were included in these analyses. Three of these four problem behaviours are types of substance use, and including each as a separate indicator could have led to an over-emphasis on the co-occurrence of risky driving with substance use. Furthermore, polysubstance use is relatively common among this age group (Gilvarry, 2000), suggesting that combining data across substances is feasible. Thus, individuals who engaged in high binge drinking (a more stringent criterion than high alcohol use), high marijuana use or high cigarette use, were deemed to be high substance users. The criteria for high antisocial behaviour remained the same. Following this, the total number of additional problem behaviours displayed by the high, moderate and low risky driving groups – high levels of substance use, antisocial behaviour or both – was determined (a possible range of 0–2).

Table 4 shows that the large majority of high risky drivers (70%) displayed one or more additional types of problem behaviour in early adulthood. Approximately half the moderate risky driving group displayed another form of problem behaviour, compared with only about one-third of low risky drivers. Furthermore, 25% of high risky drivers displayed both types of additional problem behaviour, compared with only 9% of moderate and 4% of low risky drivers.

Chi-square analyses showed that risky driving was powerfully associated with the presence of other problem behaviours ($\chi^2(6) = 98.20$, $p < 0.001$). Examination of the standardised residuals revealed that high risky drivers were significantly more likely than low risky drivers to have been involved in both antisocial behaviour and substance use or antisocial behaviour alone than expected by chance. The low risky driving group was sig-

Table 4
Percentage of each risky driving group displaying problems other than risky driving at 19–20 years

Other problem behaviours present	Level of risky driving		
	Low	Moderate	High
No other problem behaviour	65.3	46.5	30.1
High substance use only	29.0	39.9	32.9
High antisocial behaviour only	1.8	4.3	11.0
High substance use and high antisocial behaviour	3.8	9.3	26.0

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Table 5
Association between problem behaviours in adolescence and risky driving at 19–20 years

Type and pattern of problem behaviour	Percentage of risky driving groups displaying problem behaviour			Statistical comparisons					
	Low group	Moderate group	High group	Moderate vs. low group			High vs. low group		
				Wald	OR	CI	Wald	OR	CI
Alcohol use									
Stable low	75.4	66.5	55.8						
Transient	8.1	7.0	9.3	<0.01	0.98	0.52–1.87	0.61	1.56	0.51–4.73
Stable high	16.6	26.5	34.9	8.43**	1.81	1.21–2.71	8.81**	2.84	1.43–5.67
Cigarette use									
Stable low	86.4	74.3	66.0						
Transient	3.5	2.7	4.0	0.06	0.89	0.35–2.30	0.29	1.52	0.34–6.84
Stable high	10.2	23.0	30.0	19.69**	2.63	1.72–4.03	15.31**	3.86	1.96–7.60
Marijuana use									
Stable low	88.4	80.9	63.0						
Transient	5.9	8.0	23.9	1.57	1.48	0.80–2.72	18.68**	5.66	2.58–12.43
Stable high	5.7	11.1	13.0	6.88**	2.12	1.21–3.72	5.68*	3.20	1.23–8.31
Antisocial behaviour									
Stable low	85.6	75.4	49.0						
Transient	6.3	11.7	11.8	7.67**	2.11	1.24–3.58	5.91*	3.28	1.26–8.53
Stable high	8.1	12.9	39.2	5.58*	1.81	1.11–2.95	39.59**	8.44	4.34–16.39
Depression									
Stable low	86.7	89.5	89.8						
Transient	7.5	6.0	6.8	0.60	0.79	0.43–1.45	0.06	0.88	0.30–2.54
Stable high	5.8	4.4	3.4	0.72	0.74	0.37–1.49	0.60	0.56	0.13–2.41
Anxiety									
Stable low	79.2	78.7	86.7						
Transient	11.8	14.0	6.7	0.59	1.19	0.77–1.85	1.53	0.52	0.18–1.47
Stable high	9.0	7.4	6.7	0.49	0.82	0.47–1.43	0.54	0.67	0.23–1.94
Sexual activity									
Prior to age 16	10.9	12.1	13.8	0.32	1.14	0.73–1.76	0.53	1.32	0.62–2.79

Abbreviations: Wald, Wald's statistic; OR, odds ratios; CI, 95% confidence intervals.
* $p < 0.05$.
** $p < 0.01$.

nificantly more likely than the other two groups to display no problem outcomes at 19–20 years.

3.3. Relationship between adolescent problems and risky driving in early adulthood

Multinomial logistic regression analyses were again undertaken comparing the high and low risky driving groups, and the moderate and low risky driving groups, on rates of transient or stable high substance use (alcohol use, cigarette use, marijuana use), antisocial behaviour, internalising problems (anxiety, depression) and early sexual activity, in adolescence.

3.3.1. Substance use

Adolescent alcohol use ($\chi^2(4) = 14.22$, $p < 0.01$), cigarette use ($\chi^2(4) = 27.59$, $p < 0.001$) and marijuana use ($\chi^2(4) = 23.52$, $p < 0.001$) were significant precursors of risky driving in early adulthood.

The high risky driving group was found to be almost 4 times as likely as the low risky driving group to have had a history of stable high cigarette use across adolescence, about 3 times as likely to have displayed a stable high pattern of marijuana use and 2.8 times as likely to have displayed stable high alcohol use (see Table 5). Additionally, more high risky drivers (24%) had been involved in transient marijuana use during adolescence than moderate (8%) and low risky drivers (6%), with high risky drivers 5.7 times as likely as low risky drivers to have been involved in this type of use. There were no significant differences between the high and low risky driving groups on transient alcohol or transient cigarette use during adolescence.

The moderate risky driving group had also significantly more often engaged in stable high alcohol, cigarette and/or marijuana use in adolescence than the low risky driving group. However, as in early adulthood, group differences were not as large as those found between the high and low risky driving groups. Thus, moderate risky drivers were about 2.5 times as likely as low risky drivers to have a history of stable high cigarette use, about twice as likely to have been stable high marijuana users and 1.8 times as likely to have a pattern of stable high alcohol use over adolescence. There were no significant differences between the moderate and low risky driving groups in their rates of transient adolescent alcohol, cigarette or marijuana use.

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3.3.2. Antisocial behaviour

Significant associations were found between adolescent antisocial behaviour and risky driving in early adulthood, as shown in Table 5 ($\chi^2(4) = 43.50$, $p < 0.001$). Almost 40% of high risky drivers consistently engaged in high levels of antisocial behaviour in adolescence compared with only 13% of moderate risky drivers and 8% of low risky drivers. Odds ratios indicated that high risky drivers were almost 8.5 times as likely as low risky drivers to have a history of stable high antisocial behaviour in adolescence. High risky drivers were also significantly more likely than low risky drivers to have engaged in transient antisocial behaviour in adolescence (odds ratio of 3.28).

The moderate risky driving group was also more likely than the low risky driving group to have a history of stable high or transient adolescent antisocial behaviour, although less so than the high risky driving group (odds ratios of 1.8 and 2.11, respectively).

3.3.3. Emotional problems

There were no significant differences between the risky driving groups in their patterns of depression ($\chi^2(4) = 1.81$, ns) and anxiety ($\chi^2(4) = 3.73$, ns) over adolescence (see Table 5).

3.3.4. Early sexual activity

As Table 5 indicates, there were no significant differences on rates of engagement in sexual intercourse prior to age 16 ($\chi^2(2) = 0.69$, ns).

4. Discussion

This study examined associations between risky driving and a range of problem behaviours among a large sample of young Australian drivers participating in an ongoing longitudinal study. A unique aspect of this study was that it endeavoured to explore the relationship between risky driving and a range of internalising problems (anxiety, depression), externalising problems (alcohol use, binge drinking, cigarette use, marijuana use, antisocial behaviour) and precocious sexual activity. Most previous research has focused primarily on associations between risky driving and a small number of externalising problems. Another strength was that it used data from a multi-wave longitudinal dataset to examine both concurrent and longitudinal associations between risky driving and other problem behaviours. To the authors' knowledge, this is one of the first studies to examine the association between risky driving and other problem outcomes in this manner. Finally, it also examined the propensity of risky drivers to engage in single or multiple types of problem behaviours. The implications of these findings are now discussed.

4.1. Types, severity and co-occurrence of problem behaviours associated with risky driving

Consistent with previous research (e.g. Caspi et al., 1997; Shope and Bingham, 2002), risky driving was found to co-occur with a number of externalising problems in early adulthood (alcohol use, cigarette use, marijuana use, binge drinking and antisocial behaviour; see Table 3). This co-occurrence was most noticeable for antisocial behaviour and marijuana use. In contrast, internalising problems (anxiety and depression) were generally unrelated to risky driving behaviour. Thus, although previous research suggests that internalising problems co-occur with other types of risk-taking or problem behaviours (e.g. Compas et al., 1998; Cooper et al., 2003), risky driving does not appear to be one of these. The current findings suggest that road safety efforts that focus on links between risky driving and externalising problems are well targeted. On the other hand, interventions targeting internalising problems appear less indicated.

Looking back in time, significantly more high risky drivers had consistently used alcohol, cigarettes and/or marijuana and been involved in antisocial behaviour in adolescence (see Table 5). They also had more often been transiently involved in marijuana use and antisocial behaviour in adolescence than low risky drivers. Once again, antisocial behaviour (stable high) and marijuana use (transient) were the outcomes most strongly associated with risky driving behaviour. These results support those of Beirness and Simpson (1988), who found connections between adolescent substance use and risky driving. Adolescent anxiety, depression and precocious sexual activity were unrelated to later risky driving behaviour. These findings are very similar to those found in early adulthood.

While the current analyses do not allow the drawing of conclusions regarding causation, the fact that many young high risky drivers had a history of substance use and/or antisocial behaviour from adolescence onwards suggests that these problems may precede the development of risky driving. These findings are consistent with some previous research, which suggests that adolescent substance use and antisocial behaviour are risk factors for subsequent risky driving behaviour (Shope et al., 1997; Vassallo et al., in press). Hence, the current findings carry implications for the timing of interventions, as they suggest that initiatives that target adolescent substance use and antisocial behaviour may have success in impeding the development of risky driving. Research examining the impact of such initiatives on risky driving is needed to clarify this possibility.

Although individuals who engaged in high levels of risky driving were clearly the group most often involved in substance use and antisocial behaviour, moderate risky drivers also more frequently displayed problems in these areas when compared to low risky drivers. These findings suggest a co-occurrence between risky driving and other problem outcomes even at moderate levels of risky driving.

Rates of problem behaviours among risky drivers varied quite markedly depending upon whether they were viewed cumulatively or in isolation. For instance, when examined individually (as shown in Table 3), only a minority of high risky drivers, ranging from one-in-five to one-in-three, experienced any one specific problem (e.g. about 30% of high risky drivers reported high alcohol use, close to 20% reported high marijuana use). However, an examination of the rate of single or multiple problems among the three risky driving groups (see Table 4) showed that most high risky drivers (70%) had reported involvement

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in another problem behaviour (antisocial behaviour, substance use or both), as had approximately half the moderate risky drivers, but only one-third of low risky drivers. Furthermore, one-quarter of the high risky driving group reported multiple additional problems, a much higher rate than found for the moderate and low risky driving groups. These findings highlight the value in looking at rates of problem behaviours both separately and cumulatively when examining the issue of co-occurrence, as these two approaches can yield quite different findings.

4.2. Support for problem behaviour theory

Taken together, these findings offer partial support for problem behaviour theory (Jessor and Jessor, 1977; Jessor, 1987), which posits that problem behaviours are closely related to each other and may be caused by a common underlying propensity. The strong associations between risky driving, substance use and antisocial behaviour found here suggest firstly, that young adults who engage in high levels of risky driving tend to experience a broader range of difficulties beyond driving-related problems. Hence, such drivers may benefit from assistance that targets multiple aspects of their lives, such as the use of licit and illicit substances, attitudes towards societal laws and authority figures, as well as their behaviour on the road.

Secondly, these findings suggest that interventions targeted at one type of problem behaviour (for example, substance use) could potentially have a wider impact, preventing or reducing other problem outcomes (such as risky driving). Hence, while there is a clear need for initiatives targeting risky driving, more broad-based 'common solutions' approaches aimed at reducing or inhibiting multiple problem behaviours simultaneously, may also have pay-offs in decreasing risky driving.

Nevertheless, while there were powerful associations between risky driving and a number of other problem behaviours, the overlap was partial, not complete. Furthermore, while the majority of high risky drivers were found to experience another problem behaviour in early adulthood (substance use or antisocial behaviour), only a minority experienced any one specific problem. These findings offer support for the view that while problem outcomes may share common elements, they remain distinct phenomena (Willoughby et al., 2004). Hence, while a common solutions approach may help to reduce risky driving, specific programs targeting risky driving will clearly continue to be essential.

4.3. Risky drivers are a heterogeneous group

The current findings call attention to the variability among individuals who engage in risky driving. For instance, some high risky drivers also engaged in antisocial behaviour ($n = 8$, 11%) or substance use ($n = 24$, 33%), while a quarter displayed difficulties in both areas ($n = 19$, 26%). Only 30% engaged in high risky driving alone ($n = 22$). While research has examined the attributes and characteristics that predict risky driving in general (e.g. Shope et al., 1997; Vassallo et al., in press), at present understanding of the factors that might differentiate different subtypes of high risky drivers remains limited. Hence, further research examining the characteristics that typify these sub-groups and the developmental pathways they traverse would appear warranted. However, larger group sizes than those employed by the present study will be needed.

Additionally, given the heterogeneity among individuals who engage in risky driving, it is likely that a variety of interventions will be needed. Hence, programs that specifically target a particular problem behaviour (e.g. programs addressing risky driving among young traffic offenders), together with broader initiatives that target multiple problem behaviours (e.g. school-based initiatives targeting adolescent behaviour problems), and population-wide initiatives that aim to increase community awareness (e.g. media advertising campaigns addressing speeding) may all be necessary. Rigorous, high quality evaluations will also be needed to establish the efficacy of these very different approaches to increasing road safety.

4.4. Strengths and limitations

As noted earlier, this study had a number of strengths. These included the broad range of problem behaviours assessed, the examination of both concurrent and longitudinal associations between risky driving and other problem behaviours, and the different strategies used to investigate the co-occurrence between risky driving and other problem behaviours (i.e. separate and cumulative approaches). Nevertheless, the study also had several limitations. Despite the large sample size ($n = 1135$), the high risky driving group was quite small ($n = 74$), which restricted the statistical power available. As the high risky driving group contained few females ($n = 17$), gender differences could not be examined. Furthermore, due to sample attrition over the course of the study, participants of low SES backgrounds are slightly underrepresented in this sample, with the effects of family socio-economic disadvantage therefore likely to be somewhat under-estimated. Finally, risky driving and involvement in problem behaviours were assessed subjectively, via self-reports, rather than by observations or official records. However, the self-reports obtained here have been found to correlate highly with other sources such as official police records (Smart et al., 2005a,b); see Vassallo et al. (in press) for a further discussion of the utility of self-reports.

4.5. Conclusions

In conclusion, this study demonstrated powerful concurrent and longitudinal associations between risky driving and both antisocial behaviour and licit and illicit substance use. Nevertheless, the overlap between risky driving and these other problem outcomes was not absolute. Young adults who engaged in high levels of risky driving were a heterogenous group, and while most exhibited other problem behaviours, about a third engaged in risky driving only. Given this heterogeneity, no single approach is likely to be solely effective in reducing the occurrence of risky driving. Rather, a mixture of targeted initiatives and broader, 'common solutions' approaches may yield the best results.

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