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# Personality, attitudes and risk perception as predictors of risky driving behaviour among young drivers

Pål Ulleberg\*, Torbjørn Rundmo

*Department of Psychology, Norwegian University of Science and Technology, 7491 Trondheim, Norway*

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## Abstract

Within psychology, different research traditions have attempted to explain individual differences in risky driving behaviour and traffic accident involvement. The present study attempts to integrate two of these research traditions, the personality trait approach and the social cognition approach, in order to understand the mechanisms underlying young drivers' risk-taking behaviour in traffic. The study was based on a self-completion questionnaire survey carried out among 1932 adolescents in Norway. The questionnaire included measures of risk perception, attitudes towards traffic safety and self-reported risk-taking in traffic. Personality measures included aggression, altruism, anxiety and normlessness. The results of a structural equation model suggested that the relation between the personality traits and risky driving behaviour was mediated through attitudes. On this basis it was concluded that personality primarily influences risky driving behaviour indirectly through affecting the attitudinal determinants of the behaviour. Practical implications for traffic safety campaigns are also discussed.

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*Keywords:* Personality; Attitudes; Driving behaviour; Adolescents; Traffic; Mediator; Structural equation modelling

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## 1. Introduction

It is commonly acknowledged that human factors may contribute to accident involvement in traffic (Grayson and Maycock, 1988). Based on a study of 2041 traffic accidents, Sabey and Taylor (1980) concluded that human factors were contributing elements in 95% of the accidents. In particular, driving behaviour was identified as the most central of these factors. Consequently, a variety of studies

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\* Corresponding author. Tel.: +47-73-59-82-86; fax: +47-73-59-19-20.

E-mail address: [p.al.ulleberg@svt.ntnu.no](mailto:p.al.ulleberg@svt.ntnu.no) (P. Ulleberg).

have been carried out in order to identify variables which may influence accident involvement and risk-taking behaviour in traffic, meaning behaviour that indicate the possibility of a negative health outcome for the individual as well as for others. Within psychology, the different perspectives of cognitive, personality and social psychology have all attempted to explain individual differences in risk-taking and traffic accident involvement (e.g. Arthur, Barrett, and Alexander, 1991; Parker and Manstead, 1996). Cognitive research has traditionally studied variables such as management of attention and information processing capabilities, whereas personality research has focused upon the predictive value of personality traits. At the same time, social psychological research has attempted to explain differences in risk-taking behaviour and accident involvement within the framework of social cognition models.

Despite the extensive research within these areas of psychology, few studies attempt to integrate variables from these different research traditions. For instance, personality traits are rarely studied together with social cognitive variables. The present study attempts to integrate these two research traditions, the personality trait approach and the social cognition approach, in order to understand the mechanisms underlying risk-taking behaviour in traffic. Specifically, we will focus on risky driving behaviour among young drivers. This is due to the fact that adolescents are more frequently involved in traffic accidents as compared to other age groups (Bjørnskau, 2000).

Within the social cognition approach, models such as the Theory of Reasoned Action/Planned Behaviour (Ajzen and Fishbein, 1980; Ajzen, 1988) and the health belief model (Rosenstock, 1974) have frequently been applied to study the determinants of risky driving behaviour (see e.g. Parker et al., 1992; Parker et al., 1995; Rutter et al., 1995; Parker et al., 1998). According to these models, variables such as attitudes, perceived risk, social norms and perceived behavioural control are central determinants of behaviour. Evidence for the predictive value of these variables has been found in several studies. In particular, attitudes towards traffic safety have been found to correlate with aggressive driving behaviour, fast driving, and self-reported accident involvement (Parker and Manstead, 1996; West and Hall, 1997; Parker et al., 1998). Perceived risk seems also to be of importance, since young drivers, as compared to other age groups, are more likely to underestimate the probability of the specific risks caused by traffic situations (Brown and Groeger, 1988; Deery, 1999). They also tend to perceive the hazards in traffic less holistically (Milech et al., 1989; Deery, 1999), and overestimate their own driving skills (Moe, 1986).

Based on this knowledge, one of the most popular strategies of promoting road safety has aimed at changing adolescents' attitudes and risk perception related to driving. However, several literature reviews have concluded that the majority of traffic safety campaigns aimed at influencing attitudes and risk perception have failed to document any effect on the number of accidents (Elvik, Vaa and Østvik, 1989; OECD, 1994). There may be several reasons for the campaigns' apparent lack of success. One reason may be that the role of personality characteristics often has been ignored when such campaigns are carried out.

Personality traits can be defined as dimensions of individual differences in tendency to show consistent patterns of thoughts, feelings and behaviour (McCrae and

Costa, 1990). In contrast to social cognitive variables such as an attitude, defined as an evaluative condition with reference to a specific object (Eagly and Chaiken, 1993), traits are not evaluative, and are not referring to specific objects. Thus, traits are thought to be more stable and more general as compared to attitudes. The role of personality traits in traffic accidents can be traced back to Farmer and Chambers' (1939) theory of "accident proneness", who suggested that the majority of traffic accidents are caused by a small number of individuals who possess certain personality characteristics. The theory is now regarded as unsatisfactory. However, recent studies have found that personality traits are weakly, but consistently associated with accident involvement in traffic (e.g. Elander et al., 1993, for a review). In particular, sensation-seeking, aggression and social deviance are frequently related to traffic accident involvement (Hilakivi et al., 1989; Jonah, 1997; West and Hall, 1997).

There is, however, reason to believe that the role of personality traits pertaining to accident involvement in traffic may be underestimated. General measures such as personality traits are assumed to be weak predictors of accidents, mainly for the reason that accidents are relatively rare, and influenced by numerous factors, such as exposure (e.g. annual mileage), randomness and weather conditions (Friedstøm et al., 1995). From a psychometric point of view, an accident is therefore regarded as both an unsuitable and an unreliable criterion. Among others, Epstein (1979) has suggested that an aggregation of different behaviours across situations, a multiple act criterion, is a more appropriate and reliable criterion when studying the influence of personality on behaviour. Based on this, one can expect personality traits to be more successful in predicting an aggregate of different risk-taking behaviours in traffic as compared to accident frequency. This has been also been acknowledged by several researchers, who have found that the correlation between personality traits and risky behaviour increases when a multiple-act criteria is applied (e.g. Booth-Kewley and Vichers, 1994). It should also be mentioned that the same problems apply equally well when studying the relation between attitudes and specific behaviours like accidents (Ajzen, 1988; Sutton, 1998).

Another reason for a possible underestimation of personality in relation to accident involvement and risky driving behaviour is that *indirect effects* of personality traits are rarely studied. Theoretically, personality traits are thought to influence the individual's perception and appraisal of the environment (McCrae and Costa, 1995). Several studies have supported this assumption (see Matthews and Deary, 1998, for a review). Such appraisals are subsequently thought to affect behaviour. A similar point of view has been incorporated within social cognition models, which acknowledge that personality traits may affect behaviour indirectly through influencing the attitudinal or normative determinants of behaviour (Rosenstock, 1974; Ajzen, 1988). Still, such indirect effects of personality variables are rarely studied. This is probably due to the fact that the majority of studies carried out within the social cognitive framework aim at identifying the determinants of behaviour hypothesised to be most open to change. Personality traits are regarded as less open to change as compared social cognitive variables, and consequently of minimal interest in such studies.

We still believe that the role of personality should not be ignored in road safety promotion. First, taking both personality and social cognitive variables into account as sources of variation in behaviour may provide more explanatory power than either one alone. Second, traffic safety campaigns often fail to demonstrate any effects on behaviour. Designing safety programs that take personality dispositions into account may result in a more efficient measure of both communicating the message to the target audience as well as changing their behaviour.

As implied by the previous presentation, the present study aims at examining the relative importance of both traits and social cognitive variables in relation to risky driving behaviour. A central aim is to investigate whether personality traits have a direct influence on behaviour when the effects of social cognitive variables are controlled for, or whether traits primarily have indirect effects on behaviour through their influence on social cognitive variables such as attitudes and risk perception.

## 2. Method

### 2.1. Sample

A questionnaire survey was carried out among 4500 adolescents in Norway in 1998/1999. The survey was conducted in the beginning of a traffic safety campaign carried out among adolescents in Norway during the time period of 1998 to 2003 (see also Rundmo and Ulleberg, 2000a). The project was initiated by the Norwegian Authorities of Public Roads (Statens Vegvesen) in cooperation with the Police department, the Norwegian Society of Road Safety (Trygg Trafikk) and the Traffic Safety Committees of two Norwegian counties. The respondents were randomly selected high school classes from within these counties and the questionnaires were completed individually at the participating schools. A total of 3942 respondents returned the questionnaires, yielding a response rate of 85%. Of these, 56% were women and 44% were men. Mean age of the respondents was 18.5 years (modal 18 years) and the age ranged from 16 to 23 years. The analyses of the present paper are based on the 1932 respondents who had a driver licence. The majority of these (84%) had possessed the driver licence for more than 3 months.

### 2.2. Measures

Through a review of the literature we selected five personality traits that have demonstrated to have a significant relationship with risk-taking behaviour in traffic or involvement in traffic accidents (see e.g. Hilakivi et al., 1989; Booth-Kewley and Vichers, 1994; Caspi, Begg, Dickinson et al., 1997; Jonah, 1997; West and Hall, 1997; Cellar, Nelson, and Yorke, 2000). These included: *Sensation-seeking* (i.e. the need for excitement and stimulation), *Aggression* (the tendency to experience anger and frustration), *Anxiety* (a tendency to be fearful, prone to worry and being nervous), *Altruism* (characterised by active concern for others), and finally *Normlessness* (i.e. the belief that socially unapproved behaviours are required to achieve

certain goals). Sensation-seeking, aggression, anxiety and altruism were measured using facets from the NEO-Personality Inventory (Costa and McCrae, 1992). Normlessness was measured using Kohn and Schooler's (1983) normlessness scale, which consists of four items. These four items are listed in the Appendix A. All items were answered on five-point Likert scales ranging from "strongly agree" to "strongly disagree". A mean score on each of the traits was constructed on the basis of the items measuring the trait.

Risk perception was measured by two items. First, the respondents were asked to rate their subjective evaluation of the probability of them being involved in a traffic accident in the future, ranging from 1: not probable at all to 7: very probable. Second, they were asked to express how worried and concerned they were regarding being hurt in a traffic accident, ranging from 1: not worried at all to 7: very worried.

Three attitude scales were included to measure the respondents' risk-taking attitudes related to driving. These scales had previously been developed in a study by Ulleberg and Rundmo (2001, see also Rundmo and Ulleberg, 2000a). The three scales, named traffic flow vs. rule obedience, speeding and funriding, consisted of 9, 5, and 3 items, respectively. The items are listed in the Appendix. A mean score on each scale was computed on the basis of the items within each scale. A high score on a scale indicated a positive attitude towards traffic safety, meaning low preferences for risk-taking in traffic.

In addition, three behavioural scales consisting of 15 items were included to measure self-reported acts of risk-taking in traffic. The scales, named speeding, rule violations and self-assertiveness, had also been developed in a previous study by Rundmo and Ulleberg (2000a). The items are listed in the Appendix A. The respondents were asked to indicate how often they partook in the different acts of risk-taking, ranging from "never" to "very often". A mean score on each scale was constructed on the basis of the items within each scale. A high score on a scale indicated a high degree of risky driving.

### *2.3. Statistical analysis*

Cronbach's alpha coefficient was applied to evaluate the internal consistency of the personality measures, the attitude scales and the risk behaviour measure. The relationship between personality, attitudes, risk perception and risky driving behaviour were estimated using structural equation modelling. When preparing the data for analysis, we first standardised the raw data and then computed the covariance matrix. The covariance matrix was analysed by means of the LISREL 8 Program (Jöreskog and Sörbom, 1993). Missing cases were deleted listwise.

Various fit indices were used to assess the fit of the model: the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the comparative fit index (CFI), the root mean square error of approximation (RMSEA) and the expected cross-validation index (ECVI). A GFI, an AGFI and a CFI above 0.90 indicate a close fit of the model to data (Hu and Bentler, 1995). Moreover, an RMSEA of 0.08 or less also indicates a good fit, and the lower ECVI value the better fit (Browne and Cudeck, 1993).

### 3. Results

The number of items, mean scores, and internal consistency for all measures are listed in Table 1. The reliability coefficients were acceptable, with the exception of the one relating to perceived risk. This was probably due to the fact that only two items made up the scale measuring risk perception.

Table 2 pictures the correlations between the variables. To simplify the correlation matrix, latent variable scores (Jöreskog et al., 2000) were computed for risk perception, attitude toward traffic safety, and risk-taking behaviour. The measurement models for the three latent variables are shown in Fig. 1. As shown in the table, all the five personality measures were significantly correlated with risk perception, attitudes towards traffic safety, and risky driving behaviour. Altruistic and anxious individuals tended to perceive the risk related to traffic accidents as high, as well as having a positive attitude towards traffic safety. At the same time, they reported less risk-taking in traffic. In contrast, those scoring high on sensation seeking and normlessness, perceived the risk of traffic accidents as lower, demonstrated a negative attitude towards traffic safety, and reported more risk-taking in traffic. Aggressive individuals demonstrated a bit more complex pattern. They were more likely to perceive the risk related to traffic accidents as higher compared to individuals

Table 1  
Number of items, mean scores and Cronbach's alpha for all measures

| Measures                                               | Number of items | Mean (range 1–5)  | S.D. | Cronbach's alpha   |
|--------------------------------------------------------|-----------------|-------------------|------|--------------------|
| <i>Personality variables</i>                           |                 |                   |      |                    |
| Altruism                                               | 8               | 3.58              | 0.51 | 0.713              |
| Anxiety                                                | 8               | 3.01              | 0.60 | 0.744              |
| Normlessness                                           | 4               | 2.80              | 0.62 | 0.714              |
| Sensation-seeking                                      | 8               | 3.56              | 0.61 | 0.701              |
| Aggression                                             | 8               | 2.88              | 0.49 | 0.625              |
| <i>Attitude scales</i>                                 |                 |                   |      |                    |
| Traffic flow vs. rule obedience                        | 9               | 2.93              | 0.65 | 0.871              |
| Speeding                                               | 5               | 2.93              | 0.83 | 0.842              |
| Funriding                                              | 3               | 3.38              | 0.90 | 0.830              |
| <i>Risk perception</i>                                 |                 |                   |      |                    |
| "Probability of being involved in a traffic accident"  | 2               | 4.49 <sup>a</sup> | 1.52 | 0.298 <sup>b</sup> |
| "Worry and concern for yourself being hurt in traffic" |                 | 4.76 <sup>a</sup> | 1.72 |                    |
| <i>Risk-taking behaviour scales</i>                    |                 |                   |      |                    |
| Self-assertiveness                                     | 5               | 1.70              | 0.77 | 0.906              |
| Speeding                                               | 6               | 2.64              | 0.79 | 0.862              |
| Rule violations                                        | 4               | 1.80              | 0.69 | 0.731              |

<sup>a</sup> Range 1–7.

<sup>b</sup> The correlation coefficient between the two risk perception items.

Table 2

Correlations between personality traits, risk perception, attitude towards traffic safety and self-reported risk behaviour.  $n = 1881$

|                                                  | 1       | 2       | 3       | 4       | 5       | 6       | 7       |
|--------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|
| 1. Altruism                                      |         |         |         |         |         |         |         |
| 2. Anxiety                                       | 0.11**  |         |         |         |         |         |         |
| 3. Normlessness                                  | -0.22** | -0.27** |         |         |         |         |         |
| 4. Sensation-seeking                             | 0.01    | -0.29** | 0.30**  |         |         |         |         |
| 5. Aggressiveness                                | -0.30** | 0.25**  | 0.16**  | 0.10**  |         |         |         |
| 6. Risk perception <sup>a</sup>                  | 0.20**  | 0.38**  | -0.20** | -0.12** | 0.06*   |         |         |
| 7. Attitude towards traffic safety <sup>a</sup>  | 0.25**  | 0.30**  | -0.54** | -0.38** | -0.17** | 0.29**  |         |
| 8. Risk-taking behaviour in traffic <sup>a</sup> | -0.31** | -0.25** | 0.47**  | 0.34**  | 0.21**  | -0.22** | -0.79** |

<sup>a</sup> Latent variable score was computed for risk perception, risk-taking attitudes and risk-taking behaviour.

\*  $P < 0.05$ .

\*\*  $P < 0.01$ .

scoring low on this trait. At the same time, they had a negative attitude towards traffic safety, as well as reporting more risky behaviour in traffic.

Both risk perception and attitude towards traffic safety were correlated with reported risk-taking in traffic. In particular, adolescents with a positive attitude towards traffic safety were less likely to report risky driving behaviour, as indicated by the strong negative correlation between the variables ( $r = -0.79$ ). Similarly, young drivers who perceived the risk related to traffic accidents as high, reported that they were less likely to take risk when driving.

A structural equation modelling analysis was performed in order to investigate whether the hypothesised effect of personality upon risk-taking behaviour was mediated through attitudes and risk perception. Fig. 1 shows the tested model, with standardised path coefficients. Only significant paths ( $P < 0.01$ ) are shown in the figure, exempting the nonsignificant path from risk perception to risk-taking behaviour. The latter path was included to illustrate the hypothesised causal relationship between the variables in the model. The fit measures indicated that the proposed model fitted the data well:  $\chi^2$  (42,  $n = 1852$ ) = 442.23, GFI = 0.96, AGFI = 0.93, CFI = 0.95, ECVI = 0.29, RMSEA = 0.067.

The path model explained 68% of the total variance in risk-taking behaviour. Risk-taking attitudes and altruism were the only variables with direct effects on risk-taking behaviour. As indicated by the size of the standardised path coefficient ( $\beta = -0.79$ ), there was a considerable effect of risk-taking attitudes on risk-taking behaviour. Thus, the more positive attitude towards traffic safety the respondents stated, the less risky driving behaviour they reported. The relationship between altruism and behaviour demonstrate that individuals scoring high on altruism reported less risk-taking in traffic as compared to those scoring low on this trait.

Risk perception was not related to risk behaviour in traffic in the path model. This suggests that adolescents' perception of risk does not play an important role in

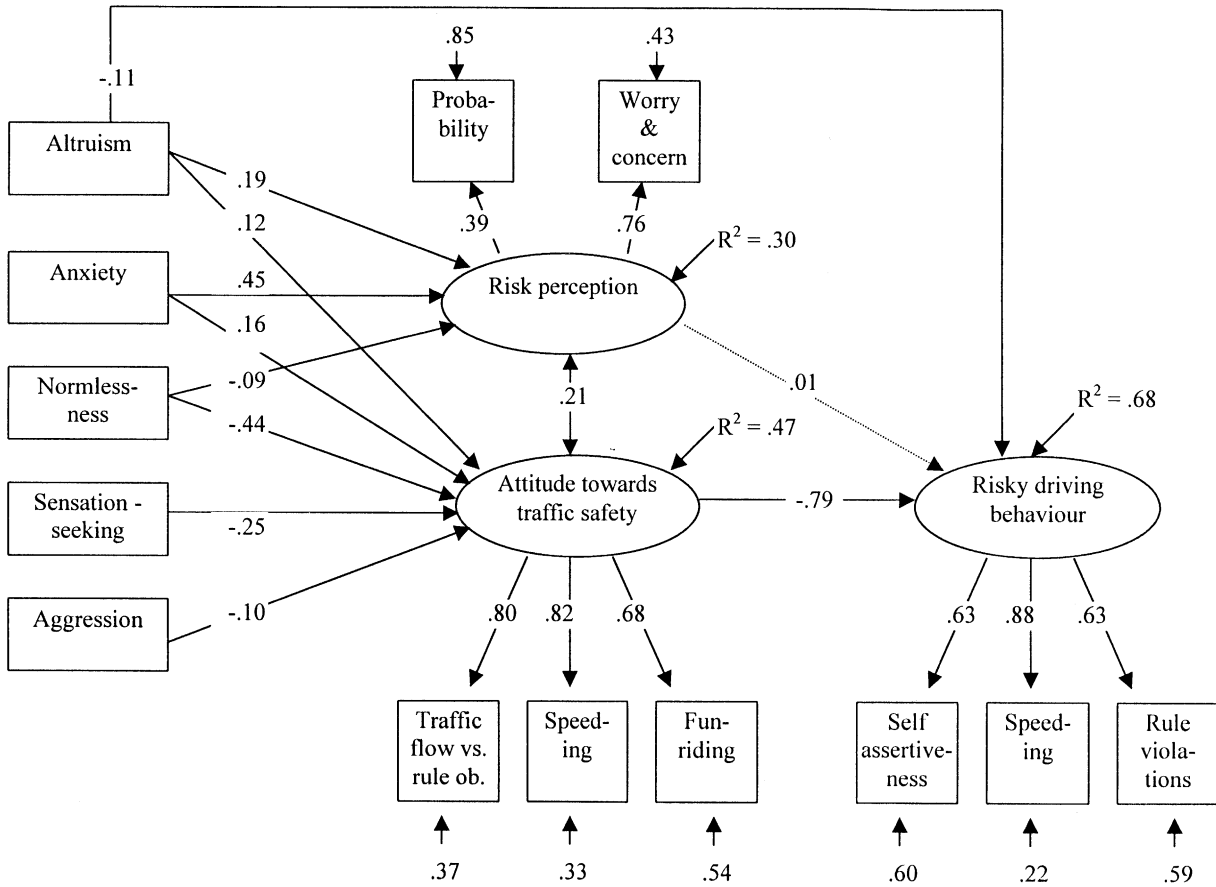


Fig. 1. Path diagram of the relationship between personality traits, attitudes, risk perception and risky behaviour.

traffic risk-taking, at least not when the effects of the other variables in the model are statistically controlled for.

As shown in the path model, a total of 47% of the variance in attitude towards traffic safety were explained by the different personality traits. The lack of direct effects of the personality traits on risk-taking behaviour implies that the effects on risk-taking behaviour were generally mediated through attitudes. That is, the personality traits had indirect effects on behaviour through influencing attitudes. In order to determine the total effects of the personality variables on risky driving behaviour, both direct and indirect effects of the personality variables were computed (Table 3). The total effects demonstrated a similar pattern as found in the correlation analysis in Table 1. High scores on sensation seeking and normlessness were associated with risk-taking in traffic. In contrast, the higher score on altruism the less risk-taking was reported. However, aggression and anxiety demonstrated small total effects on risk-taking behaviour, as shown by the sizes of the standardised total effects.

#### 4. Discussion

The main aim of the present study was to estimate the importance of personality traits and social cognitive variables in relation to risk behaviour in traffic. The results indicate that personality traits primarily have indirect effects on risk-taking behaviour through their influence on attitude towards traffic safety. Hence, the assumption that personality primarily influence behaviour through affecting the behaviour's attitudinal determinants is supported in the present study.

The findings pertaining to the personality traits are consistent with what would be expected on the basis of the descriptions of the traits. High scores on sensation seeking, normlessness and aggression were associated with both risk-taking attitudes (i.e. negative attitudes towards traffic safety), and risky driving behaviour. A plausible explanation for this is that sensation-seekers are expected to seek excitement and stimulation in traffic, which is reflected in risky driving behaviour. When it comes to normlessness, individuals scoring high on this trait are assumed to have low barriers towards socially unapproved behaviour. This may mirror itself in traffic situations, where normless individuals can be expected to show low barriers towards rule violation in traffic. Individuals scoring high on aggression are thought to be easily angered and frustrated, which may manifest itself in aggressive behaviour in

Table 3  
Direct, indirect and total effects of the personality traits on risk-taking behaviour in traffic (standardised coefficients)

|                                     | Altruism | Anxiety | Normlessness | Sensation-seeking | Aggression |
|-------------------------------------|----------|---------|--------------|-------------------|------------|
| Direct effect                       | −0.11    | −       | −            | −                 | −          |
| Indirect effect (through attitudes) | −0.09    | −0.13   | 0.33         | 0.19              | 0.08       |
| Total effect                        | −0.20    | −0.13   | 0.33         | 0.19              | 0.08       |

traffic, such as driving fast, tailgating, etc. (e.g. Deffenbacher et al., 1994). In contrast, adolescents scoring high on altruism, as well as on trait anxiety, were more likely to have a positive attitude towards traffic safety and were less likely to report risk-taking in traffic. A possible explanation is that individuals scoring high on altruism are expected to show active concern for others. Related to driving, this may cause more concern for others in traffic and thus reflect itself in less risky driving behaviour among the individuals scoring high on this trait. The link between trait anxiety and behaviour in traffic may be due to the fact that anxious individuals are characterised by the tendency to be fearful and nervous. Pertaining to traffic situations, this may cause an anxious driver to be more aware of the risk of accident involvement, hence being more careful and defensive when driving.

Furthermore, the suggested indirect effect of the personality traits presupposes a causal relationship, where the personality traits are thought of as exogenous variables influencing attitudes, which in turn affect behaviour. The present study relies on cross-sectional data, and the causal relationship between the variables is consequently difficult to determine. Although we believe that causality never can be proven, especially in cross-sectional studies, the theoretical basis for treating the personality traits as exogenous variables seems reasonable. Personality traits have been found to be relatively stable across time, and there is also evidence for them having a biological basis (Loehlin, 1992). Nevertheless, other factors such as social learning are naturally also believed to influence such traits (Bandura, 1977). But in sum, there is reason to believe that traits are more basic and fundamental in nature compared to attitudes.

Attitude towards traffic safety was the only variable with a direct effect on risky driving behaviour in the path model. The attitude measure seemed to function as a mediating variable in the relation between personality traits and behaviour. However, the personality variables accounted for 47% of the total variance in the attitude measure, suggesting that the attitude measure also had an independent effect on risk-taking behaviour. In other words, risk-taking attitudes can be said to predict additional variance in behaviour.

It is, on the other hand, problematic to claim that attitudes *predict* behaviour, because risk-taking behaviour was measured at the same time as the attitudes were measured. An alternative interpretation is that attitudes may corresponded to behaviour because people wish to justify their previous actions, not vice versa (Heider, 1958). Still, empirical evidence for the predictive value of attitudes in relation to behaviour have been found in a wide range of studies, in which attitudes and behaviour are measured on separate occasions (Kraus, 1995 for a meta-analysis). Furthermore, it is reasonable to believe that self-reported driving behaviour reflects a stable behavioural pattern, and thus makes a reliable indicator of future driving behaviour. For instance, a longitudinal study of young drivers in Finland conducted by Hattaka et al. (1997) found that self-reports of driving violations were correlated with future accident involvement, as well as future police registered traffic violations. On this basis, one may expect attitudes to be correlated with future behaviour. This does not, however, solve the causal dilemma of what comes first, attitude or behaviour.

Another methodological problem is the unknown validity of self-report measures in relation to actual behaviour in traffic. Behaviours like violating traffic rules and

engaging in risk-taking behaviour represent sensitive information about the individual, and the respondents may choose not to report such behaviours in order to present themselves in a socially desirable way. On the other hand, West et al. (1993) have found that observers' ratings of a driver's behaviour are correlated with the driver's self-reported behaviour. The use of self-reports has also several advantages compared to the alternatives of studying driving behaviour through direct observations or simulation of the driving task. First, both the alternative methods have the disadvantage of placing the individual under observation, which may cause the driver to act more disciplined compared to normal driving behaviour. Second, these methods are both expensive and time consuming. And finally, self-reports represent summary judgements of information in a variety of situations, and may therefore be the most suited measure according to the multiple-act criterion (Epstein, 1977).

Risk perception demonstrated a non-significant association with risk behaviour, suggesting that risk perception is a weak predictor of adolescent risk behaviour. Similar results have been found in studies by Rundmo (1999) and Rundmo and Ulleberg (2000b), who found that risk perception does not affect behaviour when other factors (e.g. attitudes) are controlled for. However, in the study, there were only two items measuring risk perception, subjective probability, and worry and concern. These were moderately correlated with each other, causing low reliability in the risk perception measure. Thus, one may question both the reliability and the validity of this measure. Ideally a more comprehensive measures should have been applied. It should also be mentioned that there exist other methods of measuring risk perception. According to Sjöberg (1998), perceived consequences of a negative event should also be applied as a measure of risk perception. An alternative assessment of risk perception could thus have given a better estimate of the influence of perceived risk on risky driving behaviour. There is, however, reason to question the hypothesised causal relationship between risk perception and behaviour in general. For instance, Horvarth and Zuckerman (1993) have suggested that risk perception is a consequence of behaviour, rather than being the cause of it.

A practical implication of the results would be to acknowledge the importance of personality traits in traffic safety campaigns. Of course, we do not mean that interventions should try to change the personality of young drivers, efforts that surely would be a waste of time and resources. A more meaningful intervention would be to target young drivers' risk-taking attitudes, which were strongly related to risky driving behaviour. However, one implication of the findings could be to tailor the message of attitude campaigns according to certain personality characteristics, in order to be more appealing to high-risk drivers. For instance, Palmgren, Puggles-Lorch, Donohew et al. (cited in Green et al., 2000), have found that messages with a high sensation value, meaning ability to elicit sensory, affective and arousal responses, are more appealing and efficient for high sensation-seekers. Thus, one practical implication could be to apply messages of high sensation value in traffic safety campaigns, in order to promote safety attitudes and safe driving among sensation seeking adolescents.

The strategy of traffic safety campaigns has traditionally been to get authorities of different kinds to tell young drivers to drive safe. However, individuals scoring high on normlessness are assumed to have low respect for law and authorities. Their authority defeating characteristics make them a hard to reach group, and consequently very resistant to change in both attitudes and behaviour. An alternative to the traditional authority-based strategy is to let young drivers themselves find out the need for attitudinal and behavioural change. That is, to let them draw their own conclusions about how they can change. This strategy has been successfully used in health education of students (Arborelius and Bremberg, 1988), as well as in safety programs for professional drivers (Gregersen et al., 1996). In the latter study, a group following this strategy reduced their accidents by 50% compare to a control group. To our knowledge, the strategy of self-produced, individual decisions has not yet been applied in traffic safety work among young drivers. Still, it represents an interesting alternative, especially for the adolescents with the most authority defeating characteristics.

As mentioned, aggression was indirectly linked to risky driving behaviour. This may indicate that emotional factors and probably lack of control over these are related to risky driving style. For instance, becoming frustrated and angry in traffic situations can easily trigger responses such as speeding and rule violations. To inform drivers with high aggression about the risk of accidents or to tell them to change their attitudes and behaviour is probably not a suitable intervention for such drivers. A more relevant intervention may in this case be to focus on how to deal with emotional responses in traffic. For instance, to focus on situations that can trigger reactions such as self-assertion when driving with others, and impatience and frustration in traffic. Deffenbacher et al. (2000) have recently carried out physical and cognitive relaxation interventions in order to reduce driving anger among high-anger drivers. The results showed significant reduction in driving anger and risky driving behaviour among these drivers, whereas a control group showed no reduction.

To sum up, the results of the present study demonstrate the importance of examining indirect effects of personality in relation to risk-taking attitudes and behaviour. In short, those who possessed certain personality characteristics had the least ideal attitudes towards traffic safety and tended to drive risky. However, since one cannot expect to change a driver's personality, one may ask what implications for safety research the results have. The conclusion is that the results indeed may have valuable implications. Our suggestion is to apply different strategies in road safety promotion, and that these should be tailored to certain personality characteristics of young drivers.

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**Appendix A. Mean and standard deviation of the items measuring Normlessness, attitudes towards traffic safety, and risk behaviour ( $n = 1881$ )**

|                                                                                              | Mean | S.D. |
|----------------------------------------------------------------------------------------------|------|------|
| <i>Normlessness<sup>a</sup></i>                                                              |      |      |
| It is all right to do anything you want as long as you keep out of trouble                   | 2.97 | 1.0  |
| It is OK to get round laws and rules as long as you don't break them directly                | 3.07 | 0.95 |
| If something works, it is less important whether it is right or wrong                        | 2.73 | 0.88 |
| Some things can be wrong to do even though it is legal to do it*                             | 2.43 | 0.86 |
| <i>Attitude scale 1: Traffic flow vs. rule obedience<sup>b</sup></i>                         |      |      |
| There are many traffic rules which can not be obeyed in order to keep up the traffic flow    | 3.13 | 0.94 |
| Sometimes it is necessary to bend the rules to keep traffic going                            | 2.94 | 0.96 |
| It is more important to keep up the traffic flow rather than always follow the traffic rules | 2.93 | 0.94 |
| It is better to drive smooth than always follow the traffic rules                            | 3.07 | 0.96 |
| Sometimes it is necessary to break the traffic rules in order to get ahead                   | 2.83 | 1.04 |
| Sometimes it is necessary to ignore violations of traffic rules                              | 2.75 | 0.89 |
| Sometimes it is necessary to take chances in the traffic                                     | 3.13 | 0.94 |
| Sometimes it is necessary to bend the traffic rules to arrive in time                        | 2.88 | 0.99 |
| A person who take chances and violate some traffic rules is not necessary a less safe driver | 2.76 | 0.99 |
| <i>Attitude scale 2: Speeding<sup>b</sup></i>                                                |      |      |
| If you have good skills, speeding is OK                                                      | 3.27 | 0.98 |
| I think it is OK to speed if the traffic conditions allow you to do so                       | 3.43 | 1.06 |
| Driving 5 or 10 miles above the speed limit is OK because everyone does it                   | 2.80 | 1.03 |

|                                                                                                                              |      |      |
|------------------------------------------------------------------------------------------------------------------------------|------|------|
| If you are a safe driver, it is acceptable to exceed the speed limit by 10 km/h in areas permitted to drive in 80 to 90 km/h | 2.57 | 1.09 |
| It is acceptable to drive in 100 km/h on a straight road if there are no other vehicles in a miles distance                  | 2.5  | 1.11 |

*Attitude scale 3: Funriding<sup>b</sup>*

|                                                                  |      |      |
|------------------------------------------------------------------|------|------|
| Adolescents have a need for fun and excitement in traffic        | 3.22 | 1.06 |
| Speeding and excitement belong together when you are driving     | 3.63 | 1.01 |
| Driving is more than transportation, it is also speeding and fun | 3.27 | 1.0  |

*Risk behaviour scale 1: Self-assertiveness<sup>c</sup>*

|                                                    |      |      |
|----------------------------------------------------|------|------|
| Drive recklessly because others expect me to do it | 1.76 | 0.95 |
| Drive fast to show others that I am tough enough   | 1.68 | 0.93 |
| Drive fast to show others I can handle the car     | 1.84 | 0.97 |
| Break traffic rules due to peer pressure           | 1.67 | 0.88 |
| Drive fast because the opposite sex enjoys it      | 1.6  | 0.89 |

*Risk behaviour scale 2: Speeding<sup>c</sup>*

|                                                                 |      |      |
|-----------------------------------------------------------------|------|------|
| Exceed the speed limit in build-up areas (more than 10 km/h)    | 2.79 | 1.14 |
| Exceed the speed limit on country roads (more than 10 km/h)     | 3.24 | 1.11 |
| Overtake the car in front when it is driving at the speed limit | 2.37 | 1.10 |
| Drive too close to the car in front                             | 2.56 | 0.93 |
| Bend the traffic rules in order to get ahead in traffic         | 2.65 | 0.96 |
| Ignore traffic rules to in order to get ahead in traffic        | 2.24 | 0.96 |

*Risk behaviour scale 3: Rule violations<sup>c</sup>*

|                                                      |      |      |
|------------------------------------------------------|------|------|
| Drive on a yellow light when it is about to turn red | 2.49 | 1.12 |
| Disregard red light on an empty road                 | 1.45 | 0.88 |
| Drive the wrong way down a one-way street            | 1.52 | 0.85 |

|                                                                |      |      |
|----------------------------------------------------------------|------|------|
| Break traffic rules because they are too complicated to follow | 1.78 | 0.92 |
|----------------------------------------------------------------|------|------|

\* Recoded.

<sup>a</sup> All items measured on five point Likert scales ranging from 1 “strongly disagree” to 5 “strongly agree”.

<sup>b</sup> All items answered on five point Likert scales ranging from 1 “strongly agree” to 5 “strongly disagree”.

<sup>c</sup> All items measures on five point scale ranging from 1: “never” to 5 “very often”.

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