

## The Role of Personality in Predicting the Effect of a Road-Safety Education Program on the Decrease of Reported Violations

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### Abstract

This paper examines the roles of a road safety intervention and three personality traits in predicting drivers' self-reported aberrant behaviours. Ninety-nine individuals recruited during their driver licence attendance are randomized in the experimental or control group. The intervention aimed at modifies knowledge, attitudes and behaviours. Six months later participants received the Manchester Driver Behaviour Questionnaire (DBQ) designed to assess the differentiation between deliberate deviations from safe driving practices and mistakes due to misjudgements or lapses in attention. Compared with control group, participants in the intervention group reported significantly higher scores in learning questionnaire. Statistical analysis on DBQ data showed participants in the experimental condition reporting significantly lower errors and violations compared to controls. No personality trait predicted risky driving and no interactive effect emerged in measures of self-reported driving violations. Practical implications of the study are development of relevant instruments to establish effective components of educational program in order to perform a road safety education.

**Keywords:** Road crash; Driver behaviour; Temperamental dimensions; Road safety programs.



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### 1. Introduction

According to the [World Health Organization \(2009\)](#) almost 1.3 million people were killed totally and 50 million people were injured per year due to road accidents. The most recent data of the International Traffic Safety Data and Analysis ([ITF, 2017](#)) suggest that the past trend of continued reduction in the number of road fatalities may have stalled. The number of road deaths is on the rise again even in some countries with impressive road safety improvements. This development deserves careful investigation to establish whether what is being observed in 2015 and 2016 is the start of a negative trend for road safety. Without appropriate action, by 2020, road injuries are expected to become the third leading contributor to the global burden of injuries.

Road crashes can be caused by different variables. Primary factors in the accident occurrence comprise human, vehicle, road and environment factors. Among these, human factor has a prominent role and, directly or indirectly, can be a cause of undesirable driving behaviour. Human factor refer to cognitive factors (inattention or lapses in memory) behavioural style (inclination to drive in a risky way or to commit violations) along with demographic aspects (age or gender ([Özkan and Lajunen, 2006](#))). The human factors have been investigated in several studies ([Aarts and Van Schagen, 2006](#); [Arnett, 1996](#); [Dobson et al., 1999](#); [Klauer et al., 2013](#); [Lawton et al., 1997](#); [Meadows et al., 1998](#); [Pino et al., 2014](#); [West and Hall, 1998](#)). They have indicated that accident risk relies on driver's capability (license status, term of driving, accident involvement), driver's socio-demographic attributes (gender, age, marital status, income, and educational level), and driving behaviour (number of traffic accidents in the last years, physical condition, abuse of alcohol or drugs, driving beyond speed limit, and use of cell phone). Several investigations carried out in different countries have evaluated what can predict drivers' risky behaviours and crash involvement ([Azadeh et al., 2015](#); [Cordazzo et al., 2014](#)). It was showed ([De Winter and Dodou, 2010](#)) that violations predicted accidents, errors and violations correlated negatively with age and positively with exposure, and that males reported a smaller number of errors and more violations than females.

Personality represents another factor recognized as important to predicting crash occurrence and risky driving behaviour. Personality is a relatively stable but significant cause not easily modified by road safety interventions ([Lucidi et al., 2014](#); [Zuckerman et al., 1978](#)). Many studies have highlighted the influence of personality characteristics on risky driving and road safety producing mixed findings ([Constantinou et al., 2011](#); [Schwebel et al., 2006](#); [Stradling et al., 2005](#)). Several investigations have evaluated risk for traffic crash on the basis of a mixture of different personality dimensions ([Constantinou et al., 2011](#); [Fikri et al., 2015](#); [Lucidi et al., 2014](#); [Schwebel et al., 2006](#); [Stradling et al., 2005](#); [Zuckerman et al., 1978](#)) or focusing the effect of single personality dimensions upon risky driving ([Özkan and Lajunen, 2005](#)). Factors that have emerged as predictors of accident involvement

enclose age, driver's experience, propensity towards risk taking, decision making and capability to detect hazards quickly (Af Wählberg and Dorn, 2012; Klauer *et al.*, 2013; Pourmirzakahori *et al.*, 2016).

The "biosocial" theory of personality (Af Wählberg and Dorn, 2012; Cloninger, 1987) was frequently used with the Tridimensional Personality Questionnaire (TPQ) measuring three traits highly heritable and stable across the development. The *Novelty Seeking*, based on a proposed dopaminergically grounded behavioural activation system, stimulates interest in new experiences. The *Harm Avoidance* reflects brain serotonin activity, the supposed punishment system, resulting in sensitivity to threatening conditions. Finally, the *Reward Dependence* brings the sensitivity to reinforcement contingencies with norepinephrine as the major neuromodulator (Panksepp and Davis, 2011). This model was later extended by adding to the instrument an additional temperament dimension (Persistence) and three controversial "character" traits (Self-Directedness, Cooperativeness, and Self-Transcendence), that was named the Temperament and Character Inventory (TCI) (Cloninger, 1999; 2004; Farmer and Goldberg, 2008). Mallia and colleagues (Mallia *et al.*, 2015) indicated that personality traits would relate to aberrant driving behaviours (lapses, violations and errors) directly and indirectly through the effects of attitudes towards road safety (Jonah, 1997).

For the development of preventive efforts, understanding the psychological mechanisms underlying drivers' behaviour is a main challenge. According to Reason (Reason *et al.*, 1990), a satisfactory framework for unsafe driver behaviours requires a distinction between *errors* and *violations*. There are two categories of errors: actions may unintentionally diverge from the original intention (*slips* and *lapses*) or planned actions may deviate from some path toward an anticipated goal (*mistakes*). On the other hand, violations (like speeding or driving against a red light) are deliberate infringements from those rules believed compulsory to maintain the safe operation of a hazardous system. Errors involve cognitive failures whereas violations have psychosocial and motivational roots and, consequently, can be understood only within a social context (Pourmirzakahori *et al.*, 2016). Finally, these two behaviour classes have different psychological roots and, consequently, require different remediation methods; errors can be reduced through a better information, whereas changing driving violations requires managing of beliefs, attitudes and norms underpinning those behaviours (De Winter *et al.*, 2015; Mallia *et al.*, 2015; Meadows *et al.*, 1998; Reason *et al.*, 1990).

To decrease road crashes officials and researchers refer to the "Three E's approach". *Education* targets the road user with the aim to change attitudes and behaviour of people through several forms of communication, *Enforcement* refers to legal actions, and *Engineering* encompasses measures to expand transport infrastructure. To achieve greatest effect, the Three E's should be used in combination. The present study is designed to experimentally investigate the effects of a road safety program aimed to increase knowledge, attitudes and beliefs of aspiring drivers with a hypothesized impact on drivers' self-reported aberrant behaviours (Af Wählberg *et al.*, 2015; Parker *et al.*, 1995). A previous investigation on factors affecting road accidents in the north of Italy carried out considering severity and crash circumstances have highlight that about half of road crashes was directly attributed to violations whereas high-speed, alcohol and substance use affected only a slight portion of cases (Pino *et al.*, 2014). The aforementioned study also demonstrate a positive relationship between gender, age and hourly/daily accidents' distribution: men resulted much frequently responsible than women. On Saturday and Sunday, the crash prevalence was higher during the late night hours and the youngest age class (26-25 years) was involved in a greater number of accidents particularly on 0-3 time of day class. Another qualitative study also found evidence to suggest that a level of control was linked to perception of risk (Parker *et al.*, 1996).

To maximize the potential efficacy of interventions, those who design interventions should have an understanding of theory or the hypothesized mechanisms underlying behaviour change. Behavioural theory is widely acknowledged critical for the improvement of interventions. Since insight programs focus on attitudinal-motivational skills, evaluations of such program are often done with the help of social psychological theories. Nevertheless, just few investigations had dealt with the effects on the supposed crash antecedents such as knowledge, attitudes and perceptions, which reliably predict unsafe driving behaviour and crash involvement (Forward, 2009; Hatfield and Fernandes, 2009; Parker *et al.*, 1996). The theory of planned behaviour (TPB) represents a valuable conceptual framework in so far that it establishes the link between motivational constructs and unsafe driving style representing a good theoretical model for changing behaviour (Ajzen, 1991; Delhomme *et al.*, 2009; Parker *et al.*, 1996).

The first aim of the present study was to evaluate the effect of a road safety educational program taking place during the driver' license training, on knowledge and subsequent drivers' self-reported aberrant behaviours (Glendon *et al.*, 2014). Our first hypothesis was that participants assigned to the treatment condition would display significant reductions in DBQ subscales due to the modifications occurred in their knowledge, attitudes toward risk awareness and safety following intervention rather than controls. During intervention, implications of the task-capability interface (TCI) model describing the dynamic interaction between the determinants of task demand and driver capability are discussed respect to variation in performance, resource allocation, hierarchical decision-making and the interdependence of demand and capability (Parker *et al.*, 1992). It was also hypothesized a significant Group x Time interaction. Finally, we hypothesized a positive relationship between temperamental traits of sensation seeking, and reward dependence and DBQ scores.

## 2. Method

All outcomes were collected at the baseline (T1), immediately following intervention (T2), and 6 months later to evaluate effects on drivers' self-reported aberrant behaviours (T3). Phase I lasted for approximately 15 minutes and consisted in the administration of a questionnaire in which the first section collected information about the demographics, such age, gender, and education level. The second section of the questionnaire contained the TCI-R

facets. At T1 and T2, participants received a second questionnaire specifically developed to measure the effect of training exposition on their knowledge base. Participants responded to every questionnaire's statements in a multiple choice response format. At T3 (6-months later the intervention program) in order to explore the impact of the safe-road intervention on drivers' self-reported aberrant behaviors, subjects received the Driver Behaviour Questionnaire.

## 2.1. Participants

The driving school users represent the target group of the present study. Potentially eligible participants were provided of research information obtaining written consent. A number of 90 individuals (males = 39) who had a mean age of 22 years (between the ages of 17 and 61 years) was recruited. Demographic information such as gender, age, education level, and socioeconomic status was obtained from the baseline questionnaire. Participants were allocated into the groups before participation basing on the recruitment order.

## 2.2. Experimental Design

For the study we have used quasi-experimental design with intervention (EG) and control group (CG), measuring before the intervention (T1), immediately after (T2), and with follow-up 6-months after the program (T3). The study used 2 x 2 repeated measures within subjects design.

## 2.3. Measures

Data were collected using two questionnaires. The first questionnaire was a researcher-made one used for collecting the demographic data of the participants. The data included age, gender, work experience, level of education. It incorporated as personality measures three temperament characteristics assessed using the Italian version of the Temperament and Character Inventory-Revised (TCI-R) (Fossati *et al.*, 2007). The TCI-R items are listed in random order and grouped into facets. Approximately half of the items are reverse scored. The Temperament facets were Novelty Seeking (NS): Exploratory excitability (NS1), Impulsiveness (NS2), Extravagance (NS3) and Disorderliness (NS4); Harm Avoidance (HA): Anticipatory worry (HA1), Fear of uncertainty (HA2), Shyness with strangers (HA3) and Fatigability (HA4); Reward Dependence (RD): Sentimentality (RD1), Openness to warm (RD2), Attachment (RD3) and Dependence (RD4). Driving related measure was the Driver Behaviour Questionnaire (DBQ) (De Winter *et al.*, 2015; Lajunen *et al.*, 2004), that has become one of the most widely used scales to examine self-reported driving behaviours (Wahlberg *et al.*, 2011). We used the 28-item Italian version of the scale with a three-factor structure which consists of eight errors and eight lapses, along with the extended violations scale (eight highway violations and four aggressive violations) and used in several studies in different countries (Özkan and Lajunen, 2005). A confirmatory factor analysis carried out on a sample of 508 young Italian drivers indicated that the three-factor model originally proposed (Reason *et al.*, 1990) fit the Italian data well (Mallia *et al.*, 2015). Respondents were required to indicate, on a six-point scale from zero = never to five = nearly all the time, how often they committed specific driving violations (12 items), errors (8 items) and lapses (8 items).

## 2.4. Intervention Program and Procedure

The constructs key targeted in the intervention were driving under influence of alcohol (DUI) or drug. For designing a Road Safety Education (RSE) program, we have tried to include all factors important to achieve the effective learning process addressing the promotion of knowledge and understanding of traffic situations, and strengthening and/or changing attitudes toward risk awareness and safety of road users (Assailly, 2017). We have developed the educational program for aspiring drivers taking into account theory-based evidence and recommendations from literature. Program lasted about 180 minutes, and was implemented by the first and the second authors. We integrated different approaches from giving knowledge and information about drink-driving abuse and traffic safety (informative approach), giving biological, cognitive, motivational features of crash, and their consequences (emotional approach) in a group format (15 participants) leading discussion towards safer driver behaviour (coping strategies or alternatives). We added a 15 min testimonial in which a family's member speaks of the dead of his/her 19 boys in a car crash. This emotionally moving contribution might serve to elicit self-reflection on one's own commitment to adopt safety rules. Control group participants were similarly grouped in the driving school class for the same period and invited to watch a neutral video.

## 3. Results

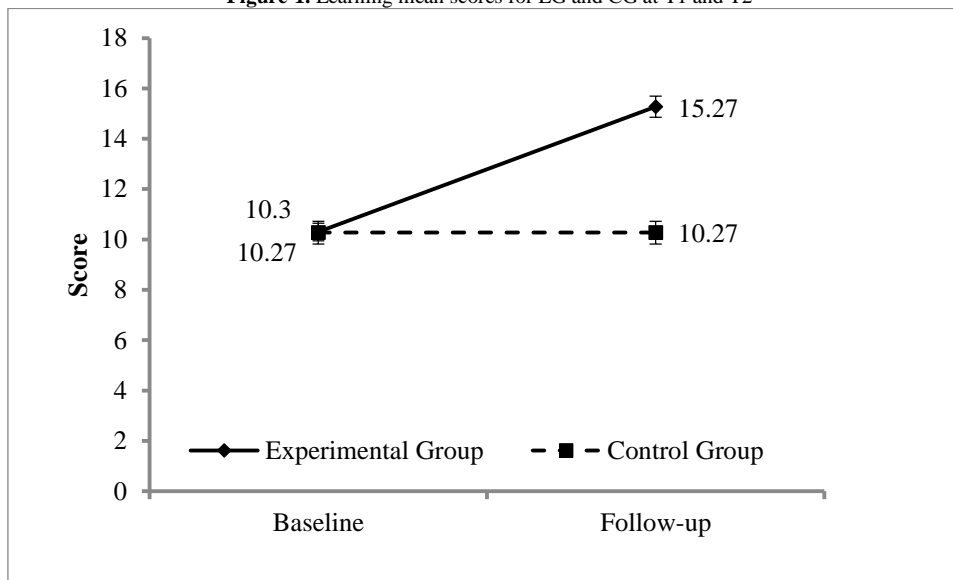
Descriptive statistics, including means for continuous variables and proportions for categorical variables, were used to summarize participant characteristics. The groups resulted statistically similar on gender distribution and mean age. The first aim of this study was to evaluate the effect of a road safety program on knowledge, attitude and reported driver's behaviour. In order to evaluate the effects of intervention and temperament a variance analysis was performed. The association between intervention exposition and errors and violations was tested with the aid of Pearson's correlation coefficient. Those variables considered to be significant were then included in the next stage. So in addition to assessing the relationship between temperament and driver's style a regression model was implemented.

In Figure 1 learning mean scores for the two groups at the two assessment points are depicted. Figure 2 reports means of occurrence for the three behavioural categories (violations, slips and errors, respectively) for the two groups at the follow-up evaluation. In Table 1 Pearson's correlations between TCI, temperamental dimensions and

behavioural categories are showed. In Table 2 Pearson’s correlations between temperamental dimensions (Novelty Seeking, Harm Avoidance and Reward Dependence, respectively), and aggressive violations are reported.

Both experimental and control subjects displayed the same pattern for violations, slip and errors but for the experimental groups all the measures were significantly lower. The analysis of variance encompassing a 2 (group) x 2 (time) design on learning scores showed a significant effect for group, [F (1, 88) = 32.59, p<.001] suggesting that the two groups produced different learning levels. In addition, the effect of times and the interaction between groups and times were significant [F (1, 88) = 128.77, p<.001]. Although the scores on questionnaire (see Figure 1) were very similar at the baseline (mean=10.3 and mean=10.27, for EG e CG, respectively), the performances diverged across the two phases (EG mean=15.27 and CG mean=10.27), indicating that the experimental participants performance increased following intervention, whereas that of the control subjects persisted unchanged respect to the baseline.

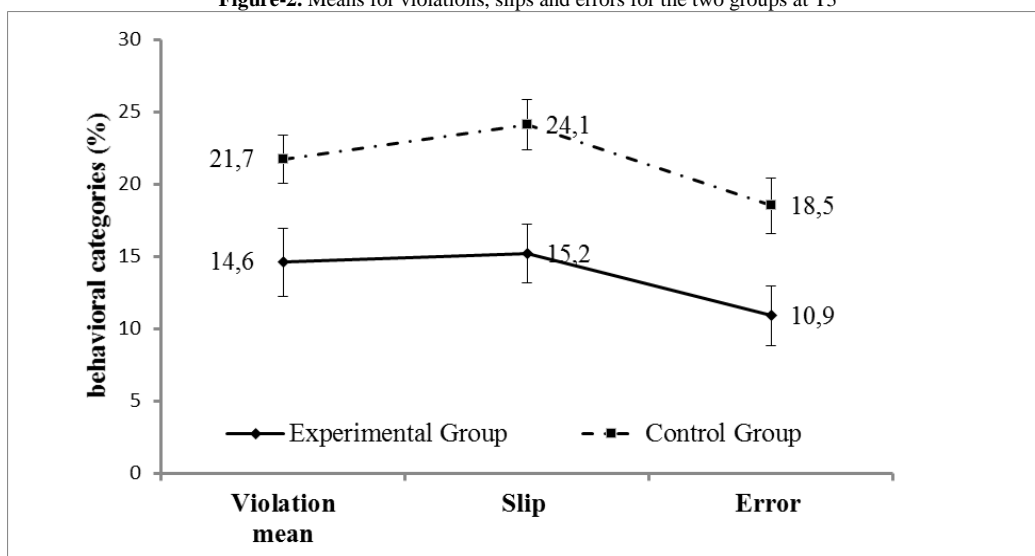
Figure-1. Learning mean scores for EG and CG at T1 and T2



The statistical analysis (ANOVA) performed on the 3 (behavioural category) x 2 (group) mixed repeated measures design suggested a significant effect for “group” [F (1, 61) = 10.30, p<.01], signifying that experimental participants showed a lower level in DBQ scores respect to controls. In addition, the ANOVA shows a significant effect for “DBQ categories” [F (2, 122) = 9.74, p<.001] indicating that, independently from the group, the three DBQ categories scores were not similar. Finally, the interaction between “Group” and “DBQ categories” did not reach the significance. Bonferroni’s post-hoc comparisons confirmed that all subjects referred to commit more errors rather than violations (means difference = .03, SE= .01; p.003) and slips (means difference = .05, SE= .01; p.000), whereas slips and violations showed a similar pattern of occurrence (means difference = -.15, SE= .013; p.735).

It is possible to conclude that the experimental intervention is effective in modifying not only the violations in the driver’s style (both intentional and unintentional) but also slips and errors.

Figure-2. Means for violations, slips and errors for the two groups at T3



With the TCI-R scores one-way between groups variance analysis was applied. Levene’s test confirmed the variances’ homogeneity (for Novelty Seeking F (1, 65) = .529, p <.05; for Harm Avoidance F (1, 65) = 1.038, p



>.05; Reward Dependence  $F(1, 65) = .633, p >.05$ ). The effect of the group did not reach the significance; so, all subjects showed an identical temperamental profile. Considering the total sample we failed to find any significant linear correlation between the three temperamental facets and violation, slips and errors.

**Table-1.** Pearson's correlations between DBQ categories with TCI-R personality facets for both groups

		Violations	Slips	Errors
EG	NS	.083. n.s.	.054. n.s.	.000. n.s.
	HA	.223. n.s.	.131. n.s.	-.090. n.s.
	RD	-.145. n.s.	.040. n.s.	-.043. n.s.
CG	NS	-.171. n.s.	-.005. n.s.	-.318. n.s.
	HA	.052. n.s.	-.127. n.s.	.218. n.s.
	RD	.081. n.s.	.086. n.s.	-.027. n.s.

NS = Novelty Seeking

HA = Harm Avoidance

RD = Reward Dependence

The same pattern emerged considering independently the two groups. Entering the variable "group" (as a dummy dichotomous variable) and the three temperament facets into a multiple regression equation did not confirm the predictability for the TCI-R neither in the relationship with the "group" factor for none of the DBQ variables.

Because of the second goal of our study was to explore the relationships between temperamental trait and aggressive violations, in the following analysis only those are used. The one-way variance analysis between groups showed that Levene's test reach statistical significance, so the application of the Mann-Whitney test for independent groups indicated that difference between groups was not significant. Considering the sample as a whole, the scores for three temperamental facets did not show any correlation with the aggressive violations. In addition, the same pattern of lack of significant correlations was revealed considering the two groups independently. Finally, adding the "group" as dichotomous dummy variable and the three temperamental facets within a multiple regression equation, it was not confirmed the predictability for the TCI-R neither in the relationship with the "group" variable.

**Table-2.** Pearson's correlations between temperamental dimensions and aggressive violations for both groups

		NS	HA	RD
<b>Experimental Group</b>	<b>Aggressive violations</b>	.008, n.s.	-.025, n.s.	-.209, n.s.
<b>Control Group</b>	<b>Aggressive violations</b>	-.212, n.s.	.111, n.s.	-.006, n.s.

## 4. Discussion and Conclusions

The present study suggests that road-safety education programs should focus on the target groups' beliefs, norms and the perception of control. At the follow-up, we noted a significant reduction on reported driver's behaviour for participants who received the intervention, not only for violations but also for slips and errors. Previous research has showed that programs tailored to the specific population are more successful than others are. We found that learning scores indicated a strong positive increase following road-safety program for participants at the experimental group. The second goal of this study was to examine the relationships between measures of driver's behaviour, particularly aggressive violations, as assessed by the DBQ and temperamental dimensions. Unfortunately, our data were unable to demonstrate, as anticipated, a positive relationship between the personality dimensions of Harm avoidance (HA) and Sensation seeking (SS), and DBQ scores. Overall, our research demonstrated a positive relationship of the reported behaviour on DBQ within the road-safety education program indicating its effectiveness. Therefore, results from the present investigation can serve as a framework for the development of road-safety education programs to be held in the driving school.

## 5. Ethics Statement

The study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki, its later amendments, and APA ethical principles regarding research with human participants and/or care and use of animals. Given that the experiment did not involve clinical tests, use of pharmaceuticals or medical equipment, did not involve the use of deception or involve participant discomfort in any other way, approval of Ethics Committee for Clinical Research of the University of Parma was deemed unnecessary. Informed consent was obtained from all individual participants included in the study. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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