

## **The recent dramatic decline in road mortality in France: How drivers' attitudes towards road traffic safety changed between 2001 and 2004 in the GAZEL cohort.**

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## Abstract

A very significant decline in the number of road casualties has been observed recently in France, concomitantly with a dramatic increase in law enforcement. The aim of this study was (1) to assess changes in attitudes about road traffic accident prevention initiatives in France from 2001-2004, and (2) to identify factors associated with an increase in positive attitudes toward RTA prevention initiatives. In 2001 and 2004, 9216 participants reported their attitudes towards traffic safety using the same self-administered Driving Behaviour and Road Safety Questionnaire. Sociodemographic, psychological and behavioural data were also available. The mean change in scores analysis showed that support for relaxing existing regulations decreased significantly during this period, while support for heightened enforcement and stricter regulations showed some decrease but remained high overall, especially concerning blood alcohol content, and speed controls. Multivariate analyses suggest that highly educated drivers changed their attitudes towards road safety regulations more than other categories. Our results suggest that increased traffic law enforcement measures led to increasing support for current restrictions. Even if support for additional traffic law enforcement began to wane slightly in 2004, a large part of our population remained in favour of strengthening law enforcement related to speeding and drunk driving.

## Introduction

Road traffic accidents (RTAs) are one of the world's largest public health problems, with more than a million deaths annually on the world's roads [1]. In France, RTAs were responsible for roughly 7000 deaths and 100000 severe injuries a year until 2001 [2]. Road safety engineering and vehicle engineering have been constantly improved in most industrialized countries, contributing to the reduction of injuries and fatalities due to road traffic crashes. However, human factors alone (such as risk behaviour, sleepy driving, or driver's error) account for, or contribute to, approximately 90% of RTAs [3-5].

A very significant decline in the number of road casualties has been observed recently in France. While over a long period (between 1975 and 2001) the average annual decrease in the number of deaths remained around 2.3%, an acceleration has since been noted, with reductions of 6.2% in 2002, 20.9% in 2003, and 8.7% in 2004. Between 2001 and 2004, death and injury rates decreased by 32.2% and 29.4%, respectively, which represents an estimated benefit over three years of 3730 saved lives [2, 6]. This success has mainly been attributed to improved road user behaviour in terms of speed, alcohol, and seat belt use, which have been the key focus of French road safety policy since 2002 [7].

Road safety strategy to reduce traffic accidents usually combines road safety engineering, prevention campaigns and law enforcement measures [2]. Increased traffic law enforcement taken by the government might have accounted for part of the trend recently observed in France. Indeed, after years of mixed traffic safety policy, traffic law enforcements were significantly enhanced in 2002, with an increased crackdown on both major violations (drunk driving, speeding) and minor ones (seat belt use, phoning while driving). Speed control efficiency has been dramatically improved, with the widespread use of laser binocular and

automatic speed radars. Over the 2001-2004 period, the number of fines for speeding increased from 1.3 to 3.1 million [7]. At the same time, significant decreases in both speed driving (-13%) and average speed (-5 km/h) were observed by the National Observatory of Road Safety [2, 6]. However, some very restrictive measures, such as lowering the blood alcohol content (BAC) limit from 0.5 g/L to 0.2 g/L, or limitations on vehicle horsepower for young people, have been ruled out by the authorities [2].

Within the social cognition approach, models such as the Theory of Planned Behaviour [8, 9] and the Health Belief Model [10] have frequently been applied to study the determinants of risky driving behaviour [11-14]. 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 toward traffic safety have been found to correlate with aggressive driving behaviour, speeding and self-reported accident involvement [13, 15-20]. Other psychological and motivational factors such as perceived driving ability, sensation seeking and perceived safety skills have also been found to influence driver's behaviour and attitudes [21-24].

Consequently, the changing of attitudes towards traffic safety is considered as effective and long-lasting [25-27]. In the light of recent road safety successes in France, it is therefore of interest to assess how drivers' attitudes toward road safety have changed, which could provide useful insights into what occurred in this remarkable period and help assessment of whether observed behavioural changes are stable.

We conducted a prospective study in a large cohort of French employees and retirees (the GAZEL cohort) in order to 1) Assess changes in attitudes about road traffic prevention initiatives in France from 2001-2004 and 2) identify factors associated with an increase in positive attitude toward road traffic safety.

## **MATERIALS AND METHODS**

### **Participants**

The participants were current employees or recent retirees of the French national electricity and gas company, Electricité De France–Gaz De France (EDF-GDF), who volunteered to participate in a research cohort, known as the GAZEL cohort. The GAZEL cohort was established in 1989 and originally included 20 624 subjects working at EDF-GDF, comprising men aged 40–50 and women aged 35–50 at baseline. Since 1989, this cohort has been followed up by means of yearly self-administered questionnaires and by data collection from the company’s human resources and medical departments. The objectives and methods of the cohort have been described in detail elsewhere [28].

### **Materials**

#### **Attitudes toward traffic safety**

A Driving Behaviour and Road Safety (DBRS) questionnaire was administered twice, in February 2001 and February 2004. The drivers who participated in the first survey received the second one in 2004. This questionnaire was previously pilot-tested on 500 randomly selected participants. The answers and comments of the 330 respondents were used to finalize it. Attitudes towards traffic safety were assessed by asking participants whether they agreed or disagreed with a set of twelve statements, referring to two topics related to traffic safety and currently debated in France, namely, “relaxing existing regulations” (six items), reflecting a belief that current traffic regulations are too restrictive , and therefore should be relaxed and 2) “increased enforcement/stricter regulations” (six items), reflecting a belief that current traffic regulations and law enforcement are not severe enough and therefore should be

reinforced. Spearman-Brown split half coefficients, indicating scale reliability, were 0.59 and 0.60 respectively. All items are listed in Table 1.

Sociodemographic data from the cohort database included gender (male/female), year of birth (three categories: 1939-1943, 1944-1948, 1949-1953), marital status (living alone, living with a partner), occupational category (unskilled worker, skilled worker, manager), educational status (college or high school degree), and alcohol consumption. Light drinkers of alcohol were defined as men (women) reporting 1-13 (1-6) drinks over one week, as opposed to heavy drinkers reporting 14-27 (men) and 7-20 (women) drinks over the same period. Regular drinkers were defined as those who reported consuming alcohol on three or more days in the week, as opposed to episodic drinkers who reported drinking alcohol on fewer than 3 days a week.

Psychological data from the 2001 DBRS questionnaire included several perceptions regarding driving, namely, experiencing fear while driving, reported caution when driving, perceived driving skills. These three variables were rated on a 6-point scale, ranging from never/very low (1) to always/very high (6). Behavioural data from the 2001 DBRS questionnaire included the report of several drivers' behaviours in the last 12 months, namely, drunk driving frequency (never, few times a year, once a month or more), maximum reported speed (in built-up areas, on rural roads, and on highways), and phoning while driving (answering the phone while driving: always, it depends on circumstances, never). Other potential predictors as recorded from the 2001 DBRS questionnaire included annual driving mileage (three categories: <10 000 km, 10 000-20 000 km, >20 000 km), type of vehicle owned (compact/economy, sedan/family/sport), history of road traffic accidents (yes/no), and close/family death in RTAs (yes/no).

## Statistical analyses

Percentages of agreement/disagreement in 2001 and 2004, and changes between 2001 and 2004, were tabulated for each statement of the questionnaire section devoted to attitudes towards traffic safety. Answers were grouped according to the two topics: relaxing existing regulations (six statements), increased enforcement/stricter regulations (six statements). Agreement was assessed by summing up the number of affirmations with each topic in a summary score (range 0-6) and a mean change in score between 2001 and 2004 was calculated by subtracting 2001 from 2004 summary scores ( $\Delta Y = Y_{2004} - Y_{2001}$ ). Comparison of mean change in score between explanatory variables ( $X_s$ ) with two or more categories was performed with one-way analysis of variance (ANOVA), a test remarkably robust to deviations from normality [29]. The independent effect of factors was further assessed with multivariate linear regression models including the baseline values ( $E[\Delta Y/X_s, Y_{2001}]$ ). The variables found to be significantly associated with the summary score changes, with a P value  $< 0.10$  in univariate analyses, were included in the multivariate model. Variables that exhibited a linear association with summary score changes were not recorded. Variables with different patterns were recorded accordingly. In order to avoid misinterpretations due to regression toward the mean, associations between baseline values ( $Y_{2001}$ ) and explanatory variables ( $X_s$ ) were assessed ( $E[Y_{2001}/X_s]$ ). When  $E[Y_{2001}/X]$  is not significantly different from 0, then the association between the explanatory variable and the mean change score (i.e.  $E[\Delta Y/X]$ ) can be considered not to be confounded by the correlation between  $Y_{2001}$  and  $X$  (which could be due to a “regression to the mean” effect) [30].



## RESULTS

### Population

In 2001, 13 447 participants (10 300 men, 3147 women) who sent back the 2001 DBRS questionnaire were sent the 2004 DBRS questionnaire. The latter was returned by 11 706 participants. Those who did not complete all items related to attitudes toward traffic safety (either in 2001 or 2004) were excluded from the analysis (n=2490). The final study population comprised 9216 respondents. Differences between the study population and participants excluded from the analysis were investigated. Several characteristics were slightly overrepresented in the study population, as compared to excluded/non-responding participants, namely, male gender (78.6% vs. 67.9%, respectively), older age (39.2% born between 1939 and 1943 vs. 36.1%, respectively), living with a partner (88.6% vs. 83.6%, respectively), higher occupational category (27.0% vs. 18.3%, respectively), and regular alcohol drinking (39.3% vs. 34.8%, respectively).

In 2001, most respondents were skilled workers (57.6%), with a high school degree (81.7%), owning a compact/economy vehicle (53.8%), who had driven less than 20 000 kilometres in the last 12 months (61.9%). Alcohol consumption was considered as “high” for 38.3% of respondents (regularly: 37.7%, episodically: 0.6%) and “low” for 45.6% of them (regularly: 17.3%, episodically: 28.3%). Sixteen percent (16.1%) reported no alcohol use. History of RTAs and having a close relation/friend killed in an RTA were reported by 49.2% and 23.0% of respondents, respectively. Most of them reported a maximum driving speed over the speed limit in the last 12 months, in built-up areas, on rural roads or on highways (71.5%, 77.8%, and 63.7%, respectively), and 23.6% of the participants reported drunk driving (a few times a year or more) during the same period. Regarding phoning while driving, 68.2% reported

“never” answering the phone while driving, whereas 26.7% reported that “it would depend on the circumstances”. Driving ability and level of cautiousness while driving were self-rated as “high” or “very high” (5 or 6 on a 6-point scale) by 52.0% and 72.7% of respondents, respectively. However, 75.7% of the respondents reported experiencing fear while driving “sometimes to always” (2 to 6 on a 6-point scale).

### Attitudinal changes

Attitudinal changes toward road traffic safety between 2001 and 2004 are shown in Table 1. The summary mean score reflecting support for relaxing existing regulations decreased from 1.49 [1.47 – 1.52] in 2001 to 1.13 [1.10 – 1.16] in 2004, which represents a 24% decrease (mean change in score: -0.36;  $p < 0.001$ ). The summary mean score reflecting support for increased enforcement/stricter regulations slightly decreased from 3.48 [3.45 – 3.51] in 2001 to 3.34 [3.30 – 3.37] in 2004, which represents a 4% decrease (mean change in score: -0.14;  $p < 0.001$ ). Changes in Percentages of agreement between 2001 and 2004 are detailed in Table 1 for each item.

### Factors associated with attitudinal changes

Univariate associations between the changes in the attitudinal scores and sociodemographic, psychological and behavioural variables assessed in 2001 are listed in Table 2. Factors found to be statistically associated with score changes with a  $p$  value  $< 0.10$  were further included in a multivariate model. The decrease in the score related to relaxing existing regulations (Table 3) was greater among participants with higher educational status ( $B = -0.079$ ,  $p = 0.008$ ) and, without reaching significance, among those owning a more powerful car ( $B = -0.043$ ,  $p = 0.074$ ). The decrease in the score related to increased enforcement/stricter regulations (Table 4) was smaller among participants with higher educational status ( $B = 0.105$ ,  $p = 0.008$ ), among those

reporting a maximum speed below the speed limit on highways in 2001 ( $B=0.126$ ,  $p<0.001$ ), and, without reaching significance, among those with a higher occupational category ( $B=0.064$ ,  $p=0.064$ ).

The strongest associations were found between baseline attitudinal scores in 2001 and mean change in scores, either as regards to agreement with relaxing existing regulations ( $B=-0.434$ ) or with increased enforcement/stricter regulations ( $B=-0.359$ ). Scores in 2004 had decreased more for those respondents with high scores in 2001 than for those with low scores in 2001.

## DISCUSSION

The present study measured significant attitudinal changes that occurred in the 2001-2004 period in France. The mean change in scores analysis showed that support for relaxing existing regulations decreased significantly during this period (-24%), while support for heightened enforcement and stricter regulations remained high in 2004, especially concerning blood alcohol content (80.4% of agreement), speed controls (60.8%) and speed reduction (60.5%).

These results suggest that, over the 2001-2004 period, many respondents realised the necessity of existing regulations and restrictions on driving behaviour. Driving licence endorsement (penalty points), in particular, seemed to be gradually more accepted, as the number of people considering it as “useless” dropped by 37% between 2001 and 2004 (see Table 1). Similarly, the number of people considering that “speed limitations should depend on the driver’s skill” dropped by 24% during the same period, showing a greater support for speed limitations.

Attitudinal changes toward increased enforcement/stricter regulations were more mixed: on average, similar proportions of respondents switched to agreement and disagreement with increased enforcement/stricter regulations between 2001 and 2004 (see Table 1). Overall, the mean change in scores analysis showed that support for increased enforcement/stricter regulations decreased slightly during this period. The biggest decrease in support was related to the necessity to reduce the BAC limit to zero: Almost half of respondents agreed with this measure in 2001, but the number dropped by 14% between 2001 and 2004. During the same period, however, and despite increased law enforcement measures implemented by the government, respondents remained largely in favour of increased checks on alcohol and speed on the road, and many people changed their mind in favour of these measures in 2004. As far

as drunk driving is concerned, this result is consistent with a large-scale international survey called SARTRE 2, showing that French drivers drink frequently, but in moderate quantities [31]. Accordingly, they reject the idea of a complete ban on alcohol at the wheel, but nevertheless try to comply with the existing legal limits (0.5 g/L for non-professional drivers).

Multivariate analyses suggest that highly educated drivers changed their attitudes towards road safety regulations more than other categories of drivers. They were those with higher educational level and who were more likely to accept existing regulations and consequently more likely to agree with further tightening of restrictions. This means that a large share of less educated drivers did not benefit from attitudinal changes observed between 2001 and 2004. The protective effect of higher socio-educational status on traffic injuries has hitherto been attributed to underlying socioeconomic inequalities that lead to differential exposure and susceptibility to traffic issues (for example, different use of protective devices by people of different socioeconomic status, or higher blood alcohol concentration among people of lower socioeconomic status) [32, 33]. Even if such an explanation is undoubtedly relevant, our results suggest that a higher educational status may also favour adoption of positive attitudes toward traffic safety, thus ensuring compliance with traffic regulations. However, as far as the score of agreement with relaxing existing regulations is concerned, we found an association between educational status and the baseline score. We cannot therefore be certain of the genuine impact of educational status on the change in this score as at least part of the association may be due to the regression toward the mean. Similarly, increased support for increased enforcement/stricter regulations was associated with reporting a maximum speed below the speed limit on highways in 2001, a characteristic directly related to safe driving. However, as this variable was also significantly related to the baseline value in 2001, its effect on attitudinal change between 2001 and 2004 may be due to the regression to the mean.

Both attitudinal scores changes were strongly correlated with baseline values. High scores in 2001 had fallen more in 2004 than low scores in 2001. This result could simply be attributed to regression toward the mean if one considers that answers to the six questions that are part of each summary score are not fully reliable. Yanez et al. [34] proposed a method to correct regression parameters, knowing the magnitude of the measurement error of the baseline variable. Taking the example of the summary score of agreement with relaxing existing regulations that ranges between 0 and 6, the variation between Y2 and Y1 ( $\Delta Y$ ) ranged between -1 and +1 for most respondents [ $\Delta Y$ : -1=13.2%, no change= 41.5%, and +1= 25.1%]. We can therefore assume that the random variation in scores due to ratings variability, if any, is very unlikely to exceed  $\pm 1$ . With the very conservative assumption that the mean random variation is  $\pm 1$ , the correction method of Yanez et al. leads to an actual estimated value of B of -0.332 instead of -0.434. It is therefore very likely that the strong association between baseline 2001 score value and score change is not explained by regression towards the mean alone. It is thus legitimate to affirm that the trend towards acceptability of existing regulation has been uneven across baseline 2001 attitudinal scores: those highly motivated to relax regulations in 2001 changed more than the others. Where agreement with increased enforcement/stricter regulations is concerned, and applying the same method, the corrected value of B would be -0.246 instead of -0.359. Scores changes exhibit a symmetrical pattern across baseline 2001 values (see Table 2). The attitudes of those with higher and lower motivations in 2001 to increase enforcement/tighten regulations levelled off in 2004, while those with intermediate scores did not change their mind on average.

These significant changes in attitudes, found concurrently with a major increase in law enforcement, may indicate that respondents have internalized traffic regulations between 2001 and 2004. Internalization of social norms requires understanding why they are of value or

why they make sense [35]. From this point of view, it is possible that internalization of traffic regulations have been supported by the actual decline in road casualties observed in France. Changing of attitudes towards traffic safety is considered as an effective and long-lasting mean to improve drivers' behaviour and reduce road burden [25-27, 36]. Our results suggest that changing laws may be an effective way to achieve this goal, which can lead to positive behaviour changes.

As far as the study population is concerned, it should be stressed that it mostly included employed or retired middle-aged drivers, which may limit the generalisability of our results. Future research should address these issues in younger participants, as RTAs causing death or injury concern mostly 15 to 24 years old drivers in France [6]. On the other hand, its large size and the inclusion of diverse trades and socioeconomic groups throughout France represent an exceptional strength for the study of road behaviours. Moreover, although measures of self-reported risky driving behaviours and attitudes have been found to have considerable validity in predicting traffic accident risk [37], they cannot possibly account for the whole risk attributable to the behavioral human factor.

Overall, our results suggest that increased traffic law enforcement measures taken by the government increased support for existing measures over the 2001-2004 period. However, even if support of additional enforcement waned slightly in 2004, the large majority of participants remained in favour of strengthening law enforcement related to speed and drunk driving, perhaps because they noticed their actual effectiveness on road traffic safety.

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