The perceived effectiveness of road safety interventions: Regulation of drivers' behavioral intentions and self-consciousness

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Full Title: The perceived effectiveness of road safety interventions: Regulation of drivers' behavioral intentions and self-consciousness

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Abstract

We consider road safety interventions to be potential sources of social influence, altering the intentions and behaviors of drivers when they are perceived by the latter as effective. We also consider that perceiving their effectiveness depends on drivers' self-consciousness. 852 drivers replied to a questionnaire measuring dispositional self-consciousness, the perception of the effectiveness of 10 road safety interventions, and reported intentions and behaviors related to speeding and drinking and driving. The results revealed several phenomena: (1) interventions were perceived as related to penalty/surveillance or social communication (factor analysis); (2) the former were perceived as more effective than the latter; (3) the perceived effectiveness of road safety interventions was moderately correlated with intentions and behaviors; (4) this link was stronger for interventions of the penalty/surveillance type; (5) age, level of education, frequency of use of a vehicle and gender were moderately associated with the perception of these interventions; (6) self-consciousness (in particular its public dimension) had an additional positive association with this perceived effectiveness. These results are discussed from a practical and methodological point of view.

Key words: Road traffic offences; behavioral intention; social communication interventions; penalty/surveillance interventions; self-consciousness

1. Introduction

With regard to road behaviors, the current frame of reference considers the car driver to be an autonomous and responsible individual, subject of course to constraints (Highway Code) and to coercion (repression), but in the end solely in charge of the choices which they make with regard to taking account of driving regulations (prevention). In this connection, compliance with the regulations is considered as a relative guarantee of safety and their transgression as a source of risk. Considering driving thus in relation to compliance with driving norms, road safety then becomes a problem of public order (creation and application of norms) and a problem of education and communication (transmission and promotion of norms), all of these interventions aiming to guide behaviors in a context conducive to the reduction of risk.

In this study, we consider the interventions implemented by public authorities and road safety organizations to promote respect for the rules (e.g. automated speed controls, prevention campaigns and driver training) as sources of social influence modifying the intentions and behaviors of drivers when they are perceived as effective by the latter. In other words, this study deals with the question of the influence and perceived effectiveness of road safety interventions on the intentions and behaviors of drivers. We also consider that perceiving their effectiveness depends on drivers' self-consciousness. We will therefore first of all address the concept of behavioral intention and its major importance with regard to compliance or non-compliance with driving regulations, and then subsequently examine the potential role of the perceived effectiveness of road safety interventions which aim to promote compliance with them.

1.1. Behavioral intentions linked to driving behavior

The theory of planned behavior (TPB) postulates that behavior originates from behavioral intention (Ajzen, 1991). In the field of road behaviors, the TBP has been cited to explain, for example, dangerous speeding excesses, non-observance of safety distances (Parker, Manstead, Stradling, Reason, & Baxter, 1992), use of mobile phones (Zhou, Wu, Rau & Zang, 2009),

aggressive behaviors (Parker, Lajunen, & Stradling, 1998), the behavior of pedestrians on the public highway (Moyano-Diaz, 2002) and the wearing of safety belts (Brijs, Daniels, Brijs & Wets, 2011). Behaviors linked to speeding and drinking and driving have been particularly studied (e.g. Castanier, Deroche & Woodman, 2013; Lheureux, Auzoult, Charlois, Hardy-Massard, & Minary, 2015; Moan & Rise, 2011). All these studies confirmed the central role of behavioral intentions with regard to traffic offences: the higher a driver's intention of complying with a driving regulation, the more likely it is that they will act accordingly. They also confirmed the impact of the theoretical determinants of intention and behavior, namely attitude (i.e. the positive or negative evaluation of the behavior), the subjective norm (i.e. the level to which the individual thinks that adopting the behavior would be compliant with the norm accepted in their immediate circle) and perceived behavioral control (i.e. the level to which the individual considers that it is possible and easy to perform the action). The majority of authors also insist on the necessity of introducing additional variables, which prove to improve predictions (e.g. anticipated regrets, moral norm, habit, personal identity; e.g. Chorlton, Conner, & Jamson, 2012; Conner, Smith, & McMillan, 2003; Elliott, Armitage, & Baughan, 2003; Sandberg & Conner, 2008).

Attitudes, subjective norms and perceived controls originate in a belief system, composed of behavioral beliefs (at the origin of attitude), normative beliefs (determining the subjective norm), and control beliefs (influencing perceived behavioral control). The structure of this system is based on the Expectancy*Value principle (Ajzen, 1991). For example, attitude to behavior depends on the level to which the individual thinks that adopting the behavior would incur certain consequences more or less automatically (Expectancy) and the intrinsic evaluative valence (positive/negative) of the latter (Value). In other words, the more an individual believes that the behavior will lead to (Expectancy) negative consequences (Value) the more negative will be their attitude to it and vice versa. In this respect, being involved in an accident is one of the potential negative consequences of road traffic offences and individuals are not at all convinced to the same degree that offending causes accidents (Expectancy). Other consequences are possible, including financial ones (e.g.

penalties, prison, and license withdrawal). The main issue in this regard is to succeed in convincing drivers that accidents – with their potentially dramatic consequences – are in fact a completely likely consequence of offending behaviors that they engage in more or less frequently. More precisely, it may be relevant to distinguish social communication actions, which seek to establish a link between non-compliance and accidents, and coercive actions (road controls, radars, etc.), which reinforce the link through sanctions. Here, the penalty is a negative reinforcement alternative to the accident. It leads to establishing an unequivocal link between violation and damage. In other words, the coercive actions may have more impact on attitudes, since they associate the offense with accidents and the penalty, while the communication actions associate the offense only with accidents.

1.2 The perception of preventive and penalizing measures

This link between intention and the perception of negative consequences of offending behaviors, *via* attitude, leads us to view road safety interventions as sources of social influence, in the sense that their aim is to convince drivers that these behaviors have potentially only negative consequences (accident, injuries, fines, *etc*.) and thus increase their compliance with driving regulations. In other words, in accordance with the TPB, these interventions can be viewed as "background factors" which could alter the behavioral beliefs at the origin of the attitude. Likewise, it may be thought that they would modify the control beliefs related to danger on the road (perceived control of danger) and reinforce the idea that compliance with the rules is socially expected and valued (subjective norm). However, the offense may be perceived as a personal threat, which can lead to psychological reactance. In this case, preventive and enforcement measures can prevent behavior change.

Accordingly, some studies have corroborated the influence of road safety interventions on TPB constructs (e.g. Elliot & Armitage, 2009; Mann & Lansdown, 2009). However, this influence was not systematically observed (e.g. Stead, Tagg, Mackintosh, & Eadie, 2005; Glendon, McNally,

Jarvis, Chalmers, & Salisbury, 2014). Exposing drivers frequently and/or over a long period of time to an intervention aiming to prevent their offending behaviors does not constitute a factor sufficient to alter their intentions and behaviors. An additional and ignored explanatory variable probably play a role; a variable that must be identified and empirically investigated.

The *perceived effectiveness* of road safety interventions may be such a variable. Perceived effectiveness refers to the degree with which a driver believes that a given road safety intervention promotes road safety as a whole. As illustrated by several studies road safety interventions are evaluated by drivers (e.g. Cauzard & Quimby, 2000; Ulleberg, 2001; Yagil, 1998) and people comply with the laws and the regulations implemented by legal authorities if they are evaluated as legitimate (Tyler, 2006). In the case of road safety interventions, their legitimacy essentially depends on their ability to effectively diminish the number of death and injuries on road. Thus, it is logical to think that the more these interventions are perceived by drivers as effective in preventing accident and on-road mortality/morbidity, the more they are likely to change drivers' offending attitudes, intentions and behaviors. Inversely, we could consider that the less drivers perceived road safety interventions to be effective in reducing road accidents and their corollary consequences, the less they are likely to be influenced.

In line with that perspective, Blincoe, Jones, Sauerzapf and Haynes (2006) noted that a not insignificant number of drivers circumvented or even deliberately defied speed cameras, as they judged the limit to be too low in view of the capacities of modern vehicles (for similar observations see Corbett, 1995, Corbett & Caramlau, 2006). In this connection, controls were perceived as *ineffective* and, consequently, illegitimate as, according to them, they do not deal with the real cause of road accidents (e.g. the lack of driving skills of some drivers). In a similar vein, Harrison and Senserrick (2000) observed that when drivers exposed to a preventive advertisement have a positive attitude toward it they report being more motivated to drive safely than when they negatively evaluate the advertisement. Situated in the TPB framework, Daignault and Delhomme (2011) report

convergent findings. They observed that the more effective drivers perceived road safety interventions to be the less they adopted offending attitudes and intentions.

Following this theoretical reasoning as well as the empirical evidence above-mentioned we can hypothesized that road safety interventions would be associated with pro-safety attitudes and behaviors if they are judged by drivers to be effective in combatting danger on the roads. More precisely, the main aim of the study described afterward was to empirically investigate three hypotheses: the perceived effectiveness of road safety interventions and intentions to commit driving violations are negatively linked (hypothesis 1); effectiveness perceptions are negatively associated with traffic offences (hypothesis 2); this relationship is mediated by intentions (hypothesis 3).

This research also aimed at corroborating some aspects of Daignault and Delhomme's (2011) study, while overcoming some of its limitations. According to them, the road safety interventions implemented could be separated into two categories, with on the one hand those aiming to convince drivers that offending behaviours are intrinsically dangerous (awareness-raising campaigns, courses, etc.) and, on the other hand, those aiming to dissuade them from offending while driving by means of surveillance and the risk of criminal penalty (radars, police checks, fines, withdrawal of license points etc.). They consider that interventions in the first category rely on an intrinsic motivation to avoid these behaviors, whereas interventions in the second category rather favor extrinsic motivation as they are based on the use of negative reinforcements by an agent external to the individual. In this connection, they postulated that drivers themselves differentiated between these two types of road safety interventions and evaluated their effectiveness separately in terms of the reduction of traffic accidents. In this regard, they hypothesized that interventions of the "penalty/surveillance" type were judged as more effective by drivers than interventions of the "social communication" type, the use of constraint being perceived as more effective in preventing dangerous behaviors than leaving drivers free to apply the recommendations they are given. With the aim of testing these hypotheses, they questioned 234 students about, in particular, the

effectiveness they attributed to ten road safety interventions (see Table 1 for a presentation of these interventions). The results obtained supported their hypotheses.

Although interesting, the study by Daignault and Delhomme (2011) had several limitations diminishing the scope of their observations/conclusions (in particular the size and the diversity of their sample and the absence of a factor analysis to confirmed their typology of interventions). Thus, a complementary aim of our study was to complete the results which they obtained by questioning a larger and more varied sample of drivers and by confirming the existence of the two types of road safety interventions through the use of factor analysis (hypothesis 4). Furthermore, this study had the aim to confirm the higher perceived effectiveness of penalty/surveillance interventions in comparison to social communication interventions (hypothesis 5).

1.3 Regulation of road behavior by self-consciousness

This study has a secondary objective: to highlight the association between self-consciousness and the perceived effectiveness of road safety interventions. The concept of self-consciousness (SC) describes the tendency of an individual to pay attention to themselves, to a greater or lesser extent, and, therefore, their awareness of their own characteristics (Duvall & Wicklund, 1972). This consciousness can be induced by the situation (self-awareness) or constitute a stable disposition (self-consciousness) and concerns internal elements not directly visible to an observer (attitudes, emotions, memories, knowledge etc.) as well as directly observable external elements (behavior, appearance). Consciousness of elements of the first type is referred to as *private*, whereas consciousness of the second type of elements is referred to as *public*, these forms of SC being correlated while being distinct (Buss, 1980; 2001). Generally speaking, the more an individual pays attention to themselves the more likely they are to become aware of discrepancies between their actions and the elements of the Self to which they are paying attention at that moment. This awareness then induces a process of self-regulation, conducive to the connection of behaviors with internal elements (e.g. attitude) or external elements (e.g. social judgment)

connected with the Self. It should also be noted, that for individuals with a high private SC this process of regulation responds above all to an intrinsic motivation, whereas for individuals with a high public SC this process is above all extrinsically motivated (Plant & Ryan, 1985).

In line with this point of view, several studies have put forward the idea that this tendency to self-regulation is at the origin of driving related decisions and behaviors which are sustainable and safe. This was highlighted amongst drivers who had suffered a brain injury (Lundqvist & Alinder, 2007) or, more simply, whose cognitive functions had deteriorated with age (Wong, Smith, & Sullivan, 2012). In this case a high level of SC (and of limitations induced by physical harm) appeared as a necessary condition for the induction of a self-regulation process (taking these limitations into account). Some researchers have therefore paid attention to the practical aspects of preventive measures by positioning SC / self-awareness as a driving element of change. In this context, the evaluation of driving abilities (e.g. through the use of a questionnaire or training sessions) would provide the beneficiaries with informative feedback about themselves leading to an activation of self-awareness (Eby, Molnar, Shope, Vivoda & Fordyce, 2003; Molnar, Eby, Kartje, & St Louis, 2010; Navasdi, 2007). More generally speaking, it may be thought an elevation of the level of SC/awareness could be at the origin of regulating numerous road behaviors (e.g. effect of anger on aggressive driving, Millar, 2007).

Thus, in line with these theoretical and empirical elements we formulated two hypotheses. Firstly, given that individuals with a high public SC are more extrinsically motivated (Plant & Ryan, 1985) and so pay more attention to external norms (the opinion of others, social judgment, *etc*.) when it comes to adopting a point of view and acting, we expected that they view *all* types of interventions more favorably than individuals with a low public SC (i.e. positive correlation with the perceived effectiveness of each type of road safety intervention) (hypothesis 6). Concerning private SC an interaction with the type of interventions was expected (Hypothesis 7). First, given that individuals with a high private SC are intrinsically motivated, we expected them to perceive more favorably interventions which aimed at obtaining the cooperation of drivers and at obtaining a

voluntary acceptance of the rules following a modification of personal beliefs relative to their usefulness than individuals with a low private SC. In other words, we expected private SC to be positively associated with the perceived effectiveness of social communication interventions (hypothesis 7a). Inversely, as penalty/surveillance interventions impose respect for the rules without seeking to convince people that offending is intrinsically risky, we expected private SC to be negatively associated with their perceived effectiveness (hypothesis 7b). In other words, drivers who need to perceive traffic offences as intrinsically risky to be motivated to comply with regulations (i.e. drivers with a high private SC) are expected to evaluate less positively interventions that use external negative reinforcement than drivers who not need to (i.e. drivers with a low private SC). Moreover, this hypothesis is in concordance with Carver and Scheier's study (1981) which showed that individuals with a high private SC are more prone to reactance when facing a coercive persuasion attempt as they are more aware of the negative emotion caused by the threat of their freedom.

2. Method.

2.1 Participants

Our sample was made up of 852 participants (mean age 34 years, 52% women, 57% living as a couple, 42% with a child/children, 56% employed, 5.8 jobseekers and retired and 38% students). From the point of view of their relationship with the road, participants had had their license for an average of 15 years and 84.7% covered less than 25,000 km/year. 96% of the sample was car drivers, 8.6% were motorcyclists and 2.2 % were lorry drivers. The sample therefore was quite diversified, thus ensuring a relatively good generalizability of the results across sub-groups. In particular, this sample includes both students and non-students drivers, which constitutes a difference with the sample of Daignault and Delhomme (2011).

2.2 Materials

The subjects replied to 17 items of the French version of the dispositional SC scale (Pelletier & Vallerand, 1990), namely 10 items referring to the private dimension of SC (for example, I constantly examine my reasons for acting) and 7 items referring to public SC (for example, I am aware of the impression I give). They responded via 4-point scales of the Likert type ranging from “not all like me” (0) to “very like me” (3).

They had to evaluate to what extent various road safety control and preventive measures effectively promotes road safety as a whole in France (Daignault & Delhomme, 2011); driver training; penalties for driving in a state of inebriation; alcohol checks by the police (breathalyzer); prevention campaigns; variable message boards on the road; penalties for speeding; withdrawal of points from the driving license; courses raising awareness of the causes of road accidents; police surveillance on the roads; information radars indicating real speed and automated speed checks (radars). Daignault and Delhomme conducted their study from January to March 2008. Our study was conducted from July 2011 to February 2012. Between these two periods public action on road safety included: driving license reform 2009; strengthening of measures against risky behaviors (alcohol, drugs, speeding); breathalyzer for all vehicles. These measures reflect a strengthening of sanction policies/supervision over the period. Participants responded via a scale ranging from “not at all effective” (0) to "very effective” (3).

Two items were used to measure intention: “To what extent do you intend to drive above the speed limit in the coming months” and “I will probably drive above the speed limit in the coming months”. Similar items were given for driving under the influence of alcohol. Participants responded via a 7 point scale ranging from "never” (0) to “always” (6).

Drivers also reported their behaviors in relation to speeding and drinking and driving. First of all they indicated the frequency with which they engaged in this behavior on a scale ranging from "never" (0) to “extremely frequently” (6). For three different contexts (conurbations, roads in rural areas and motorways) they next indicated the speed they most frequently adopted and the maximal speed they had already adopted. Responses ranged from “more than 40 km/hr. *above* the speed

limit" (10) to "less than 20 km/hr. *below* the speed limit" (0). The response "exactly on the limit" obtained the score of 4. In a similar vein, they specified the number of glasses of alcohol which they most often consumed before driving when the context was conducive to consumption, and the maximal number of glasses which they had already consumed before driving. For both speeding and alcohol, the three responses obtained were standardised (centred and reduced) in order to create a single behavioural indicator.

2.3 Procedure

We approached drivers *via* government organizations, associations and a large company. The students and staff of the university which the research team belonged to were also approached. These individuals were invited to reply on a voluntary basis to an electronic questionnaire created using the Limesurvey® program and accessible via a URL sent to the recipients through internal emailing lists. After a general presentation of the study, SC, perception of the effectiveness of road safety interventions and intentions and behaviors linked to speeding and drinking and driving were measured. These offences were chosen as they are known to highly increase the likelihood of being involved in a traffic accident (as well as being injured or killed) and because they are frequently targeted by both types of road safety interventions. For one half of the drivers, SC was measured before the questions on driving, for the other half, it was measured afterwards.

3. Results

3.1 The perception of road safety interventions

We first of all carried out a principal axis factorial analysis with Oblimin direct as rotation method. In accordance with hypothesis 4, inspection of the scree plot revealed two factors with eigenvalues greater than the unit. Together the two factors accounted for 51.22 % of the available variance (Table 1). The first factor which was labelled "penalty/surveillance" included items related to penalties for drunkenness, speeding and police and automated checks. This first factor explained

34.76% of the variance. The second factor explained 16.46% of the variance and included items related to training, information and awareness-raising. We named it “social communication”. The two factors exactly reflect the two groups postulated by Daignault and Delhomme (2011). Following the analyses, we considered penalty/surveillance interventions (*Cronbach* α = .81) and social communication interventions (*Cronbach* α = .66) overall. The use of a confirmatory factor analysis with Lisrel 8.8 (Jöreskog & Sörbom, 2006) globally confirmed this bi-factorial structure, although two error covariance (suggested by modification indices) have to be added to the model in order to obtain satisfying fit indices $\chi^2(32) = 197.69$, $p<.0001$, RMSEA = .076, ECVI = .28, NNFI = .93, CFI = .95, SRMR = .054). The two error covariance concerned the perceived effectiveness of alcohol checks by the police (breathalyzer) which covary independently from the two latent factors with penalties for driving in a state of inebriation and with police surveillance on the roads.

Insert Table 1 here

With the aim of testing hypothesis 5, a repeated measures analysis of variance was conducted with the type of road safety interventions as independent within-subject variable. This analysis highlighted a significant difference between these two types of interventions ($D(1.842)= 129.41$, $p<.0001$, $\eta^2= .13$), penalty/surveillance interventions being judged on average as more effective (M=1.88) than social communication interventions (M=1.60). With the exception of driver training (M=2.00), social communication interventions ($1.33<M<1.61$) all obtained lower scores than penalty/surveillance interventions ($1.64<M<2.00$) (see Table 1). Analyzed differently, this data revealed that 75.7% of the drivers questioned judged driver training to be moderately or very effective, 74.3% police surveillance, 73.3% breathalyzer, 71.4% penalties for blood alcohol levels, 71.6% withdrawal of points from the driving license and 66.7% penalties for speeding. Other interventions were distinctly less consensual: automated speed checks (58%), awareness-raising courses (56%), prevention campaigns (46.6%) and variable message boards (39.1%).

3.2 Relationships between the perceived effectiveness of road safety interventions, road behaviors, intentions and self-consciousness

Table 2 below presents the correlations between the different variables (corrected for random measurement error, see Osborne, 2003).

Insert Table 2 here

In accordance with hypotheses 1 and 2, the perceived effectiveness of penalty/surveillance interventions was negatively correlated with the two intentions and the two behaviors reported, whereas the perceived effectiveness of social communication interventions was only correlated with intentions and behaviors related to speeding, consequently only partially supporting hypotheses 3b and 4b. The positive correlations observed between public SC and the perceived effectiveness of the two types of interventions corroborated the hypothesis 6. In accordance with hypothesis 7a, private SC was positively correlated with the perceived effectiveness of social communication interventions. However, contrary to what was expected (hypothesis 7b), the expected negative correlation with the perceived effectiveness of penalty/surveillance interventions was not observed.

Six hierarchical multiple linear regression analyses were conducted, with successively as dependent variable the intention to drive above the speed limit (analysis 1), the intention to drive under the influence of alcohol (analysis 2), the overall reported behavior for speeding (analysis 3), and for drinking and driving (analysis 4) and, to conclude, the perceived effectiveness of social communication interventions (analysis 5) and penalty/surveillance interventions (analysis 6). For all these analyses, the socio-demographic and road -related variables were entered during step 1 (except for driving experience which was collinear with age, $r = .98$). For the analysis of intentions and behaviors the perceived effectiveness of the two types of road safety interventions was included in the second step. Intention for action was added during a third step for the prediction of behaviors. With regard to the perception of road safety interventions, the two dimensions of SC were included

during the second step.

Insert Table 3 here

The first two analyses revealed that only the perceived effectiveness of penalty/surveillance interventions had a significant effect on the two behavioral intentions in the presence of socio-demographic and road related variables (step 2). It also significantly increased the explained variance, even though this increase was minor ($\Delta R^2 = .01$, $p <. 05$). With regard to current reported behaviors, a quasi-similar phenomenon was observed (effects solely of the perceived effectiveness of penalty/surveillance interventions), the only difference being that the increase in the explained variance was significant only for alcohol. The addition of intention (step 3) increased the share of explained variance and rendered non-significant the association between the perceived effectiveness of these interventions and behaviors, an observation which supported the idea that intention mediated the latter.

Complementarily, we used the PROCESS macro for SPSS (Hayes, 2013) in order to more thoroughly test the mediation by intention hypothesis. This procedure permit to robustly estimate indirect (i.e. mediated) effects *via* the use of the bootstrap technique. The original sample was resampled 2000 times and the bias-corrected percentile method was used to create 95% CI. These analyses confirmed the entire mediation of link between the perceived effectiveness of penalty/surveillance interventions and speeding ($b = -.11$, $SE = .04$, $CI = -.19/-03$, $z = -2.92$, $p <.01$) and drinking driving ($b = -.10$, $SE = .05$, $CI = -.18/-03$, $z = -2.40$, $p <.02$). Any statistical effect of the perceived effectiveness of social communication interventions was significant.

The two last hierarchical regression analyses highlighted the fact that older drivers evaluate the two types of interventions as more effective than younger drivers. To a lesser extent, the fact of being a woman favored the adoption of positive judgments. Two variables had inverse effects. On the one hand, the greater use drivers made of their vehicle (average number of kilometers covered annually) the less effective they judged the two types of interventions to be. On the other hand, an

increase in the level of education was associated with a lower perceived effectiveness of social communication interventions. Although these variables had significant effects, the total explained variance was low. In accordance with hypotheses 5 and 6, the addition of the two SC dimensions (step 2) significantly increased the explained variances although in a limited proportion ($\Delta R^2 = .02$, $p <. 01$). As expected, public SC had a significant positive effect for the two types of interventions. Private SC had a significant positive effect on the perceived effectiveness of social communication interventions only.

Finally, given that within-subject variables cannot be included in hierarchical regression analyses, we performed a complementary repeated measures ANOVA with the “type of interventions” as within-subject variable, and with the same other variables that were included in regression analyses as between-subject variables or as continuous covariates. This analysis allowed to estimate the significance of the expected interaction between type of interventions and private SC (hypothesis 7). This interaction was significant ($D(1,775)=3.81$, $p = .05$, $\eta^2_p = .01$). Public SC has a significant effect on the overall effectiveness of interventions ($D(1,775)=25.52$, $p = .05$, $\eta^2_p = .03$), while private SC has not ($D(1,775)=0.38$, *ns*).

4. Discussion

4.1. Main results

In this study, we anticipated that the two types of road safety interventions would be perceived separately by drivers. As expected, the results obtained via factor analysis highlighted the existence of the two supposed factors, the first grouping the interventions associated with control and penalization and the second grouping interventions related to social communication. However, driver training appears to have an intermediate status (its saturations in factor analysis were the lowest). It is possible that its compulsory and restrictive nature for many car drivers (cost of training) led them to attribute an intermediate status to driver training between the dissemination of information and constraint.

In addition, interventions of the penalty/surveillance type were judged as more effective than those of the social communication type. These observations therefore confirmed the approach of Daignault and Delhomme (2011), over a larger group of people and in a constant cultural context. According to these authors, this difference between the two types of interventions is based on the idea that sanction/surveillance interventions coerce *all* drivers to comply with the law, including those who are not convinced that offending is risky, whereas social communication interventions are more exposed to resistance from offenders (message withdrawal or rejection). Another possible explanation is that sanction/surveillance interventions are more involving, as they affect the driver personally and evoke the possible negative consequences of offences, which are more perceptible and more often directly experienced by drivers. Conversely, social communication interventions evoke more general and hypothetical situations, which refer less to situations that have been personally experienced by drivers. Given that personal involvement has been identified as a moderator of intervention effectiveness (e.g. Lewis, Watson, & White, 2008), this interpretation is plausible. Future work should pit these two explanations against each other.

With regard to the impact of the perceived effectiveness of road safety interventions on current intentions and behaviors, the results obtained were overall consistent with the hypotheses while being limited in magnitude. These effects are in line with attitude change research (see Petty & Wegener, 1999) showing that when interventions evoke positive cognitive responses, this increases their effect on attitudes and behaviors. These results are all the more important given that attitudes and intentions toward traffic offences have been identified as predictors of driver behaviors (see Introduction) and as such constitute targets of road safety interventions. Thus, our results highlight the need to increase the perceived effectiveness of these interventions.

Public SC was positively correlated with the perceived effectiveness of the two types of road safety interventions and retained its effects in the presence of other individual characteristics (age, gender, *etc*.). Similar results were obtained with regard to the link between private SC and the perceived effectiveness of interventions of the social communication type. This result stresses again

the importance of SC in explaining road behaviors. These are social behaviors that are regulated in relation to compliance with (social) standards (Wiekens & Stapel, 2010), through the raising of public SC, which makes drivers more receptive to external sources of influence. The relationship between private SC and the perceived effectiveness of social communication suggests that drivers with a high private SC are more disposed to accept social communication interventions and subsequently to change their personal standards. Although we observed a significant interaction between private SC and the type of intervention, the perceived effectiveness of sanction/surveillance interventions was independent of private SC. This observation refutes hypothesis 7b, which postulates a negative relationship between them. This result may be explained by the fact that private SC has an overall weaker effect than public SC when individuals are exposed to external standards (Buss, 2001) coupled with the fact that most individuals with a high private SC in our sample also had a high public SC (as illustrated by the correlation of .48). Finally, as has been noted on several occasions in the past (e.g. Chan, Wu, & Hung, 2010; Elliott & al., 2003), women, older drivers and those using their vehicle infrequently had current intentions and behaviors that were more respectful of the rules than their male counterparts, with less driving experience and using their vehicle more often. These two driver profiles also judged road safety interventions differently, their perceived effectiveness being generally higher for the former than the latter. These results can be interpreted as a tendency of young males who drive frequently to resist interventions that are mostly designed to change their attitudes and behaviors, such resistance being all the stronger given that individuals are forewarned of the attempt to change their views and actions (Petty & Cacioppo, 1977).

4.2. Limitations and recommendations for future research

The procedure employed in this study presented the advantage of simplicity and, consequently, encouraged participation by a relatively large number of drivers. This allowed us to corroborate the existence of a relationship between the perceived effectiveness of road safety

interventions on the one hand and intentions and behaviors on the other hand amongst a diverse sample of drivers.

However, this procedure had several limitations. First of all, it did not allow us to control the effect of the exposure of drivers to the different road safety interventions studied. Consequently, the specific effects of exposure to an intervention and of its perceived effectiveness could not be estimated, nor could a potential interaction between these two variables. Furthermore, the fact of having questioned the drivers on one occasion only limited the analysis of causal relationships between variables.

The results revealed that there is a relationship between the perceived effectiveness of interventions of the penalty/surveillance type and the behaviors adopted and that it is mediated by intention. However, not all the variables theoretically mediating this effect were measured (attitudes towards behavior, subjective norms, etc.), which limited the possibilities for analysis (e.g. Does perceived effectiveness primarily have an effect on attitude? Which construct most mediates the association between perceived effectiveness and intention? *etc*.).

Although the hypotheses were corroborated overall, the correlations between variables were weak in magnitude. This observation could have several complementary explanations. First, it is very likely that the drivers questioned in this study had not considered that they were contributing to danger on the road and that, when judging the effectiveness of the interventions implemented, they were referring more to other drivers and less to themselves. This explanation is all the more plausible in that numerous studies have shown that individuals have a high tendency to judge themselves as better drivers than others (e.g. McCormick, Walkey, & Green, 1986; Svenson, 1981; Taylor & Brown, 1988), to display a bias of the illusion of control and overconfidence type, and therefore to underestimate their exposure to the risk of accident in comparison with others (e.g. Gosselin, Gagnon, Stinchcombe, & Joanisse, 2010; Helweg-Larsen & Shepperd, 2001; Martha & Delhomme, 2014; Price, Pentecost, & Voth, 2002; Rothman, Klein, & Weinstein, 1996). More specifically, in line with this interpretation, they would have evaluated the ability of a road safety

intervention to reduce the dangerous behaviors of other drivers but not to change their own behaviors. In fact, if the drivers questioned had had to evaluate the capacity of each intervention to change *their* way of driving, it is likely that they would have given different answers. In other words, the fact of having carried out a general questioning (judging the effectiveness of each intervention in reducing danger on the road in France), not focused on the behavior of the driver being questioned, probably reduced the prediction of intentions and behaviors.

This interpretation also explains why the level of education of the drivers questioned was negatively correlated with the perceived effectiveness of interventions of the social communication type. *A priori*, it could be expected that individuals most accustomed to abstract reflection and argument would judge interventions of the social communication type more favorably. However, if they are referring to other drivers, this leads them to deliver inverse judgments (i.e. for the average driver, only penalty and surveillance work).

Another factor probably diminished the predictive force of the measures employed. By focusing driver evaluation solely on the instrumental dimension of attitudes (perceived effectiveness) and, in so doing, excluding the affective/emotional dimension, the correlations were probably reduced. In fact, these two dimensions of attitude could lead to independent or even inconsistent evaluations and have separate effects on behaviors (e.g. Lawton, Conner, & McEachan, 2009; Lawton, Conner, & Parker, 2007). It is therefore likely that many drivers would judge interventions of the penalty/surveillance type to be more effective than interventions of the social communication type but, at the same time, experience a stronger aversion towards the former than the latter. Finally, experiences regarding penalty interventions were not measured. As this could have had an influence on the perceived efficacy of penalty interventions, and/or interact with public SC, this constitutes a limitation that should be addressed by future research.

The mention of these limitations does not call into question the approach employed, inspired by the works of Daignault and Delhomme (2011). It enables us to interpret the results obtained more accurately, to evaluate the relevance of the approach of these authors and to envisage several

developments of the latter, which should broadly increase its predictive strength. Several recommendations for further research proceed from the results obtained and the identification of these limitations. With regard to procedure, employing an experimental methodology controlling the effect of exposure to interventions of the two types (social communication and penalty/surveillance) with a non-exposed control group and measures before and after the period of exposure would remove the limitations identified. It would also be pertinent to employ techniques encouraging the heightening of self-awareness (e.g. replying in a group, making the responses public). With regard to the material to be employed, measuring the two dimensions of attitude towards road safety interventions, and focusing the individual on themselves or on other drivers, should alleviate the relevant limitations identified. Finally, including measures to estimate all of the TPB constructs would enable this material to be optimized.

5. Practical implications and conclusion

From a practical point of view, our results suggest that a perception of the effectiveness of road safety interventions should be encouraged. The effect of context on self-awareness must also be considered. For instance, self-awareness diminishes when individuals are in open spaces or are intoxicated (Hull, Levenson, Young & Sher, 1983). Thus, this type of context should be avoided in order to preserve the perceived effectiveness of interventions. Conversely, an increase in self-awareness could be induced by the encouragement of feedback in groups, while limiting anonymity as far as possible. Likewise, filmed feedback during training or awareness-raising sessions would be likely to promote a heightening of public self-consciousness. Finally, road safety awareness campaigns should favor, more than they have done so far, messages referring to the image that is given to others (driving style, views of close family and/or acquaintances, etc.) and the manner of acting in public spaces (aggressive behavior, good manners, etc.).

The fact that drivers attribute a higher effectiveness to penalty/surveillance interventions than to social communication interventions must be taken into account. This result highlights the

need to increase the perceived effectiveness of social communication interventions, especially for drivers with a high private SC. Several features that favor the positive appraisal and effectiveness of this type of intervention have been identified and should be more systematically implemented (e.g. Elvik, Vaa, Erke, Sorensen, 2009; Harrisson & Senserrick, 2000; Phillips, Ulleberg, & Vaa, 2011; Wundersitz, Hutchinson, & Wooley, 2010), such as personal/tailored communication with roadside delivery of campaign messages, and adapting the emotional content to target groups (e.g. positive emotional content for males, fear appeal for females).

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Table 1
Factor structure (principal axis factor analysis with direct oblimin rotation) and perceived effectiveness of road safety interventions (means and standard deviations)

	F1: Penalty / surveillance		F2: Social communication			
	Eigenval.(% expl.) 3.45 (34.76)		Eigenval.(% expl.) 1.65 (16.46)			
	Pattern matrix	Structure matrix	Pattern matrix	Structure matrix	*M*	*SD*
Penalties for driving in a state of inebriation (3)*	**.591**	**.628**	.097	.319	2.00	.87
Alcohol checks by the police (breathalyzer) (2)	**.597**	**.653**	.150	.374	2.00	.86
Driver training (4)	.059	.195	**.362**	**.384**	2.00	.83
Withdrawal of points from the driving license (6)	**.662**	**.636**	-.070	.179	1.93	.89
Police surveillance on the roads (5)	**.583**	**.619**	.096	.315	1.92	.82
Penalties for speeding (1)	**.762**	**.740**	-.057	.229	1.82	.91
Information radar indicating real speed and automated speed checks (10)	**.625**	**.597**	-.076	.159	1.64	.96
Courses raising awareness of the causes of road accidents (9)	.081	.295	**.570**	**.601**	1.61	.85
Prevention campaigns (7)	-.094	.206	**.798**	**.763**	1.47	.82
Variable message boards on the road (8)	-.024	.187	**.560**	**.552**	1.33	.84

Note. * Between brackets, rank on sample Daignault & Delhomme (2011). In bold, loading for each factor

Table 2
Zero-order correlations between all variables corrected for random measurement error

		M %	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1. Sex (% females) [a]	52	/															
	2. Children [b]	42	/	-.11*														
	3. Age	34.17	14.40	-.19*	.75*													
	4. Income	4.25	1.94	-.08*	.43*	.44*												
	5. Study level	4.72	1.22	.05	-.09*	-.09*	.24*											
	6. Driving experience	15.18	13.96	-.21*	.74*	.98*	.43*	-.09*										
	7. kilometers per year	2.73	1.54	-.27*	.25*	.23*	.12*	-.10*	.26*									
Speeding	8. Intention	2.85	1.42	-.18*	-.18*	-.28*	-.15*	-.01	-.26*	.20*	(.92)							
	9. Global behavior [c]	0	0.88	-.17*	-.10*	-.19*	-.09	-.03	-.17*	.25*	.86*	(.86)						
Drinking driving	10. Intention	1.40	0.68	-.16*	.06	.08*	.05	-.02	.08*	.08*	.24*	.28*	(.86)					
	11. Global behavior [c]	0	0.89	-.30*	.04	.06	.02	.00	.06	.14*	.29*	.40*	.80*	(.87)				
Road safety interventions	12. Social communication	1.60	0.59	.06	.17*	.22*	.09	-.11*	.22*	-.05	-.13*	-.09*	.04	-.03	(.66)			
	13. Penalty / surveillance	1.88	0.64	.08	.08*	.11*	.03	-.04	.11*	-.11*	-.17*	-.16*	-.08*	-.11*	.41*	(.81)		
Self-consciousness	14. Private	1.91	0.55	-.08	-.10*	-.15*	-.10*	.08	-.14*	-.08	-.01	-.02	-.02	-.02	.10*	.04	(.74)	
	15. Public	1.76	0.67	.14*	-.17*	-.18*	-.07	-.06	-.17*	-.13*	.05	.07	-.05	-.04	.17*	.20*	.48*	(.80)

Note. * $p < .05$; [a] 0 = male, 1 = female ; [b] 0 = no, 1 = yes ; [c] after standardization of the three measures ; coefficient α in brackets for multiple item measures

Table 3
Hierarchical regression analyses – Dependant variables: intentions, behavior and perceived effectiveness of road safety interventions

	Intention				Global behavior [c]						Road safety interventions			
	Speeding		Alcohol		Speeding			Alcohol			Social Com.		Penalty /surv.	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 1	Step 2
Gender [a]	-.16**	-.15**	-.14**	-.14*	-.12**	-.11**	.00	-.24**	-.24**	-.14**	.09	.08	.10	.08
Age	-.43**	-.42**	.02	.02	-.35**	-.34**	-.03	.00	.00	-.01	.19	.20	.10	.11
Have children[b]	.04	.05	.02	.03	.07	.07	.04	-.01	-.01	-.03	.03	.03	.06	.07
Income	.02	.02	.04	.04	.04	.04	.02	.01	.01	-.02	-.11	-.11	-.03	-.02
Study level	-.04	-.04	-.03	-.03	-.07	-.07	-.03	.00	.00	.02	-.09	-.08	-.15	-.14
kilometers per year	.20**	.18**	-.02	-.04	.21**	.19**	.06*	.01	.00	.03	.00	.01	-.01	-.01
Social communication	/	.01	/	.06	/	.02	.00	/	.04	.00	/	/	/	/
Penalty / surveillance	/	-.12**	/	-.12**	/	-.09*	.00	/	-.10*	-.02	/	/	/	/
Intention	/	/	/	/	/	/	.76**	/	/	.69**	/	/	/	/
Private self-consciousness	/	/	/	/	/	/	/	/	/	/	/	.09*	/	.03
Public self-consciousness	/	/	/	/	/	/	/	/	/	/	/	.10*	/	.11**
Model R^2	.19	.20	.03	.04	.12	.13	.59	.06	.07	.53	.06	.08	.05	.07
ΔR^2		.01*		.01*		.01*	.46**		.01*	.46**		.02**		.02**

Note. * $p < .05$, ** $p < .01$; [a] 0 = male, 1 = female ; [b] 0 = no, 1 = yes ; [c] after standardization of the three measures