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Martinez, Marie-Axelle Granié

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Towards a Multidimensional Model of Legitimacy: Validation of the Traffic Rules Perceived Legitimacy scale

Florent Varet¹, Marie Pelé², Laurent Carnis³, Anthony Piermattéo⁴, Frédéric Martinez⁵,
Marie-Axelle Granié⁶

¹. ANTHROPO LAB – ETHICS EA 7446, Université Catholique de Lille, F-59000 Lille, France.

<https://orcid.org/0000-0002-5248-3740>

florent.varet@hotmail.fr

². ANTHROPO LAB – ETHICS EA 7446, Université Catholique de Lille, F-59000 Lille, France.

<https://orcid.org/0000-0003-2297-5522>

marie.pele@univ-catholille.fr

³. AME-DEST, Université Gustave Eiffel-campus de Marne-la-vallée, 5 boulevard Descartes, 77454 Marne-la-Vallée, France.

<https://orcid.org/0000-0001-8557-1424>

laurent.carnis@univ-eiffel.fr

⁴. PSyCOS – ETHICS EA 7446, Université Catholique de Lille, F-59000 Lille, France.

<https://orcid.org/0000-0002-9598-983X>

Anthony.PIERMATTEO@univ-catholille.fr

⁵. AME-MODIS, Université Gustave Eiffel-campus de Lyon, 25 avenue François Mitterand, 69675 Bron, France.

<https://orcid.org/0000-0002-6884-0124>

frederic.martinez@univ-eiffel.fr

⁶. AME-MODIS, Université Gustave Eiffel-campus de Lyon, 25 avenue François Mitterand, 69675 Bron, France.

<https://orcid.org/0000-0003-2267-4367>

marie-axelle.granie@univ-eiffel.fr

Author Note

Correspondence concerning this article should be addressed to Florent Varet, Université Catholique de Lille – Maison des chercheurs, 14 boulevard Vauban, 59000 Lille – F. Email: florent.varet@univ-catholille.fr

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CRedit authorship contribution statement

Florent Varet: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Visualization; Writing – original draft

Marie Pelé: Conceptualization; Methodology; Writing – review and editing

Laurent Carnis: Conceptualization; Funding acquisition; Methodology; Writing – review and editing

Anthony Piermattéo: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Supervision; Validation; Visualization; Writing – review and editing

Frederic Martinez: Conceptualization; Funding acquisition; Methodology; Writing – review and editing

Marie-Axelle Granié: Conceptualization; Funding acquisition; Methodology; Writing – review and editing

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Abstract

Perceived legitimacy is important, often more so than deterrence, to explain and improve compliance with legal rules. However, several issues in the definition and measurement of perceived legitimacy have recently been highlighted and in different fields. A previous review of the literature (Varet et al., 2021), carried out on this issue, in the field of road safety, proposed a multidimensional model of the perceived legitimacy of traffic rules. The present study developed and tested these insights through the validation of a self-report scale: the Traffic Rules Perceived Legitimacy scale. A hierarchical model underlying the scale was hypothesized with two second-order factors (i.e., instrumental factor, normative factor) and four first-order factors (i.e., effectiveness, efficiency, moral alignment, fairness). A pilot study ($N = 74$) was designed to pre-test a pool of items. The main study ($N = 833$) was designed to assess the internal and the external validity of the proposed scale, and a quicker single-item measure. The results corroborate the internal validity of the scale and the hypothesized hierarchical model. As expected, hierarchical regression analyses confirmed that the perceived legitimacy of traffic rules was a better predictor of compliance than perceived deterrence, risk of accident, and social norms. The value and limitations of the corroborated model for defining and measuring the perceived legitimacy of other objects, within and beyond the field of road safety, are discussed. Practical implications in the field of road safety field are also discussed.

Keywords: legitimacy; compliance; traffic rules; scale validation; moral alignment

The interest in the concept of legitimacy within the social sciences has grown in recent decades, in particular in the field of psychology and more specifically in the study of the determinants of compliance with rules and authorities (Jackson, 2018; Tyler, 2006). The legitimacy perspective postulates that people voluntarily comply with the rules when they perceive them, along with the authorities that enforce them, as effective, just, fair, and aligned with their values, representations, and beliefs (Kelman, 1961; Tyler, 2006; Yagil, 1998). Several studies show that legitimacy can predict compliance with legal rules (see Walters & Bolger, 2019, for a meta-analysis) and yield a greater level of obedience than deterrent factors (Hough et al., 2010; Jackson et al., 2012a; Jackson et al., 2012b; Sunshine & Tyler, 2003; Tyler, 2010, 2011; Van Damme, 2013). The deterrence approach postulates that individuals are motivated to avoid the negative consequences of rule transgression when they are aware of them and that this is an important trigger for rule compliance (Blumstein et al., 1978; Tittle, 1980). Deterrent effects are notably characterized by the perceived certainty of being caught, the severity of the punishment and certainty of being punished. All these factors create an external motivation to comply (Gibbs, 1975). In this case, compliance relies on an external motivation and must therefore be based on means that maintain this motivation. These are often costly to implement and keep up over time. In contrast, the perception of legitimacy creates a voluntary compliance with rules, based on an internal motivation, as the individual believes that following the rules is “the right thing to do”. Interestingly, this self-regulated compliance does not require the presence of any external pressure and therefore has a long-lasting effect on behaviors (Tyler, 2009).

The relevance of the concept of legitimacy in explaining and prompting compliance with rules and recommendations is found in different fields such as legal socialization and citizen-police relations (Trinkner & Reisig, 2021), crime prevention (Lee & Park, 2021), compliance with medication (Stevenson et al., 2002), compliance with anti-pandemic

measures (Lacko et al., 2023), or compliance with traffic rules (Varet et al., 2021). In these different fields, some recent contributions have highlighted several issues and challenges related to the definition and measurement of legitimacy, in particular a significant variability in the definition and measurement of legitimacy which limits the comparability between studies and thus the accumulation of theoretical knowledge and the development of applications (Hough et al., 2013; Jackson, 2018; Jackson and Gau, 2016; Lacko et al., 2023; Van Petegem et al., 2021; Varet et al., 2021; Walters & Bolger, 2019). For example, several concepts such as the obligation to obey, moral alignment, perceived effectiveness, and procedural justice are positioned differently in relation to legitimacy from one study to another. They can be considered as being components of legitimacy, as distinct but related concepts, or as causes or consequences of legitimacy (Lacko et al., 2023; Varet et al., 2021). These issues need to be addressed because rule violations in different areas of daily life can represent societal issues, for example for safety, health, or community life.

To the best of our knowledge, there has not yet been a cross-disciplinary literature review of definitions and measures of perceived legitimacy. However, such reviews have been conducted in specific fields. Varet et al. (2021) conducted a scoping review on the perceived legitimacy of traffic rules and proposed theoretical and methodological recommendations in an attempt to develop a unifying framework for the study of perceived legitimacy. The authors (Varet et al., 2021) note that different objects on which legitimacy judgments are based (e.g., traffic rules, traffic offences, police, legal procedures, legislative institutions) are often included without being differentiated in the same definitions or measurement scale of perceived legitimacy. For example, in Penner et al., (2014) perceived legitimacy was measured with a single-index measure scale including support for the police, support for the courts, and feeling of obligation to obey the law. In Tyler et al. (2015), perceived legitimacy was measured with a single-index scale mixing feeling of obligation to

obey the police, moral alignment with the police, and moral alignment with the law. Varet et al. (2021) argued that this point was problematic and that it would be preferable to focus on how best to define and measure the perceived legitimacy of a single object before investigating its possible generalization or adaptation to defining and measuring the perceived legitimacy of other objects. Subsequently, Varet et al., (2021) focused their recommendations on defining the perceived legitimacy of traffic rules as this was the object most often considered in the studies they analyzed. Importantly, they suggested that the perceived legitimacy of traffic rules could be articulated around a multidimensional model.

In the present study, we propose to build on the theoretical proposal of Varet et al. (2021), to complete it, and to test it empirically by developing and validating a multidimensional scale of the perceived legitimacy of traffic rules. Finally, based on the results obtained, we propose to discuss the generalizability of these contributions to the study of the perceived legitimacy of other objects within and beyond the field of road safety. In the following introductory sections, we present in more detail the findings and theoretical proposals of Varet et al. (2021). In addition, we complement these speculations by mobilizing the literature on perceived legitimacy more broadly (i.e., beyond the field of road safety). Finally, we examine how the dimensions of the perceived legitimacy of traffic rules might relate to each other and to the explanation of traffic rule compliance.

The Main Issues in Defining and Measuring the Perceived Legitimacy of Traffic Rules

As in other fields, in the field of road traffic, legitimacy represents an interesting and promising concept to better understand and increase compliance with traffic rules (Varet et al., 2021). Indeed, the perceived legitimacy of traffic rules appears to be a stable predictor of compliance, often more so than deterrent factors such as the perceived certainty or severity of punishments (Bautista et al., 2015; Van Damme et al., 2016). Promoting compliance with traffic rules is important because violations are an important factor in the occurrence and

severity of fatal and serious accidents (Barraclough et al., 2016; de Winter and Dodou, 2010). Additionally, road traffic accidents are the 9th cause of mortality worldwide, with about 1.25 million deaths per year (World Health Organization, 2015).

In their scoping review, Varet et al. (2021) observed an important level of heterogeneity from one study to another in the assessment of concepts related to legitimacy such as moral alignment or the obligation to obey. Given the lack of clarity and uniformity of theoretical approaches and means of measurement, perceived legitimacy is mainly assessed through other concepts which should be considered as separate. As a result, no self-reported measure of the perceived legitimacy of traffic rules has been validated and used consistently across studies. More precisely, there has been only one study identified that proposes a factor analysis of a scale related to traffic legitimacy, but its focus was only on the perceived legitimacy of the police (Demir et al., 2018). Varet et al. (2021) noted that, to the best of their knowledge, the possible multidimensionality of the perceived legitimacy of traffic rules had not yet been formalized theoretically and tested empirically. Interestingly, Van Damme et al. (2016) proposed to use a multidimensional model of legitimacy based on Hough et al. (2013) in the field of road safety, but this was also focused on traffic police and not on traffic rules.

On the basis of the various theoretical definitions, components, and empirical measures they reviewed, Varet et al. (2021) proposed to (re)define the perceived legitimacy of traffic rules as “a propriety that individuals associate with a given traffic rule which promotes acceptance of its implementation, enforcement, and motivates individuals to respect the prescriptions that result from it.” (p. 14). Based on the same elements, they also proposed that perceived legitimacy of traffic rules could be considered as a multidimensional construct based on four dimensions that are perceived effectiveness, efficiency, moral alignment, and fairness.

The Four First-Order Dimensions of the Perceived Legitimacy of Traffic Rules

According to Varet et al. (2021), the *effectiveness* of traffic rules refers to their perceived ability to effectively meet the objectives leading to their creation, which is mainly the prevention of accidents and limiting their severity. This dimension aims to capture and represent the definitions and measures of traffic rules legitimacy that have been identified and relate them to their perceived rationality, adequacy, appropriateness (Bautista et al., 2015; Havarneanu & Havarneanu, 2012). Effectiveness was differentiated from efficiency in order to avoid its definition and operationalization being too broad and heterogeneous. This distinction between effectiveness and efficiency was not explicit in the literature, although some studies did use them as different aspects of their measure of the perception and perceived legitimacy of traffic rules (Alonso et al., 2017; Bautista et al., 2015). *Efficiency* refers to the proportionate character of the injunctions which emanate from a rule (i.e., to the fact that these injunctions are considered neither insufficient nor excessive). In other words, effectiveness is focused on the assessment of the purpose of the rules and the appropriateness of the means mobilized to that end, while efficiency is focused on the assessment of the intensity of those means.

Fairness was proposed by Varet et al. (2021) as the perception that traffic rules follow a principle of equity among all road users, are inclusive, do not generate unfair discrimination, and do not favor certain categories of users at the expense of others. Fairness has already been mobilized in the literature to define and measure the perceived legitimacy of traffic rules, but without having been explicitly defined (Bradford et al., 2015; Demir et al., 2018). Varet et al., (2021) found, in the field of road safety, that “fairness” and “distributive justice” on the one hand and “trustiness” and “procedural justice” on the other, are used interchangeably. The authors proposed fairness as a way of translating the concept of distributive justice (which initially refers to judgments about the judiciary process by which

an agent or institution makes decisions and produces outcomes) and procedural justice (which initially refers to judgments about the allocation of outcomes, resources) to the perception of traffic rules. The concept of “fairness” can also refer to “distributive” and “procedural justice” in the literature on police legitimacy outside the field of road safety. Tankebe (2013, p. 111) defines “distributive fairness” or “distributive justice” as the “perceptions that the outcomes people receive (e.g., decisions to arrest or to prosecute) are fair and that the distribution of outcomes (as between rich/poor, different ethnic groups, male/female, etc.) is fair also”, while he defines “procedural fairness” or “procedural justice” as “the fairness of the processes employed to reach specific outcomes or decisions (Tyler, 1990)” (p. 111).

Moral alignment was proposed as another dimension of the perceived legitimacy of traffic rules. It can be defined as the degree of consistency between the values individuals attribute to traffic rules and those they themselves consider to be important. This notion is very often mobilized to define and measure legitimacy in the field of road safety (Varet et al., 2021) but it is also in other fields just like routine cooperation with the police and justice (Hough et al., 2013). This dimension also allows us to consider definitions and measures of the perceived legitimacy of traffic rules based on the notion of acceptability (McKenna, 2007; Shaaban, 2017), given the significant overlap between the two and the lack of definition of the latter. In addition, moral alignment also covers definitions and measurements of the perceived legitimacy of traffic rules based on the concepts of moral judgment and attitude, which are mobilized with a similar meaning (Bautista et al., 2015; Bradford et al., 2015).

Finally, it is important to note obligation to obey was not retained by Varet et al. (2021) as a possible dimension of the perceived legitimacy of traffic rules, although it is often mobilized as one of the two main dimensions of legitimacy along with moral alignment (Van Petegem, 2021). Indeed, on the one hand moral alignment can be considered to result from a perception of legitimacy rather than a dimension of it (Varet et al., 2021). On the other hand,

traditional measures of obligation to obey have been criticized for their inability to differentiate between the compliance resulting from an intrinsic motivation and the one that stems from an extrinsic motivation while perceived legitimacy is associated with intrinsic motivations (Van Petegem et al., 2021).

The Two Second-Order Dimensions of the Perceived Legitimacy of Traffic Rules

Recent research on perceived legitimacy, particularly of the police, often considers this perception to be organized around two orthogonal dimensions, one instrumental and the other normative (Kim et al., 2020; Kyprianides, 2022; Tost, 2011). The instrumental dimension is based on a cost-benefit calculation, whereby individuals will prefer to comply with the law and cooperate with the police if the benefits outweigh the costs (Tyler et al., 2006). In the case of the police, the instrumental dimension is based on perceived police effectiveness (in fighting crime) and perceived risk of sanction (for rule breakers, see Kim et al., 2020; Kyprianides, 2022; Sunshine & Tyler, 2003). The normative dimension is based on more relational aspects, relying on moral alignment (or normative alignment) with the police and the fairness (or procedural justice) of police procedures used to achieve certain decisions or outcomes (Tankebe, 2013; Tyler, 2006).

By transposing the dimensions of perceived police legitimacy to the object of traffic rules, it seems possible to link them to the four dimensions proposed by Varet et al. (2021). Indeed, the effectiveness and efficiency of traffic rules correspond to their ability to achieve their objectives (reducing the risk and severity of accidents) by means that are correctly proportionate. It can therefore be compared to the effectiveness of the police and the risk of sanctions and thus with the instrumental dimension of perceived legitimacy¹. Fairness and

¹ Note that the perception that obeying traffic rules is important to avoid penalties could be considered as another instrumental dimension of the perceived legitimacy of traffic rules (and not only of the police), in addition to the perception that obeying traffic rules is important to avoid accidents. However, we propose to consider only the latter as an instrumental dimension of the perceived legitimacy of traffic rules as a simpler way to test the multidimensional model proposed in this study and to avoid possible confounding between perceptions of traffic rules and traffic penalties or traffic police.

moral alignment with traffic rules can be compared with fairness of and moral alignment with the police and thus with the normative dimension of perceived legitimacy. As a result, the perceived legitimacy of traffic rules would be based on a hierarchical model with effectiveness, efficiency, moral alignment, and fairness as first-order dimensions and instrumental and normative aspects as second-order dimensions.

Relationship Between Dimensions of the Perceived Legitimacy of Traffic Rules

Given that the perceived legitimacy of traffic rules is based on several dimensions, the question arises as to the relationship between these dimensions in predicting compliance with the rules. In other words, what is their respective weight and are their effects additive or interactive? With regard to the respective weight of instrumental and normative dimensions in predicting compliance with rules, the literature reports contradictory effects. Normative concerns typically appear to be a stronger predictor of overall perceived police legitimacy or cooperation with the police, than instrumental concerns (Nam et al., 2022), while some other studies report the opposite (Bradford, 2014; Hinds, 2009; Hinds & Murphy, 2007; Murphy & Cherney, 2011; Tankebe, 2009). Therefore, we propose to test the explanatory power of each dimension on compliance with traffic rules from an exploratory perspective.

Few studies appear to have investigated the possible interactions between instrumental and normative dimensions of legitimacy on compliance with rules. For example, Tyler (2006) found that the normative aspect of perceived legitimacy was a stronger predictor of compliance for people who perceived high rather than low police and court effectiveness. Nam et al. (2022) found that police procedural justice moderated the effect of police effectiveness on overall ratings of police legitimacy. The less procedurally fair the police is perceived to be, the less its perceived effectiveness positively predicts its overall perceived legitimacy. This may suggest that individuals will conform their behavior to rules according to perceived instrumental legitimacy only if they perceive normative legitimacy to be

sufficiently satisfactory. Accordingly, we propose to test the possible interactions between instrumental and normative dimensions of the perceived legitimacy on traffic rules compliance.

Aims of the Study and Overview

This paper aims to validate a multidimensional self-reported scale of the perceived legitimacy of traffic rules, based on the theoretical model derived from a previous literature review (Varet et al., 2021) and considerations from the literature on perceived police legitimacy. To our knowledge, no study has yet developed such a scale, following the main steps recommended in a psychometric approach (McKenzie et al., 2011). Developing this scale and corroborating its theoretical model may allow better comparability between future studies on this topic. This would improve the cumulative knowledge on the determinants and consequences of legitimacy in the field road safety as well as their possible applications. In addition, future research programs could attempt to adapt and transpose this scale to the study of the legitimacy of other objects in the field of road safety (e.g., means of enforcement, traffic police, legal procedures) and in other fields more broadly such as legal socialization or medication compliance.

A pilot study ($N = 74$) was designed to both evaluate the relevance of a pool of items the authors collectively elaborated to assess each of the four dimensions as well as their comprehensibility and select the items most appropriate for the main study (Boateng et al., 2018; McKenzie et al., 2011). The main study ($N = 833$) was designed in order to (a) evaluate and compare the fit of the theoretical hierarchical model (four first-order factors and two second-order factors) with alternative models through factor analyses, (b) evaluate the internal consistency, the test-retest reliability and the inter-correlations of the dimensions retained, (c) explore their respective predictive power and possible interactions on compliance with traffic rules, (d) test the predictive validity of the model in forecasting self-

reported compliance with traffic rules over and above the classical predictors that are deterrent factors, accident risk, and social norms. Indeed, among the deterrent factors, the effects of the perceived certainty and severity of punishment on compliance with traffic rules are well documented (Briscoe, 2004; Homel, 1988; Kergoat et al., 2017). Compliance is also well known to be motivated by the perceived probability and severity of a traffic accident in the event of a violation (Fernandes et al., 2010; Yao et al., 2019). Descriptive and injunctive norms concerning the respect of traffic rules by relatives are also important determinants of compliance, beyond the previous ones (Cestac et al., 2011; Geber et al., 2019). In parallel to these steps, we also propose (g) to test the validity of a single-item measure of the perceived legitimacy of traffic rules. Single-item measures offer some advantages over longer measures, such as reducing the mean time to complete a questionnaire (Konrath et al., 2014), limiting the boredom and fatigue of participants and thus increases response quality (Robins et al., 2001; Robinson et al., 1991) and completion rate (Edwards et al., 2004).

The pilot study and the main study were conducted in accordance with the 1964 Helsinki declaration (WMO, 1964) and its amendments, the ethical principles of the French Code of Ethics for Psychologists (CNCDP, 2012), and the 2016 APA Ethical Principles of Psychologists and Code of Conduct (APA, 2017). Before starting the studies, all participants were informed that they could stop their participation at any time without any consequences and signed an informed consent form. Confirmatory factor analyses were made using Lavaan package with Maximum Likelihood as estimator and NLMINB as optimization method (Rosseel, 2010), in RStudio (Posit team, 2023). All other statistical analyses were made using Jamovi (The jamovi project, 2023), all parametric tests are bivariate and the significance threshold α was set at .05. The pilot study and the main study were not preregistered.

Pilot Study

Method

A first pool of items supposed to represent each of the four theoretical dimensions (i.e., effectiveness, efficiency, moral alignment, fairness) of the perceived legitimacy of traffic rules was developed (McKenzie et al., 2011). First, the authors collectively established a list of synonyms of the four dimensions in order to generate multiple alternative items for each of them. Second, every author independently generated several items for each of the four dimensions based on their respective definitions and identified synonyms. Third, the authors discussed collectively to reach a consensus on the relevance of each item to the corresponding dimension and eliminate items that were redundant or too far from the theoretical definitions. Ultimately, 108 items, including reversed items, were pre-selected for the pilot study.

An online survey was proposed to undergraduate students during psychology courses ($N = 186$, $M_{age} = 19.48$, $SD_{age} = 2.32$, 79% women) and to the general population through social media ($N = 104$, $M_{age} = 34.66$, $SD_{age} = 12.69$, 65% women). The survey was presented as a study on how comprehensible different sentences were in order to validate a tool to measure the relationship of individuals to traffic rules. Each participant was presented with a random selection of 20 items from the pool and was asked to rate the fit of each item with each of the four dimensions and how easy these items were to understand. For instance, the fit with the effectiveness dimension was measured as follows: “The assertion assesses effectiveness, i.e., whether the rules are able to meet the objectives for which they were put in place” and the fit with the efficiency dimension was measured by the following item: “The assertion assesses efficiency, i.e., that the rules are insufficient or do too much to achieve their objectives”. Fits were rated from 1 (*the statement does not refer to the dimension*) to 5 (*the statement refers to*

the dimension). For each item, readability was measured as follows: “How easy do you find the statement to understand?”; and was rated from 1 (*very difficult*) and 5 (*very easy*).

Results

Only 74 participants out of 290 completed the questionnaire fully. While the questionnaire was relatively short, this poor completion rate suggests that the task was too complex for the participants and/or required too much time to be completed. Due to this small number of participants, each item was evaluated by a range of 8 to 27 individuals. Even if the low values of this range can be considered to be small, they do not prevent the realization of paired samples Students’ *t*-tests or their nonparametric equivalent (de Winter, 2013). Thus, for each item, paired comparisons were made between its means on each of the four dimensions (i.e., effectiveness, efficiency, moral alignment, fairness) and a Bonferroni correction was applied (Field, 2013). The aim of these analyses was to determine whether an item that was originally designed to reflect a particular dimension (e.g., fairness) was actually characterized by an adequacy score for this dimension that was significantly higher than the score assessing its adequacy for the other dimensions (i.e., effectiveness, efficiency, and moral alignment). In other words, this first criterion allowed us to select an item if, in the eyes of the participants, it better reflected the dimension to which it was supposed to relate than the others. In addition, a one-sample Student’s *t*-test was carried out for each item, comparing the mean of readability against the middle value of the scale (i.e., 3). This second analysis allowed us to consider that the item was judged to be easy to understand.

All items that met both criteria (i.e. adequacy to the intended dimension and readability) were selected. However, in some cases the selection of items depended on a final decision among the research team. This was especially the case when two items whose meaning was very close were selected —and where only one should be kept— or when a dimension was composed of too many or too few items. In those cases, the descriptive

statistics regarding the item, its meaning and fit in the overall meaning of its dimension were taken into account. Finally, 26 items were selected (10 for effectiveness, 5 for efficiency, 6 for moral alignment, 5 for fairness) to constitute the Traffic Rules Perceived Legitimacy (TRPL) scale. These were retained for the main study (see Table 2 for English translation; see Appendix for original French items).

Main study

Method

An online survey was sent in two stages, 10 days apart, to 1500 participants. The participants were the same for both stages. They were part of a company panel (EasyPanel: <https://easypanel.fr/>) and were compensated for their participation. They all had a driving license for a car and/or a motorcycle, were all at least 18 years old and declared residency in France. The survey was presented as a study about drivers' and motorcyclists' relationship to traffic rules.

The first stage of the survey included the following measures:

Traffic Rule Perceived Legitimacy scale. The 26-items version of the TRPL scale resulting from the pilot study was proposed. Participants were told that the items were intended to measure their opinions about traffic rules in general. They were asked to rate their agreement with each item from 1 (*strongly disagree*) to 7 (*strongly agree*), based on the prompt "Regarding rules of the road in general, I think that:". To validate a short single measure of the perceived legitimacy of traffic rules, the item "they are legitimate" was added at the end of the scale.

Mobility variables. Participants were asked to indicate the year they obtained their driving license; how often they drive a car or ride a motorbike in a typical week, from 1 "never" to 6 "several times a day"; and in what type of environment they travel most often in

a typical week, from 1 “only in a rural environment (countryside)” to 7 “only in an urban environment (city, suburbs)”.

Sociodemographics. Participants were asked to indicate their gender, age, SES, and educational level. SES was binary coded². Education level was coded from 1 (*no degree*) to 8 (*Ph.D. degree, equivalent or more*).

Self-reported disturbance check. Participants were asked to answer the question "Have you been disturbed or distracted by your environment during the study?", with the responses “not at all”, “a little”, or “a lot”.

Self-reported seriousness check. Participants were asked if they had participated seriously in the study or if they had just clicked anywhere to see what the study looked like (Aust et al., 2013).

The second stage of the survey included the following measures:

Compliance with traffic rules. Usual compliance with traffic rules was assessed with the following single item: “Usually, how well do you follow the rules of the road as a motorist or motorcyclist?”, rated from 1 (*I never comply with traffic rules*) to 7 (*I always comply with traffic rules*).

Traffic Rules Perceived Legitimacy scale. As in the first stage, the 26-items version of the TRPL scale and the single-item were used.

Perception of deterrence. Perceived deterrence was assessed through its two main components that are the perceived probability of being punished for violating a traffic rule,

² Low SES included the following answers: “never worked or long-term unemployment”, “workers (e.g., drivers, agricultural workers, mechanics, cleaners)”, “employees (e.g., office workers, hospital workers, salesmen, firemen)”, “farmers (e.g., market gardeners, ranchers, loggers, fishermen)”, “other non-working person (e.g., housewife or househusband)”, “students”. High SES included the following answers: “intermediate occupations (e.g., nurses, non-commissioned officers in the army and gendarmerie, teachers, special educators)”, “craftsmen, shopkeepers, and business owners (e.g., bankers, cab drivers, hairdressers, restaurant owners)”, “executives and higher intellectual professions (e.g., engineers, doctors, teachers, lawyers...)”.

rated from 1 (*very low*) to 7 (*very high*) and the perceived severity of the penalties following such a traffic rule violation, rated from 1 (*not very severe*) to 7 (*very severe*; see Kergoat et al., 2017 for similar measures).

Risk perception of road traffic accidents. Risk perception associated with road traffic accidents was assessed through its two components that are the perceived probability of being involved in a road traffic accident in case of a traffic rule violation, rated from 1 (*very low*) to 7 (*very high*) and the perceived severity of the accident following a traffic rule violation, rated from 1 (*not serious at all*) to 7 (*extremely serious*; see Weinstein, 2000 for similar measures).

Descriptive and injunctive norms associated with compliance with traffic rules. According to the distinction proposed by Cialdini et al. (1991), the descriptive norm associated with compliance with traffic rules was assessed with the following item: “How well do you think people in general comply with traffic rules?”, rated from 1 (*They never comply with traffic rules*) to 7 (*They always comply with traffic rules*). The injunctive norm associated with compliance with traffic rules was assessed with the following item: “In your opinion, for people in general, breaking traffic rules is:”, rated from 1 (*very badly perceived*) to 7 (*very well perceived*). This item was reverse-scored for the subsequent analyses.

Self-reported disturbance and seriousness checks. The same two items were used than in the first stage.

Moreover, the order of presentation of traffic rule perceived legitimacy, perception of deterrence, risk perception of traffic accidents, and descriptive and injunctive norms was counterbalanced.

Sample and Data Screening

Of the 1500 participants who were invited to participate in the two-stage survey, 667 were identified as careless or inattentive participants and excluded from the database. The

exclusion criteria and the references on which they are based are presented in Table 1.

Ultimately, 833 participants were retained for the subsequent analyses ($M_{age} = 51.99$, $SD_{age} = 13.27$; 52% women; 1% students, 18% unemployed, 39% employees or workers, 24% intermediate occupations, 3% tradespersons, shop or business owners or farmers, 15% executives or intellectual professions). Eight hundred and twenty-seven participants reported holding a valid car driver's license for 32.39 years on average ($SD = 13.39$) and 158 reported holding a valid motorcycle driver's license for 31.86 years on average ($SD = 14.71$; note that several participants reported holding both licenses). For each participant, an average score on each legitimacy item of the first and second stages of the survey was calculated and retained for the subsequent analyses unless otherwise stated. The dataset used for this main study, after participants exclusion, is available in the following OSF repository:

<https://doi.org/10.17605/OSF.IO/HSRKE>.

Results

Confirmatory Factor Analysis on the Traffic Rule Perceived Legitimacy Scale

The sample was randomly split into two subsamples (Mondo et al., 2021; Willmer et al., 2019; Yıldırım & Güler, 2022) after matching subjects based on their gender, age, and SES. A confirmatory factor analysis (CFA) was carried out on the first subsample ($n = 416$) on the TRPL scale to test the hypothesized hierarchical model (with four first-order factors: effectiveness, efficiency, moral alignment, fairness; and two second-order factors: instrumental motives, normative motives). The items were positioned on their respective theoretical dimension. Two reversed items theoretically linked respectively with fairness ("Their application creates inequalities between people") and moral alignment ("Morally, I find it acceptable to break these rules") were excluded to improve the fit of the model and because they had the lowest saturation on their respective dimensions. They were also excluded from the subsequent other models tested, for comparability purposes.

Table 1*Participant exclusion criteria applied to the database.*

Participant exclusion criteria	<i>N</i>	References
Answering the first stage but not the second stage of the survey.	200	-
Not indicating in which year at least the car driving license or the motorcycle license was obtained or providing an incorrect or ambiguous answer to at least one of the two questions (e.g., “1”, “2984”).	15	-
Answering “a lot” to the self-reported disturbance check, in at least one of the two stages.	33	-
Answer of having just clicked anywhere to see what the study looked like in the self-reported seriousness check, in at least one of the two stages.	6	Aust et al. (2013)
Consistently providing the same answer on all items of at least one multi-item scale (i.e., long strings of patterned responses), in at least one of the two stages. ^a	145	Curran (2016) Desimone et al. (2015) Meade & Craig (2012)
Completing the survey in less than 5 min and 50 s in the first stage or in less than 5 min and 35 s in the second stage. ^b	214	Curran (2016) Desimone et al. (2015) Huang et al. (2012)
Completing the survey with an amount of time greater than +1 <i>SD</i> from the mean completion time (> 37 min and 50 s for the first stage or > 49 min and 42 s for the second stage). ^c	54	Curran (2016) Desimone et al. (2015) Huang et al. (2012)

Note. ^a In addition to the Traffic Rules Perceived Legitimacy scale, this criterion was also applied to scales that were included in the questionnaire (i.e., chronic regulatory focus scale, Zimbardo time perspective inventory, sensitivity to punishment/sensitivity to reward questionnaire, traffic locus of control scale) but not reported in this study because they addressed other objectives of the questionnaire that go beyond those of this study.

^b These time values were determined on the basis of a pretest leading to the estimation of a duration below which participants would not have been able to read all the items.

^c That these time values were calculated on the remaining participants after application of all the previous exclusion criteria.

Factor loadings and descriptive statistics for retained items are presented in Table 2.

Finally, all indices reached the ideal threshold, except for the RMSEA which remains

acceptable ($\chi^2/df = 2.90$; CFI = .95; TLI = .95; SRMR = .05; RMSEA = .07; AIC = 24214.25;

BIC = 24427.88; Browne & Cudeck, 1993; Burnham & Anderson, 2002; Hu & Bentler,

1999; Marsh, Hau & Wen, 2004; Wheaton et al., 1977). A model with only four factors (i.e.,

effectiveness, efficiency, moral alignment, fairness) was tested and showed similar indices,

while a model with only two factors (i.e., instrumental factor, normative factor) showed poor

fits (see Table 3).

Table 2

Factor loadings and descriptive statistics from the confirmatory factor analysis for the hierarchical model (four first-order and two second-order factors) on the Traffic Rules Perceived Legitimacy scale.

Factors and items	Unstandardized Estimate	SE	Z	Standardized Estimate	Mean (SD)
Effectiveness					
They are well suited to avoid road traffic accidents. (1)	1.00			0.74	5.70 (1.04)
They are a reasonable solution to the problem of accidentality. (4)	1.15	0.07	16.61	0.79	5.27 (1.12)
For me, their advantage for road safety is indisputable. (6)	1.18	0.08	14.67	0.70	5.56 (1.29)
They are essential for road safety. (9)	1.28	0.07	19.22	0.90	5.95 (1.09)
They have a real impact on road safety. (11)	1.22	0.07	17.72	0.83	5.55 (1.12)
They have an obvious advantage for road safety. (14)	1.29	0.07	19.64	0.91	5.75 (1.08)
We understand their interest in avoiding road traffic accidents. (16)	1.30	0.07	19.96	0.93	5.82 (1.07)
They are necessary to avoid road traffic accidents. (19)	1.26	0.06	19.81	0.92	5.93 (1.05)
They are useful to avoid road traffic accidents. (21)	1.25	0.06	19.52	0.91	5.90 (1.05)
Their advantage in reducing road traffic accidents seems clear to me. (25)	1.41	0.07	19.50	0.91	5.70 (1.19)
Efficiency					
They are too strict.(3)*	1.00			0.82	4.84 (1.49)
They are too restrictive.(8)*	1.08	0.05	20.85	0.85	5.09 (1.56)
They are exaggerated in relation to their objective of avoiding accidents. (13)*	1.18	0.05	23.75	0.92	5.04 (1.57)
There are too many rules. (18)*	1.08	0.06	18.21	0.77	4.20 (1.71)

They go too far in relation to their objectives. (23)*	1.15	0.05	22.81	0.90	4.94 (1.56)
Moral alignment					
Morally, I find it acceptable to break these rules. (2)* #	-	-	-	-	5.75 (1.34)
They do not correspond to my personal values. (7)*	1.00			0.62	5.70 (1.35)
On a moral level, they seem questionable to me. (12)*	1.32	0.11	12.56	0.73	5.40 (1.52)
Morally, I have no problem with them. (17)	1.02	0.08	12.72	0.74	5.90 (1.15)
Morally, I have good reasons to defend them. (22)	1.19	0.09	13.71	0.82	5.56 (1.22)
Morally, I find them unacceptable.* (26)	1.08	0.08	12.91	0.76	6.04 (1.20)
Fairness					
They are the same for everyone. (5)	1.00			0.84	5.74 (1.38)
They apply to everyone in the same way. (10)	1.05	0.05	23.11	0.89	5.80 (1.37)
They do not differentiate between individuals. (15)	0.92	0.06	16.62	0.72	5.34 (1.49)
Their application creates inequalities between people. (20)* #	-	-	-	-	5.05 (1.54)
They treat everyone the same. (24)	1.16	0.05	23.63	0.91	5.43 (1.49)
Instrumental factor					
Effectiveness	1.00			0.88	5.71 (0.96)
Efficiency	1.51	0.11	13.84	0.84	4.82 (1.39)
Normative factor					
Moral alignment	1.00			0.97	5.72 (1.03)
Fairness	0.92	0.09	10.47	0.65	5.58 (1.26)

Note. All $ps < .001$.

Number in parentheses at the end of the items indicates the item's order of presentation in the survey. * Indicates items that are reverse-scored. # Indicates those items excluded from the final version of the scale. All factor loadings are $p < .001$. Items were rated from 1 (*strongly disagree*) to 7 (*strongly agree*).

Table 3

Fit indices for the five confirmatory factor analysis models tested on the Traffic Rules Perceived Legitimacy scale.

Model	χ^2	df	<i>p</i>	CMIN /df	CFI	TLI	SRMR	RMSEA [90% CI]	AIC	BIC
Four-first order and two second-order factors	715.88	247	< .001	2.90	.95	.95	.05	.07 [.06, .07]	24214.25	24427.88
Four-dimensional	683.94	246	< .001	2.78	.95	.95	.04	.07 [.06, .07]	24184.32	24401.97
Three-dimensional	660.19	249	< .001	2.65	.96	.95	.04	.06 [.06, .07]	24154.56	24360.13
Two-dimensional	2238.57	251	< .001	8.92	.79	.77	.09	.14 [.13, .14]	25728.94	25926.45
One-dimensional	2347.78	252	< .001	9.32	.78	.76	.09	.14 [.14, .15]	25836.15	26029.62

Note. χ^2 = Chi-square statistic; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; SRMS = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation. AIC = Akaike Information Criterion.

Unless otherwise stated, all models were tested without considering second-order factors.

To identify and test other competing models, an exploratory factor analysis (EFA) with Maximum Likelihood method and Promax rotation was carried out on the second subsample ($n = 417$). Based on a parallel analysis, the EFA suggested a three-dimensional model differentiating effectiveness, efficiency, and fairness and for which the items theoretically associated with moral alignment are included in the effectiveness and efficiency dimensions. All items saturated at least at .42 on one of the three dimensions. This three-dimensional model as well as a one-dimensional model including all items on the same dimension were tested with a CFA on the first subsample. The three-dimensional model presented a similar fit to the hierarchical and the four-dimensional models while the one-dimensional model presented poor fits (see Table 3). Finally, the hierarchical model provided a satisfactory fit, allowed for the consideration of two levels of factors, is more parsimonious than the four-dimensional model (Rindskopf & Rose, 1988), and, to the best of our knowledge, is the best supported by theoretical considerations. It was therefore retained for the following analyses.

Internal Consistency, Test-Retest Reliability and Correlations Between Factors and Single-Item Measure

Descriptive statistics, internal consistency, and test-retest reliability for the factors and the single-item measure of TRPL are presented in Table 4. Each of the first-order and second-order factors of the TRPL scale showed a high internal consistency in the first stage and the second stage, with all Cronbach's $\alpha \geq .80$. These factors also showed an acceptable test-retest reliability from the first stage to the second stage (all Pearson correlations $\geq .64$, all $ps > .001$). The single item measure of TRPL also showed an acceptable test-retest reliability ($r = .65$, $p < .001$). Means of the factors and the single-item measure are above the theoretical central value of the 7-points Likert scales, ranging from 4.80 ($SD = 1.41$) to 5.80 ($SD = 1.12$)

and medians range from 4.90 to 6.00. Correlations between the factors and the single-item measure of the TRPL are presented in Table 5. Instrumental and normative factors are positively and strongly correlated with each other ($r = .82, p < .001$) and with the single item ($r = .88, p < .001$ and $r = .80, p < .001$, respectively). The four first-order factors presented positive moderate to strong correlations with each other (from .40 to .80) and with the single item (from .58 to .88).

Table 4

Descriptive statistics, internal consistency, and test-retest reliability for the factors of the Traffic Rules Perceived Legitimacy scale and the single-item measure.

	Effectiveness	Efficiency	Moral alignment	Fairness	Instrumental factor	Normative factor	Single-item legitimacy
Mean (SD)	5.75 (0.96)	4.80 (1.41)	5.70 (1.04)	5.60 (1.29)	5.43 (1.02)	5.66 (1.01)	5.80 (1.12)
Median	5.95	4.90	5.90	5.88	5.57	5.89	6.00
Cronbach's alpha - First stage	.94	.89	.81	.84	.94	.85	-
Cronbach's alpha - Second stage	.94	.89	.80	.89	.94	.87	-
Test-retest reliability (Pearson correlation)	.70	.77	.68	.69	.77	.64	.65

Note. All mean scores were based on items rated from 1 (*strongly disagree*) to 7 (*strongly agree*). For test-retest reliability all $ps < .001$.

Table 5

Pearson correlations between the factors and the single-item measure of traffic rule perceived legitimacy, concurrent predictors, and compliance with traffic rules.

	Effectiveness	Efficiency	Moral alignment	Fairness	Instrumental factor	Normative factor
Efficiency	.68	—				
Moral alignment	.80	.78	—			
Fairness	.63	.40	.53	—		
Instrumental factor	.94	.89	.86	.58	—	
Normative factor	.82	.68	.88	.87	.82	—
Single-item legitimacy	.88	.71	.81	.58	.88	.80

Note. All $ps < .001$

Predictive Validity

Correlations between the factors and the single item of the TRPL with self-reported compliance with traffic rules and other predictors were examined (see Table 6). Results show that instrumental and normative factors presented a positive small to medium correlation with compliance with traffic rules ($r = .37, p < .001$, $r = .29, p < .001$, respectively). All the four first-order factors presented positive small to medium correlations with compliance with traffic rules (ranging from $r = .21, p < .001$ for fairness to $r = .37, p < .001$ for effectiveness). Consistently, the single item measure of TRPL presented a positive medium correlation with compliance with traffic rules ($r = .34, p < .001$). All measures of TRPL showed positive small to medium correlations with the perceived probability of being involved in an accident (ranging from $r = .08$ to $.18$), the perceived severity of the accident (ranging from $r = .13$ to $.22$) and the injunctive norm (ranging from $r = .09$ to $.19$). All measures of TRLP showed negative small to medium correlations with perceived severity of penalties (ranging from $r = -.12$ to $-.39$). No measures of TRLP were correlated with perceived probability of being

punished, except for efficiency ($r = -.08, p < .05$). Finally, descriptive norm was weakly and positively correlated with effectiveness, fairness, normative factor and with the single-item measure of TRPL.

Table 6

Pearson correlations between the factors and the single-item measure of traffic rule perceived legitimacy, concurrent predictors, and compliance with traffic rules.

	Probability of being punished	Severity of penalties	Probability of accident	Severity of accident	Descriptive norm	Injunctive norm	Compliance with traffic rules
Effectiveness	.01	-.19***	.13***	.20***	.11**	.19***	.37***
Efficiency	-.08*	-.39***	.15***	.20***	-.02	.09*	.29***
Moral alignment	-.04	-.27***	.18***	.22***	.02	.13***	.30***
Fairness	.01	-.12***	.08*	.13***	.14***	.16***	.21***
Instrumental factor	-.03	-.30***	.15***	.22***	.06	.16***	.37***
Normative factor	-.02	-.22***	.15***	.20***	.09**	.17***	.29***
Single-item legitimacy	-.02	-.22***	.17***	.20***	.08*	.13***	.34***
Compliance with traffic rules	-.01	-.08*	.07	.14***	.08*	.13***	—

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

In order to compare the effects of the different predictors on compliance with traffic rules, to assess the predictive validity of the TRPL scale and the single-item measure, and to test interactions between the factors of the TRPL scale, three hierarchical regression models were tested. In each model compliance with traffic rules was entered as a dependent variable. In the first regression, TRPL was considered with the two-second order factors (i.e., instrumental factor, normative factor). In the second regression model, TRPL was considered

with the four first-order factors (i.e., effectiveness, efficiency, moral alignment, fairness). In the third model, TRLP was considered with the single measure. In each regression, deterrence, risk perception, social norms variables, and TRPL measures were entered as independent variables in a first step. For the first regression (TRLP considered with the two second-order factors) and the second regression (TRLP considered with the four first-order factors), interaction term(s) between the TRLP factors was or were entered in a second step. Socio-demographic and mobility variables that were significantly associated with at least one of the measures of TRPL considered in the model were entered as independent variables in a third and final step in order to be accounted for (for a presentation and a discussion of the results about differences in TRPL according to socio-demographic and mobility variables, see the ‘Supplementary analyses’ file in OSF). For the third regression (TRLP considered with the single item measure), relevant socio-demographic and mobility variables were entered in the second and final step.

In the first regression (i.e., TRLP considered with the two second-order factors), in the first step (including deterrence, risk perception, social norms variables, and TRPL measures) compliance with traffic rules was positively predicted by the injunctive norm with a small effect size ($\beta = .07, p < .05$), by the instrumental factor with a medium effect size ($\beta = .41, p < .001$), but not by the normative factor ($p > .10$). In the second step, the added interaction term instrumental*normative factor was not significant ($p > .10$) and previous effects stay unchanged. At the third step (adding socio-demographic and mobility variables), the effect of injunctive norm became non-significant ($p > .10$) while other previous effects stay unchanged (see Table 7). Multicollinearity issues were detected for instrumental factor (tolerance = 0.04, VIF = 25.25) and normative factor (tolerance = 0.05, VIF = 19.30).

Table 7

Results of the final step of the hierarchical regression testing the effect of the two second-order factors of traffic rules' perceived legitimacy and other predictors on compliance with traffic rules.

Step	Predictor	Estimate	S.E.	<i>t</i>	<i>p</i>	Standardized estimate	95% CI	
							Lower	Upper
1	Intercept	5.77	17.27	0.33	.738			
	Probability of being punished	-0.01	0.02	-0.27	.788	-.01	-.09	.07
	Severity of penalties	0.02	0.03	0.56	.576	.02	-.05	.09
	Probability of accident	0.00	0.02	-0.18	.854	-.01	-.09	.07
	Severity of accident	0.04	0.03	1.43	.153	.06	-.02	.13
	Descriptive norm	0.06	0.03	1.69	.091	.06	-.01	.12
	Injunctive norm	0.05	0.03	1.72	.086	.06	-.01	.12
	Instrumental factor	0.47	0.17	2.81	.005	.40	.28	.51
	Normative factor	-0.04	0.15	-0.28	.776	-.09	-.21	.03
2	Instrumental factor * Normative factor	-0.01	0.03	-0.34	.732	-.01	-.06	.04
3	Age	0.01	0.01	1.21	.225	.13	-.08	.34
	Educational level	-0.02	0.02	-0.72	.471	-.02	-.09	.04
	Year of obtaining car license	0.00	0.01	-0.18	.859	-.02	-.23	.19
	Frequency of travel as car driver	0.06	0.03	2.19	.029	.07	.01	.14
	Frequency of travel as motorcyclist	-0.04	0.05	-0.81	.420	-.03	-.09	.04
	Travel in urban environment	0.00	0.02	0.21	.836	.01	-.06	.07
	Gender	-0.10	0.07	-1.39	.164	-.09	-.23	.04
Overall model		<i>R</i>	<i>R</i> ²	<i>Adjusted R</i> ²	<i>F</i>	<i>df1</i>	<i>df2</i>	<i>p</i>
		.42	.18	.16	10.83	16	810	< .001

In the second regression (TRLP considered with the four first-order factors), in the first step (including deterrence, risk perception, social norms variables, and TRPL measures), compliance with traffic rules was positively predicted by effectiveness with a medium effect size ($\beta = .35, p < .001$), but not by the other first-order factors (all $ps > .05$). In the second

step (adding the first-order interaction terms between the TRLP factors), compliance with traffic rules became positively predicted by the injunctive norm with a small effect size ($\beta = .07, p < .05$). While compliance with traffic rules became negatively predicted by fairness ($\beta = -.03, p < .05$) and not yet by effectiveness ($p > .10$), these main effects are qualified by a significant effectiveness*fairness interaction ($\beta = .10, p < .05$). As fairness increases, the positive effect of effectiveness on compliance with traffic rules becomes stronger. However, in the third step (adding socio-demographic and mobility variables), the effectiveness * fairness interaction, as well as the effect of injunctive norm and the main effect of fairness became non-significant (all $ps > .05$). Following the principle of parsimony, the hierarchical regression was repeated with the interaction terms removed. The same variables were then included in step 1, while socio-demographic variables were included in step 2. In the second step, compliance with traffic rules was only predicted (positively) by effectiveness, with a medium effect size ($\beta = .32, p < .001$) (see Table 8). No serious multicollinearity issues for each of the four first-order factors were detected (tolerance ranges from 0.25 to 0.58, VIF ranges from 1.73 to 3.96).

In the third regression (TRLP considered with the single item measure), in the first step (including deterrence, risk perception, social norms variables, and TRPL measures), compliance with traffic rules was positively predicted by perceived severity of accident and injunctive norm with small effect sizes ($\beta = .09, p < .05$, and $\beta = .08, p < .05$, respectively), and by the single item measure of TRPL with a moderate effect size ($\beta = .32, p < .001$). In the second step (adding socio-demographic and mobility variables), the effects of perceived accident severity and the single measure of TRPL remained unchanged, while the effect of the injunctive norm became non-significant ($p > .05$; see Table 9).

Table 8

Results of the final step of the hierarchical regression testing the effect of the four first-order factors of traffic rules' perceived legitimacy (excluding interaction terms) and other predictors on compliance with traffic rules.

Step	Predictor	Estimate	S.E.	<i>t</i>	<i>p</i>	Standardized estimate	95% CI	
							Lower	Upper
1	Intercept	4.61	17.26	0.27	.790			
	Probability of being punished	-0.01	0.02	-0.33	.739	-.01	-.09	.06
	Severity of penalties	0.00	0.03	0.15	.884	.01	-.07	.08
	Probability of accident	0.00	0.02	-0.08	.936	.00	-.08	.08
	Severity of accident	0.04	0.03	1.44	.151	.06	-.02	.13
	Descriptive norm	0.05	0.03	1.55	.121	.05	-.01	.12
	Injunctive norm	0.04	0.03	1.59	.113	.05	-.01	.12
	Effectiveness	0.36	0.07	5.37	< .001	.32	.21	.44
	Efficiency	0.08	0.04	1.91	.056	.11	.00	.21
	Moral alignment	-0.04	0.07	-0.63	.528	-.04	-.16	.08
	Fairness	-0.06	0.04	-1.63	.104	-.07	-.15	.01
2	Age	0.01	0.01	1.23	.220	.13	-.08	.34
	Educational level	-0.02	0.02	-0.73	.465	-.03	-.09	.04
	Year of obtaining car license	0.00	0.01	-0.10	.924	-.01	-.22	.20
	Frequency of travel as car driver	0.05	0.03	2.07	.038	.07	.00	.14
	Frequency of travel as motorcyclist	-0.04	0.05	-0.90	.369	-.03	-.09	.04
	Travel in urban environment	0.00	0.02	0.06	.949	.00	-.06	.07
	Gender	-0.11	0.07	-1.48	.138	-.10	-.23	.03
Overall model		<i>R</i>	<i>R</i> ²	<i>Adjusted R</i> ²	<i>F</i>	<i>df1</i>	<i>df2</i>	<i>p</i>
		.42	.18	.16	10.38	17	809	< .001

Table 9

Results of the final step of the hierarchical regression testing the effect of the single-item measure of traffic rules' perceived legitimacy and other predictors on compliance with traffic rules.

Step	Predictor	Estimate	S.E.	<i>t</i>	<i>p</i>	Standardized estimate	95% CI	
							Lower	Upper
1	Intercept	5.19	17.11	0.30	.762			
	Probability of being punished	0.00	0.02	-0.17	.866	-.01	-.08	.07
	Severity of penalties	-0.01	0.03	-0.24	.812	-.01	-.08	.06
	Probability of accident	-0.01	0.02	-0.42	.672	-.02	-.10	.06
	Severity of accident	0.05	0.03	1.97	.049	.08	.00	.15
	Descriptive norm	0.04	0.03	1.29	.196	.04	-.02	.11
	Injunctive norm	0.05	0.03	1.78	.076	.06	-.01	.12
	Single-item legitimacy	0.29	0.03	8.79	< .001	.31	.24	.37
2	Age	0.01	0.01	1.20	.230	.13	-.08	.33
	Educational level	0.00	0.03	0.19	.852	.01	-.07	.08
	Year of obtaining car license	0.00	0.01	-0.12	.903	-.01	-.22	.19
	Travel in urban environment	0.00	0.02	0.12	.903	.00	-.06	.07
	SES	0.22	0.08	2.77	.006	.21	.06	.36
Overall model		<i>R</i>	<i>R</i> ²	<i>Adjusted R</i> ²	<i>F</i>	<i>df1</i>	<i>df2</i>	<i>p</i>
		.40	.16	.15	13.09	12	814	< .001

In order to compare the predictive power of the TRPL scale with that of the single-item, on compliance with traffic rules, the first hierarchical regression (TRLP considered with the two second-order factors) and the second hierarchical regressions (TRLP considered with the four first-order factors) were retested by adding the single item to the independent variables (and without including the interaction terms between the factors of the TRLP scale). In the first regression, the effect of the single item on compliance with traffic rules was not significant ($p > .05$), while the effect of the instrumental factor was unchanged. In the second

regression the second model, the effect of the single item on compliance with traffic rules was not significant ($p > .10$), while the effect of effectiveness was unchanged.

Discussion

The aim of this study was to validate a multidimensional scale of the perceived legitimacy of traffic rules, based on a theoretical model derived from a review of previous literature (Varet et al., 2021) and on considerations from the literature on perceived police legitimacy. To our knowledge, no study has yet proposed the development of such scale, following the main steps recommended in a psychometric approach (McKenzie et al., 2011).

Internal Validity of the Traffic Rules Perceived Legitimacy Scale

The different CFAs tested on the TRLP scale suggest that, after excluding two reversed items, the hypothesized hierarchical model (including effectiveness, efficiency, moral alignment and fairness as first-order factors, instrumental legitimacy and normative legitimacy as second-order factors), the four-dimensional model (including only the four first-order factors), and the three-dimensional model suggested by an EFA showed similar and satisfactory fit indices. We proposed to retain the hypothesized hierarchical model, because it allows two levels of factors to be considered (i.e., first-order or second-order factors), because second-order CFA models are more parsimonious than first-order CFA (when there are four or more first-order factors, Rindskopf & Rose, 1988), and because it appears to have the best theoretical underpinning. Finally, the four first-order and the two second-order factors presented good internal consistency in both stages of the study and an acceptable test-retest reliability. Note however that the 10-days interval between the two stages is relatively short and that a longer interval is often used (e.g., 3-week for the Attitude Toward the Criminal Legal System; Martin & Cohn, 2004). It would therefore be important to establish the test-retest reliability of our scale in further studies with a longer interval as it would allow us to appreciate the extent to which the perceived legitimacy of traffic rules is a

rather stable or a context-dependent construct. Previous studies on the conditionality of traffic rules compliance suggest that the perceived legitimacy of some traffic rules can be conditioned by their perceived alignment with the characteristics of the immediate road environment (e.g., offering protection from an obvious danger) and by individual contextual variables such as a driver's emotional or motivational state (Gaymard, 2014; Gaymard & Tiplica, 2015). Therefore, one would need to check how the perceived legitimacy of traffic rules would be assessed under different road environments. In addition, investigating the possible context-sensitivity of the perceived legitimacy could also provide insight into the possibility of manipulating it in experimental studies and acting on it to change behaviors.

Results showed that the four first-order and two second-order factors and the single-item measure of perceived legitimacy are all positively, moderately to strongly, correlated. Also, their correlation patterns with the other variables (sociodemographic, mobility variables, concurrent predictors of compliance) are similar but not always identical and hierarchical regression models indicated that only instrumental factor (among the second-order factors), effectiveness (among the first-order factors), and the single-item measures significantly predicted compliance. These results suggest that the four first-order factors of the TRPL scale present both a partial independence that can justify considering legitimacy as a multidimensional construct, two common dimensions that refers to the second-order factors, as well as an unique common dimension which could be summarized by the single-item measure. Thus, considering the 24 items retained for the TRPL scale could provide a more accurate but longer measure of the perceived legitimacy of traffic rules while the single-item measure could provide a less accurate but quicker measure. The choice of one measure or the other should therefore be considered according to the objectives and constraints of the researchers.

More broadly, the results discussed so far corroborate the fact that the perceived legitimacy of traffic rules can indeed be structured around four evaluative dimensions with effectiveness and efficiency referring to instrumental aspects and moral alignment and fairness referring to normative aspects. The internal validity and structure of the TRPL scale should be further corroborated by focusing on the perceptions of other road users such as cyclists and pedestrians, but also in other countries since behaviors and perceptions towards traffic rules can be influenced by cultural factors (Granié et al., 2021; Ozkan et al., 2006). Also, previous studies on the conditionality of the compliance with traffic rules suggest that their perceived legitimacy can vary significantly from one rule to another (Gaymard, 2014; Gaymard & Tiplica, 2015). Consequently, future studies should evaluate whether the proposed legitimacy scale can be adapted to the study of specific road rules and to what extent the legitimacy attributed to specific traffic rules may depend on the legitimacy attributed to these rules as a whole.

The four first-order factors and theoretical insights proposed by Varet et al. (2021) are based on a scoping review limited to the field of road safety. This field is unlikely to be representative of the different definitions of perceived legitimacy, its components, and close concepts. Therefore, additional factors or sub-factors of the hierarchical model validated in the present study could be considered in future research. For example, aspects of procedural and distributive justice, both of which are included in the fairness dimension here, could be differentiated in another version of the scale. In addition, it might be interesting to distinguish between equity and equality (in the strict sense), insofar as some people might consider it fairer to have traffic rules that treat users differently according to their needs or characteristics.

More broadly, it seems important to explore further the extent to which the model developed in the present study could serve as a valid basis for defining and measuring the

perceived legitimacy of other objects in the field of road safety and beyond. In the field of road safety, Varet et al. (2021) identify different objects, which they group into three levels: traffic rules (e.g., specific traffic rules, traffic rules as a whole), enforcement (e.g., means of enforcement, legal procedures, police) and institutions (e.g., social order and system, governmental and legislative institutions)³. This typology could be translated to other fields, such as compliance with pandemic preparedness measures.

External Validity of the Traffic Rules Perceived Legitimacy Scale

Results show that all four dimensions of the TRPL scale and the single-item positively correlate with self-declared compliance with traffic rules, with small to medium effect sizes. When sociodemographic factors, mobility variables, and concurrent psychological predictors were taken into account in hierarchical regression models, the effects of the TRLP scale on compliance persisted, but only through the instrumental factor (when considering the two second-order factors), effectiveness (when considering the four first-order factor), as well the effect of the single-item measure (when it is considered the only measure of perceived legitimacy), with medium effect sizes that outweigh the significant effects of other variables. These results corroborate the predictive validity of both the TRPL scale and the single-item measure on compliance with traffic rules. Hierarchical regressions also showed that the instrumental factor and effectiveness were better predictors of traffic rules compliance than the single-item measure. This suggests that it is preferable to use the TRLP scale rather than the single-item measure where possible. The possible impact of multicollinearity issues for the two second-order factors was investigated by rerunning the hierarchical regression with one of the two factors alternately. The results suggest that the

³ As mentioned in the introduction section, the instrumental dimension of the perceived legitimacy of traffic rules was only considered with the perception that obeying traffic rules is important to avoid accidents, but not with the perception that it is important to avoid penalties (although this variable was considered separately in this study). The latter also refers to an instrumental dimension of the perceived legitimacy of enforcement or traffic police. This means that it may be difficult to clearly distinguish between the different objects of legitimacy in a given area, as suggested by Varet et al. (2021).

effect size for the instrumental factor may have been slightly overestimated, without calling into question its effect on compliance and its greater explanatory power than that of the normative factor. An underestimation of the effect of the normative factor leading to a false negative seems unlikely. In fact, the effect of the two second-order factors (i.e., moral alignment, fairness) was also not significant in the second hierarchical regression, where no serious problem of multicollinearity was found.

Importantly, the results indicate that the perceived legitimacy of traffic rules (through the instrumental factor, effectiveness, and the single-item measure) has a greater explanatory power on traffic rules compliance than classical psychosocial variables such as deterrence, risk perception, and social norms. In line with the literature on legitimacy in the field of road safety (Bautista et al., 2015; Van Damme et al., 2016) and beyond (Hough et al., 2010; Jackson et al., 2012a; Sunshine & Tyler, 2003; Tyler, 2010; Van Damme, 2013), this suggests that perceived legitimacy is an important lever, in addition to deterrence, to promote compliance. Interestingly, the more drivers perceive traffic rules as legitimate, the less they perceive penalties for violations as severe. This may suggest that individuals who are more supportive of traffic rules are also more supportive of deterrence strategies, as has been observed previously (Watling & Leal, 2012). However, it may also suggest that perceiving sanctions as too severe leads people to reject the legitimacy of the rules, through a reactance effect (Ward et al., 2021). Therefore, it seems important for future research to examine the causality between perceptions of legitimacy and deterrence using experimental or longitudinal designs.

Since perceived effectiveness is the only dimension of the TRPL scale that predicts compliance (when the other dimensions are taken into account), road safety interventions should focus on how to increase it, for example by using tried and tested persuasive messages. Increasing positive perceptions on the other dimensions of the perceived

legitimacy could also be effective, as they are all highly correlated with effectiveness. In addition, previous considerations suggest that improving users' attitudes towards deterrence strategies may improve the perceived legitimacy of traffic rules.

In terms of the relationship between the dimensions of the TRPL scale, the instrumental dimension and more specifically effectiveness, are the only factors that predict compliance (when the other factors are taken into account). Drivers seem to attach more importance to the fact that traffic rules are effective in preventing accidents and their severity, rather than to the fact that they are not too disproportionate, unfair, or inconsistent with their personal values. This is consistent with the objective nature of traffic rules, which are essentially designed to ensure the safety of road users. This finding is consistent with studies reporting instrumental concerns as a stronger predictor of overall legitimacy judgments than normative concerns (Bradford, 2014; Hinds, 2009; Hinds & Murphy, 2007; Murphy & Cherney, 2011), although the opposite seems to be more frequently reported (Nam et al., 2022). For example, Tankebe (2009) found that cooperation with the police was predicted by its perceived effectiveness (an instrumental aspect) but not by perceived normative aspects, concluding that people cooperate with the police not for moral reasons, but when they believe there is a real benefit to be gained, in terms of personal and collective safety. Similarly, in the health field, the perceived effectiveness of health recommendations has been found to be one of the stronger predictors of compliance (Carpenter, 2010; Janz & Becker, 1984; Lithopoulos et al., 2021). Taken together, these findings suggest that the instrumental aspects would have a greater impact on compliance than the normative aspects when people believe that the object of perceived legitimacy involves personal or collective safety. In other words, the implication of personal or collective safety would be a moderator of the effects of the instrumental and normative dimensions of perceived legitimacy on compliance. Obviously, this theoretical proposition needs to be tested in future studies. Finally, considering perceived

legitimacy as a multidimensional construct would make it possible to identify precisely which dimensions should be prioritized to increase compliance, depending on the values (e.g., safety-related or non-safety-related values) to which the object of legitimacy relates.

The results showed no significant interaction between the instrumental and the normative factor of perceived legitimacy on compliance with traffic rules. When considering the first-order factors, without controlling for socio-demographic and mobility variables, the results revealed a significant effectiveness*fairness interaction, with the effect of effectiveness on compliance increasing as fairness increases. This is consistent with the finding that perceived police effectiveness is more predictive of overall perceived legitimacy when it is perceived as highly procedurally fair (Nam et al., 2022). However, the effectiveness*fairness interaction became non-significant when socio-demographic and mobility variables were taken into account. Given that few studies seem to have examined the possible interactions between the dimensions of perceived legitimacy and that the few existing results are unclear, it seems important to address this issue in future studies.

Additional limitations and perspectives

In the main study, the two items used to identify participants who lacked attention and seriousness during the study may be limited because they rely on a direct and honest response from them on this issue. The number of excluded participants was particularly high, which may raises questions about the quality of the sample. Given that this rate is not as high in studies using a similar combination of exclusion criteria (Abbey et al., 2021; De Bosscher et al., 2023), it could be related to a large number of inattentive participants in this panel, possibly due to the incentive structure of the panel or the possibly boring nature of the survey. More importantly, the present study did not examine the convergent and divergent validity of the TRLP scale. Future research should therefore investigate the links between the TRLP scale and close constructs and compare their predictive power of compliance with

traffic rules. These constructs could be, for example, the perceived legitimacy of the traffic police (Demir et al., 2018; Van Damme et al., 2016), the moral judgment towards traffic violations (Bradford et al., 2015; Bautista et al., 2015; Oceja et al., 2001), the perceived obligation to obey the law (Tyler, 2006), or the attitudes towards the law more broadly (Fine et al., 2016). Future investigations could also aim to propose and evaluate a shorter version of the scale, which would facilitate its use in the field, particularly if other measures are also to be considered (Goetz et al., 2013).

Moreover, it is important to note that we measured intentions to comply with a single item. Although intentions to violate traffic rules or to comply with them is often measured with a single item (e.g., Bordarie, 2019; Forward, 2010; Matović et al., 2014; Parker et al., 1996; Walsh et al., 2008), one should consider self-reported scales that aggregate multiple items and have been validated, such as the Driver Behavior Questionnaire (Reason et al., 1990; Winter & Dodou, 2010), in the absence of better measures of actual behavior. In addition, future research should also investigate the causal link between the perceived legitimacy of traffic rules and compliance with them through experimental and longitudinal design, especially since almost no previous studies have done so (Varet et al., 2021). Finally, to better understand the processes involved in the way perceived legitimacy determines compliance and to be able to act on this lever, it appears necessary to identify the variables that mediate this effect. Indeed, compared to a low perception of legitimacy, a high one should imply a stronger internalization of rules, a more intrinsic and less extrinsic motivation to comply (Tyler, 2009).

Conclusion

This study corroborates the relevance of a new conceptualization of perceived legitimacy in the field of road safety regarding traffic rules, through the validation of the TRPL scale, which relies on a multidimensional model. The main results indicate that the

perceived legitimacy of traffic rules predicts compliance with said rules, particularly on the basis of their perceived effectiveness. In terms of practical implications, this suggests that road safety interventions should focus on increasing the perceived effectiveness of traffic rules. Regarding theoretical implications, in order to better identify the psychological processes underlying the perception of legitimacy, future studies should investigate (a) the extent to which the model validated in the present study could be a solid basis for defining and measuring the perceived legitimacy of objects other than traffic rules within and beyond the field of road safety; (b) the possible differences in the predictive power of each dimension of perceived legitimacy according to the nature and the field of the object considered, as well as individual and contextual differences.

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Appendix. French version of the Traffic Rules Perceived Legitimacy scale

Les affirmations suivantes portent sur les opinions que l'on peut avoir vis-à-vis des règles de circulation routière en général.

Veuillez indiquer votre niveau d'accord avec chacune des propositions suivantes en vous positionnant sur l'échelle allant de 1 (Pas du tout d'accord) à 7 (Tout à fait d'accord).

Concernant les règles routières en général, je pense que :

Efficacité [Effectiveness]

- Elles conviennent bien pour éviter les accidents de la route. (1)
- Elles sont une solution raisonnable au problème de l'accidentalité. (4)
- Pour moi, leur intérêt pour la sécurité routière est indiscutable. (6)
- Elles sont essentielles à la sécurité routière. (9)
- Elles ont un vrai impact sur la sécurité routière. (11)
- Elles ont un intérêt évident pour la sécurité routière. (14)
- On comprend leur intérêt pour éviter les accidents de la route. (16)
- Elles sont nécessaires pour éviter les accidents de la route. (19)
- Elles sont utiles pour éviter les accidents de la route. (21)
- Leur intérêt pour réduire les accidents de la route me semble clair. (25)

Efficience [Efficiency]

- Elles sont trop sévères. (3)*
- Elles sont trop contraignantes. (8)*
- Elles sont exagérées par rapport à leur objectif d'éviter les accidents. (13)*
- Il y a beaucoup trop de règles. (18)*
- Elles vont trop loin par rapport à leurs objectifs. (23)*

Alignement moral [Moral alignment]

- Moralement, je trouve acceptable de ne pas respecter ces règles (2)* #
- Elles ne correspondent pas à mes valeurs personnelles. (7)*
- Sur le plan moral, elles me semblent contestables. (12)*
- Sur le plan moral, elles ne me posent aucun problème. (17)
- Moralement, j'ai de bonnes raisons de les défendre. (22)
- Moralement, je les trouve inacceptables. (26)*

Equité [Fairness]

- Ce sont les mêmes pour tout le monde. (5)
- Elles s'imposent à tous de la même façon. (10)
- Elles ne font pas de différences selon les individus. (15)
- Leur application crée des inégalités entre les personnes. (20)* #
- Elles traitent tout le monde de la même façon. (24)

Mesure en un item [Single-item measure]

Elles sont légitimes.

Note. Number in parentheses indicates the item's order of presentation in the survey.

* Indicates those items that are reverse-scored.

Indicates those items were excluded from the final version of the scale.