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Road users: formal & informal rules

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Declaration

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1 INTRODUCTION

Dealing with the formal and informal rules of the road users is to focus on the task of driving in the traffic system that is the work of the driver in interaction with other users. The task of driving a motorized vehicle is not a solitary and isolated activity but rather a collective activity that takes place in a dynamic environment. To evolve in this road space and regulate their driving in terms of direction and speed, the drivers refer to two systems of rules: the formal rules that come mostly from the Highway Code and the informal rules that will specify the driving behaviour to be followed according to the behaviours of the other users and the conditions of the infrastructure (setting-specific conditions), or which depend on the categories of drivers (Juhlin, 2010).

In the first part, the two formal and informal rules systems currently found in road driving will be presented and compared. Then the origin of these rules systems will be sought in social representations as a system of common knowledge shared by drivers about how one should behave on the road with respect to other drivers and the Highway Code. The consideration of these two systems of rules on the analysis of human error in traffic accidents will be studied based on the distinction between the prescribed task and the redefined task. Finally, the impact of the coexistence of these two systems of rules on the nature of traffic and road safety systems will be mentioned.

2 COMPARISON OF TWO SYSTEMS OF RULES

The institutional norms of the Highway Code define the field of action in terms of traffic and road safety by specifying what the driver can or cannot do. They reflect the dominant values and ideals of society. Norms, for example the obligation of caution of the strongest towards the weaker, materialization of values, such as respect for the integrity of others, are distinguished from rules, such as the control of his vehicle, which constitute the application of values and the concrete expression of norms. They relate to the way in which users can use the public road (drive right or left, speed limitation, ...) and to the way users interact with each other (priority rules).

The formal rules are produced by the State in the form of laws, codes and regulations to solve the problem of coordination between users on the road (use of lanes, speed limits, priority rules, ...). It is a system of heteronomous and explicit rules that require the control of the Police for their applications. They have a top-down control regulation function (Reynaud, 1989). Established by the government and enacted by politicians, they are assumed to be in phase with the infrastructure and road vehicles that were designed by engineers. The logic is that

drivers will share the same representation of the driving situation in homogeneous environments and follow the same set of plans, which will allow a mutual understanding of the behaviour on the road. Drivers have a common frame of reference rather at the level of cooperation in planning than at the level of cooperation in action. A set of formal clues such as traffic signs and markings will function as signs producing information to adapt their behaviour.

Saad (1975) wondering whether the Highway Code provides drivers with the rules necessary to carry out the task of driving concludes that the Highway Code governs only a small part of the movement operations that the driver. It highlights the role of "on the job" learning of rules of conduct, which will take on an informal character, with a concomitant work of structuring the task. Because for her,

> "the driving task is:
> - complex because of the continuous adjustment it requires,
> - unstructured in the sense that neither the highway code nor the training clearly define the modalities of these adjustments ".

But where will this organization of action or of structuring of the driving task be? The ecological approach provides an initial answer where it is postulated that part of the organization of the driving action is taken in charge by the road environment in patterns easily interpretable by the driver. Nevertheless, several versions are possible. We can look in the environment for the elements that direct and structure the action of the subject, or on the contrary look for how the environment is exploited by the subject. The representations that the driver must make of the conditions of the infrastructure and the traffic are deposited, and made available in the physical world by affordance (Norman, 1998). The structure of the road has a function of controlling the action by making it "readable". Situational norms represent accepted and knowledge-based beliefs about how to behave in particular situations and are learned by associating normative behaviour to these situations. For example, slowing down on an urban street when some children are present on the pavement. Social norm is used to refer to normative social belief, which is an individual's beliefs about the behaviours and evaluations of others in a social setting, that is a cognitive construct and mental representation of the actual social norm. It has to be distinguished from the consideration of a social norm which refers to the actual reality of behaviours which are common or approved in a social group. A further distinction is applied between descriptive norm (common or typical behaviour) and injunctive norm (approved or accepted behaviour). The representations that drivers form, propagate and transform within the road system are directly observable through their behaviours and can be translated by verbalization into informal rules of conduct.

A second answer is provided by the interactionist approach in the line of situated action. The informal rules are elaborated on the road and the street in the interactions between the drivers of the motorized vehicles and with the other users (pedestrians, cyclists). These implicit rules are those shared by drivers to understand what other drivers are thinking and planning to do. Drivers act on the basis of a supposedly shared cognitive environment that governs their interactions. In the theory of Situated Action, the other users' activities are indicative of driving situations in which it is appropriate to respond by the terms of the rules that will adjust to the conditions of current interaction. For example, to get onto a highway from an access ramp, it is recommended to exceed the speed limit on the ramp to better fit into the flow of vehicles traveling at high speed on the highway. This type of rule is of the "flow priority" type. Moreover, to this practice, is added a rule of co-operation in the insertion of ramp vehicles into the flow of

vehicles on the motorway that does not follow the priority rules selected by the road engineers. This ramp-highway organization can be interpreted as "situated cognition" where a group of drivers will coordinate so that insertions unfold without conflict. It is an autonomous actor-environment system where there is a co-determination of the internal structures of drivers and structures (obviously external) of the road environment (including social) through interactions. To attain and maintain a social order on road, drivers rely on cooperative norms like a norm of reciprocity emerging from repeated games in close-knit group of drivers in different traffic situations.

Other informal rules are based on the identity or categorization of users to adjust their driving behaviour (social attribution theory). A subject infers the intentions or characteristics of others from the properties that the social category to which he belongs to him (and to his group). We change our behaviour according to the information provided by a set of informal indices such as, the assumed age or sex of the other driver/user or of their type (mass/power) (Granié, 2010).

This is a double widening in the consideration of the isolated driver in his driving task regulated by formal rules to know and apply, first of all in interaction with the road environment (located action), then in interaction with others users (distributed cognition). Informal rules appear as the emergent properties of these autonomous interaction systems.

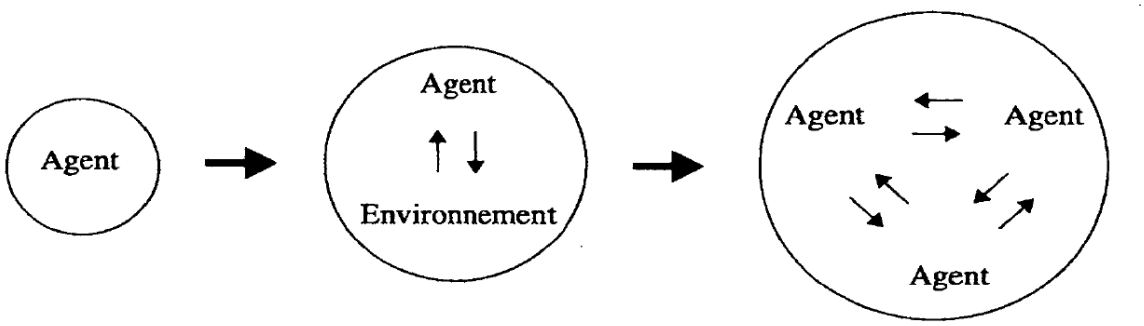

Figure 1. Double expansion of interaction systems (Laville, 2000)

3 ORIGIN OF INFORMAL NORMS AND RULES

Since there is hardly any rule or practice that is not evoked or accompanied by a set of representations (Moscovici, 2001), it is possible to explore the formation of norms and rules from social representations that can be defined by a form of collective thinking through which drivers learn and represent the social traffic system and as knowledge generated and socially maintained with social interactions. A social representation is structured hierarchically and organised around a central core that determines the significance of the representation. The function and organisation of social representations are governed by a dual system: a central system and a peripheral system. The central system has organizing and meaning-bearing functions. It constitutes the common and collectively shared part of a social representation that is stable, coherent and resistant to change. On the contrary, the peripheral system enables the representation to be adapted to various social contexts by integrating the transformations, distortions and contradictions.

They have a knowledge function to understand and explain the reality and a prescriptive orientation function operating as a system for anticipating expectations (Abric, 1994). We can understand the norms and rules regulating the practices as resulting from the social representations of the more or less dominant groups of road users.

Social representations theory is a cue to understand how the practical knowledge about driving comes from what is called "common knowledge". As stated by Moscovici, science is the process which makes familiar phenoma or objects unfamiliar, and common knowledge, the reverse process which makes unfamiliar phenomena or concepts familiar. When considering the task of car following which consist into the longitudinal and lateral control of trajectory and speed according to the behaviour of the preceding cars, we could observe how the driver regulates the distance with the car in front and model this regulation by a differential equation such as

$$\dot{x}_n(t+\mathcal{T}^r) = \mathcal{R}\left\{x_{n+1}(t) - x_n(t), \dot{x}_{n+1}(t)\right\}$$

relating the speed with a delay T to a function R of the distance between the cars and of the speed of the preceding car. Furthermore this formula could be used as an algorithm to control the following behaviour in a ACC (Automatic Cruise Control) system installed as an driving aid in car or in an autonomous car (robot). The function R has a form which is shared by the drivers as shown below indicating that the driver tries to maintain a constant time gap between his car and the preceding one. This rule is an example of common knowledge got by drivers through their experience in the traffic.

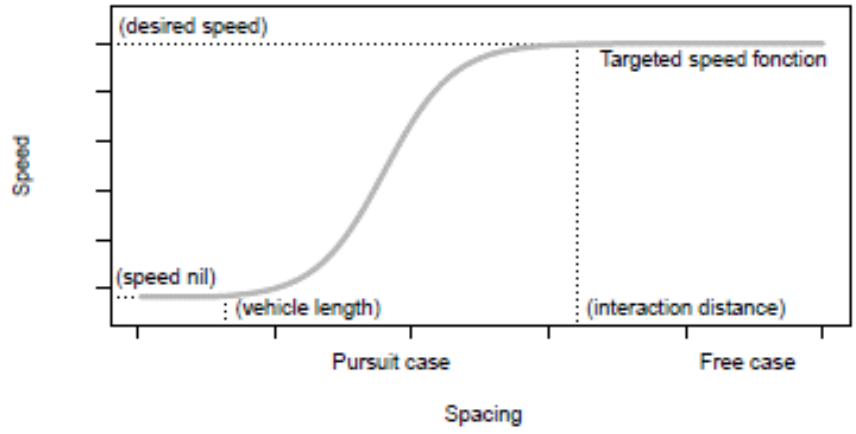

Figure 2. Common spacing function of the speed in car following.

The knowledge about crash avoidance by breaking and/or swerving is built upon the idea that « Thanks to this popular physics we avoid collisions » . As the experience of severe conflicts on the road is avoided as much as possible, the learning process cannot bring a performing behaviour in crash avoidance and then the driving aids such as ABS (Antiblockiersyste) or ESC (Electronic stability control) come to compensate for failures in the decision and execution of the collision avoidance task .

As speeding is common on roads and speed limits systematically violated to the point that these norms about speed have been called perverse, the question rises about the ambivalent meaning of speed in our society. Whether or not to respect speed limits is not just complying or disobeying traffic regulations. Pianelli and Saad (2016) have explored the social representation of speed and speed limits on a sample of 1,005 drivers in order to predict the acceptance of ISA (Intelligent Speed Adaptation). For the population as a whole, the representation of speed was organised around a central core comprising a single element: *Danger* (Table II). The negative aspect of the Speed was reinforced by the presence of the element *Imprudence* in the first periphery of the representation. However, a positive aspect of the Speed appeared also in the first periphery: the *Pleasure* related to the speed. This positive aspect was reinforced by the presence of three peripheral elements, which referred to its functional and useful aspects: *Gaining time*, *Motor sport* and *Rapidity.* In the zone of "the contrasted elements" appeared two elements enunciated by few people who considered them as very important: *Speed Limit* and *Vigilance.* In the second periphery, One finds an element associated with the social rules: *Enforcement*, as well as an element linked to their transgression: *Speeding*.

Table 1. Social representation of Speed

		Average degree of importance	
		Top ranks (≥2)	Bottom ranks (<2)
Frequency	High (≥.10)	Danger (.60/1,7)	Pleasure (.28/2,1) Imprudence (.15/2,1) Gaining time (.15/2,1) Motor sport (.10/2,1) Rapidity (.14/2,1)
	Low (<.10)	Vigilance (.06/1,9) Speed limit (.06/1,9)	Enforcement (.09/2,3) Speeding (.06/2)

4 CONSIDERATION OF TWO SYSTEMS OF RULES IN THE ANALYSIS OF HUMAN ERROR IN ROAD ACCIDENT

The reference to human error is a stereotype in the attribution of a cause or in the determination of a cause as an explanatory factor of the traffic accident. The first of the four key principles of the Safe System is "People make mistakes that lead to road crashes". This is a kind of "natural" and simplistic statement which needs to be reviewed in line with the scientific work around the human error. The error refers to an external norm or rule for driving on the road: what should have been done has not been, and human refers to attributing the deviation to a particular driver. Leplat (1993) proposed a model to analyse the role of intention into action which could

be applied to the driving task by distinguishing three types of task: prescribed, redefined and carried out.

The prescribed task is to be carried out as conceived by the designer of the system and/or the safety manager. It sets out formally a number of prescriptions up to procedures, which are supposed to guide driver activity, or more informally some missions with general objectives or principles to follow, which are supposed to influence to some extent driver activity. In other words, the prescribed task defines **the expected driving behaviour**, what the driver should do (in terms of performance and/or procedures to follow).

The redefined task refers to the intentions which could be said as "goals pictured in the mind's eye". We find the ideas of representation of action, triggering and guiding the action as well as the distinction between prior intention and intention in action.

The actual task carried out is what the driver actually does, with the demands and constraints that s/he effectively takes into account. Identifying the actual task calls for a detailed analysis of driver behaviour with the aim of determining exactly how drivers organise and perform the driving task (Ergonomics):

- What their goals and intentions are,
- What information they select from the environment,
- What motives and criteria underlie their decision-making,
- What regulating actions they take?

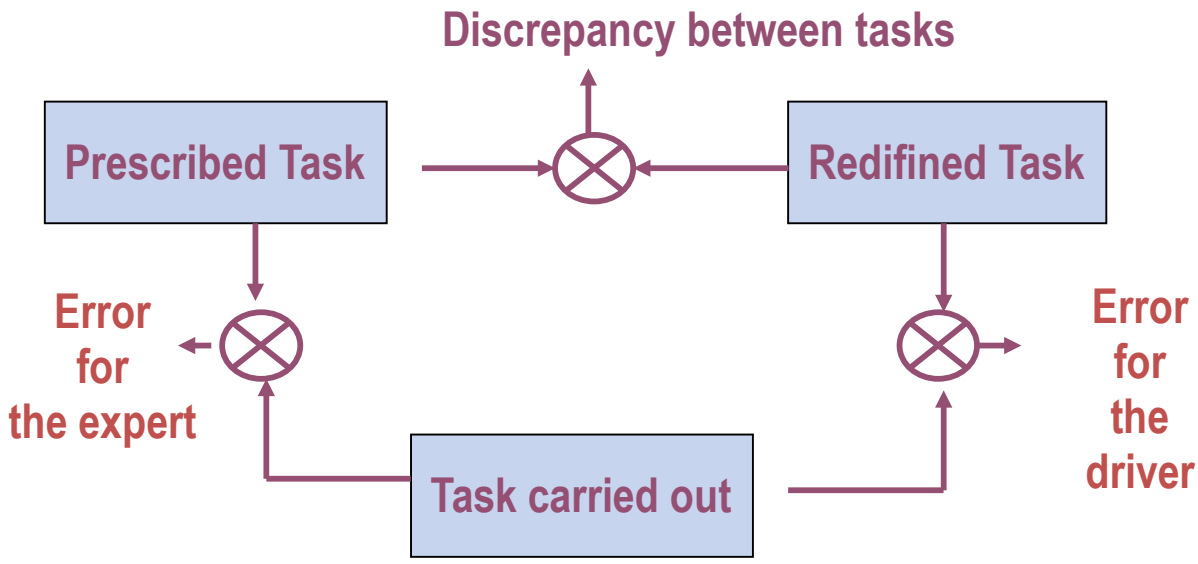

Figure 3. The two types of errors.

The driver's activity is not always fitted to the prescribed driving task as we have already noticed the difference between the formal and institutional rules coming from the heteronomous normative system and the informal rules defined by the inter-drivers normative system. Two main cases occurred to characterize the error from the expert point of view who looks for the responsibility in the accident:

1. The driver knows the prescribed task but moves on purpose away from it. This type of situation is called violation. The reasons of such violation are various: unjustified task, refusal of principles or norms underlying the prescription, harmful character of the prescription in the present situations. Most of the reasons are anchored into the system of informal rules set up by the group of drivers.
2. The driver has a faulty knowledge of the prescribed task, principally about the internal or external conditions of its execution and the coupling of them. This gives place generally to planning errors called "mistakes"

From the driver point of view, we could have an inadaptation of actions to intentions with two categories:

1. Inadaptation attributed to the driver. It evokes the type of errors called "slips" (Leplat, 1993).
2. Inadaptation which may be attributed to non-mastered task modifications, which invalidate the foreseen course of action. The sources are uncontrollable factors, complex collective activity and unforeseeable situations.

5 RULED SAFETY AND MANAGED SAFETY

The road transport system is an open socio-technical system with two systems of regulation operating at the same time: the institutional and formal rules and the informal and inter-drivers rules. It is then difficult to characterize such a system on the two dimensions of interaction (linear/complex) or description (tractable/intractable) and coupling (tigth/loose) (Perrow, 1994).

In fact two types of systems coexist:

Tractable and loose system defined by the formal rules where we could apply some root cause analysis to identify causes of accident and try to prevent accidents by elimination of causes and restriction of performance. We end with the ruled safety or safety by constraint (Hollnagel, 2014).

An intractable and tight system where accidents are the result of unexpected combinations of normal variability of system functions, which are translated into informal rules, and consequences of accident are out of proportion of the initiating event. We end with the managed safety (Hollnagel, 2014).

Applying a systemic approach entails focusing on **interaction phenomena** between the driver(s) and the technical and organisational components of the system (vehicle, road infrastructure, legislation, traffic management,...) and hence **going beyond a simplified view of causality in analysing system malfunctions.**

Unlike those for whom, with misunderstanding, the communication is ineffective and the formation of the joint action blocked, one can consider in a system of safety by management the misunderstanding as the real source and the motor conflict of the development of the communication. The real source also of the actual understanding and the paradoxical safety.

These two systems are rooted to two visions of the universe: reified and consensual, and two visions of the regulation which could be structured as vertical versus horizontal and be defined as heteronomous versus autonomous.

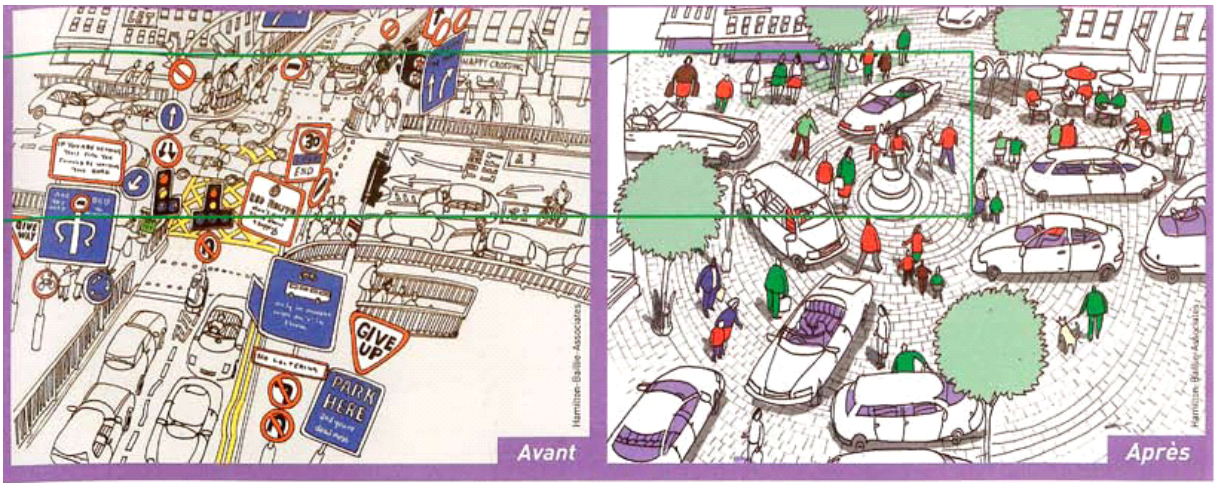

Figure 4. The illustrated schematision of the two systems of rules.

6 CONCLUSION

The driving task is complex and unstructured. The regulations and institutional rules cannot cover the variety of driving situations encountered by drivers on the road. This set of formal rules is being challenged by groups of drivers who will develop informal rule systems to manage interactions on the road.

These systems of rules rely on belief and knowledge systems about norms and ways of behaving in traffic. They are studied through the theory of social representations which show that the representations of driving situations are constructed from representations of self as driver, those of other drivers, those of the driving task and those of the road and traffic environment.

The analysis of the error becomes more complex when one seeks to which system of rules or norms refer the driving task. Much of what is described as violations in relation to the prescribed task needs to be reviewed in the light of the content of informal rules systems shared by groups of drivers.

The existence of two formal and informal rule systems in road driving must be recognized and taken advantage of in order to reconcile two modes of safety: regulated and managed.

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