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# “ROAD RULES”: ANALYZING TRAFFIC SIGNS THROUGH A SOCIO- COGNITIVE APPROACH

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## abstract

*Around 1.3 million people die every year because of road traffic crashes. Although safety rules, vehicle standards and post-accident health care, have all seen significant improvement, rising population and quick motorization rates have added to the casualty numbers. Road safety has been included among the Sustainable Development Goals, but the target set of halving the number of road deaths by 2020 will be missed. With the emergent attention to road safety, several approaches may be adopted. One is tightening penalties to induce more prudent behavior. The second is to improve protection devices and vehicles. The third is to adapt road designs, including roadside signs, to modern roads and vehicles and to human behavior. This last approach in particular is the one where I think that substantial improvements may still be achieved. One of the most interesting aspects in terms of impact and effectiveness of rules, may be understood by focusing on the cognition process of the rule that is incorporated into a road sign, and by how this cognition can be framed so that voluntary compliance is enhanced. Road signs have always made extensive use of explanatory images. But it is also the unconscious social pressure that one's driving behavior is being watched that produces compliance. A normative-semiotic perspective should be integrated by a cognitive perspective, so that insights from both the natural and the social sciences may achieve higher degrees of precision and predictability.*

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## keywords

road sign, behavior

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**1. Introduction** In this article I will consider the non-linguistic rules represented by road signs that regulate the circulation of vehicles and pedestrians on public roads. In the first place I will try to delimit the field, and define the kinds of norms present in road signs. Secondly, I will try to understand how traffic signals influence human behavior, based on socio-psychological research and some recent neurocognitive discoveries. Thirdly, I will hazard some predictions, based also on ongoing research, with respect to what may be the directives of change for road safety and traffic organization.

The approach I intend to adopt is a socio-cognitive one. Although choices and decisions taken by a driver can be considered as eminently individual, and mainly influenced by biological-genetic cognitive factors (attention span, visual acuity, submissiveness and tendency to obedience, impulsiveness and aggressiveness), the way in which these attitudes are expressed is undoubtedly influenced by the social context and by what is derived from it (tendency to conformism, weight attributed to reputation, knowledge and respect for social norms). These factors in turn feed-back into the fundamental structures that determine our basic individual behaviors.

Because the dynamic underlying the law is also bio-social (Cominelli 2018), one of the approaches that does not risk neglecting any of these fundamental factors is therefore that which considers these types of norms as functioning in an ecological bio-social context.

**2. Road safety** According to a World Health Organization report (WHO, 2018), around 1.3 million people die every year because of road traffic crashes. This means that around 3.700 people, or around one person every 23 seconds, dies for causes related to transit. Many more (in the number of tens of millions) are injured or permanently disabled. These figures have increased on a global scale in recent years. In relative terms, road risk is decreasing in developed countries but it's increasing exponentially in developing countries, where it is three times as high. Between 2013 and 2016, road deaths slightly diminished in 48 middle and high income countries, while they went up in 104 countries, most of them in the low-income group. Although levels of safety rules, higher vehicle standards and post-accident health care, have all seen significant improvement, rising population and quick motorization rates have added to the casualty numbers (WHO 2018). Road safety has been included among the Sustainable Development Goals, but the target set of halving the number of road deaths by 2020 will most certainly be missed (Target 3.6 of the SDG). Road design and safety measures for cyclists and pedestrians in particular represent the hardest hurdle for developing countries, while the increasingly better

quality of pavements has allowed cars and trucks to increase their speed, which was earlier limited by the poor conditions of roads.

Leaving aside the fortuitous cases, and those cases where a defective vehicle or road infrastructure is to blame, accidents happen because of negligence and violation of the rules of circulation. Most harmful events are related to these violations, and may be directly attributed to speeding, drunk driving, or lack in the use of restraining or safety measures such as helmets, safety belts and child seats. The Dutch Institute for Road Safety Research estimated that just respecting the speed limit would decrease the number of casualties by 25-30% (Wegman *et al.*, 2007). The inability to recognize road hazards has been considered as contributing to around 25-50% of accidents (Charlton, 2006, p. 496).

Despite the fact that road traffic crashes are now the eighth leading cause of death at the global level (and the first cause of death for people aged between 5 and 29 years), the diluted nature of such accidents lowers the perception of this risk in the public eye, and makes infractions to road safety rules as a minor offence in common perception. While shooting a gun recklessly in the middle of the street bears serious consequences for the shooter, speeding your car in a city is not normally frowned upon that much. Up until some years ago, even if road safety had been an issue in the public debate for more than a century (McMurtry, 1915), the social disvalue of reckless driving and negligent behavior behind the wheel was underestimated. The situation is now changing, due to the perception of human life and health as something sacred, but only when serious harm happens, that same negligent behavior takes on a higher social disvalue. For their weight and speed, motor vehicles can be considered a weapon to handle with particular care, and this chance is reflected in the fact that vehicular “homicide”, in the form of “vehicular manslaughter”, has begun to appear in several jurisdictions, where it now stands between voluntary murder and manslaughter (Dahl, 2004; Massaro, 2016).

As difficult as it may seem, some have attempted to measure the material and immaterial costs of road accidents. In the Netherlands, one of the countries in the world with the safest roads, it was calculated that society at large bore a staggering cost of 12,3 billion of Euros, amounting to 2,6% of the Gross National Product (Wegman *et al.*, 2007, 324).

With the emergent attention to road safety, several approaches may be adopted. One is tightening penalties to induce more prudent behavior. The second is to improve protection devices, forcing drivers and passengers to wear helmets or safety belts, to subject vehicles to periodic checks, to forbid the consumption of alcohol or other psychotropic substances even in moderate quantities before driving, and to prohibit any tool that may distract drivers. The third is to adapt road designs, including roadside signs, to modern roads and vehicles. This last approach in particular is the one where I think that substantial improvements may still be achieved, especially if policy changes will incorporate the insights of sociology and cognitive science on how individual and social behavior intersect.

Road signs convey norms of circulation. Road signs are expressed in a symbolical language, that through the conventional combination of pictures, writing, color and shapes, communicate rules. It is different from verbalized language, at least in length, as it cannot use the most complex syntactic constructions, because it needs to be seen and understood in most cases in a short time span. Different expressions have been used for this kind of normativity, such as “graphic rules” (Moroni & Lorini, 2017) or “pictorial law” (Boehme-Neßler, 2010). Some put the origin of this law of images in the *ius imaginum* of the ancient Rome, where heraldic arms and the hierarchy or precedence in military, social and ecclesiastical affairs was visualized in banners, coats, liveries, short inscriptions or insignia (Goodrich, 2014, p. 3). Colors, figures and combinations were also a part of it. It all indicated foremost the difference

### 3. What are road signs?

between what was familiar and friendly, and what was instead hostile and foreign (Goodrich, 2014, pp. 4-5).

During a subsequent phase, and with the process of rationalization of the law (Weber, 1995), legal systems have increasingly become skeptical of “regulation through images”. Formalized and analytical language seemed to be at this point the best way to orient and control social behavior (Boehme-Neßler, 2010, p. 90, p. 101). During this historical time, eliciting behavior by vivid and salient images started to be in contradiction with the Cartesian rationality of human legal action. Pictures and images in a rational discourse could be considered at best decorative and primitive. According to the legal common sense, pictorial law had to be the exception, save for some limited cases (urban planning, zoning, patent and brand ownership), and it had to be avoided as intrinsically subjective, if not “linked with sensuality, sin, emotions and irrationality” (Boehme-Neßler, 2010, p. 107). Visual signs, and foremost road signs, must then be clearly regulated in details through technical annexes that define the minutiae and specifications that pictures need to respect in order to be considered binding.

And yet, due to their immediate salience, pictures are being rediscovered as a means to convey normative messages. The legal world is taking notice: graphic illustrations are still quite rare in legal briefs and court judgements, but these habits are changing, as time constraints are turning communication into something less verbal and more visual<sup>1</sup>.

Images have a potential impact which cannot be ignored. Visual representations are harder to challenge than verbalized concepts. An image can be complex, and its contradiction “dissipates without having any effect, because it can only ever deal with a small, limited aspect of the image at a time” (Boehme-Neßler, 2010, p. 130). In a way, pictures are better at controlling human behavior imperatively. The efficacy of visual norms has a biological-anthropological explanation that will be later illustrated (see par. 4). Furthermore, the law is increasingly personalized (Cominelli, 2018, p. 182), and this revival of pictorial law could be at the same time a cause and a consequence of appealing to individual sensitivities (Boehme-Neßler, 2010, p. 134).

Semiotic studies have tried to overcome the lingering distrust by arguing that pictorial law has the same linguistic value as verbalized law. Studincki, for example, draws the distinction between normative road signs (the speed limit) and descriptive road signs (eg: the danger sign of a slippery road, or of wandering animals), and by doing this he implicitly seems to maintain that road signs are proper normative messages because they are a proper language themselves (Studnicki, 1970).

More recently, Dudek (2018) criticizes the decisions by the Polish Constitutional Tribunal and by the Polish Supreme Court on some aspects of the basic traffic sign categories in Poland (obligatory, prohibitory, informative and warning) moving from the perspective of semiotic theory. The case in point is a traffic sign informing of the need to pay a fee for a parking space. The judges argued that non-normative signs (informative and warning signs) were non-separable from their normative basis. In another work, Dudek maintains that traffic signals, both as signs and realizations, are an integral part of the legal norms that are encoded in such provisions, and not a secondary part of them (Dudek, 2015, p. 366).

And yet, it's clear that even an informative sign, and above all a warning sign, can have a fully normative content, in the sense that they raise the minimum mandatory standard of diligence,

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1 In 2012, an amicus curiae brief submitted in an antitrust case to contest a settlement proposal by the Department of Justice, was drafted as a comic strip to comply with a length limit of 5 pages set by a US District Court Debra Cassens Weiss, *Faced with a Five-Page Limit, Lawyer Files Cartoon Amicus Brief with Proper Font Size*. Retrieved April 9, 2019, from the American Bar Association Journal website, [http://www.abajournal.com/news/article/faced\\_with\\_a\\_five-page\\_limit\\_lawyer\\_files\\_cartoon\\_amicus\\_brief\\_with\\_proper\\_/](http://www.abajournal.com/news/article/faced_with_a_five-page_limit_lawyer_files_cartoon_amicus_brief_with_proper_/)

which couldn't have been predetermined without the knowledge of the road conditions. The depiction of a harmful event or dangerous situation, therefore calls for a greater level of attention and a higher standard of diligence, in the absence of which liability could be incurred.

I think however that a purely semiotic approach misses the mark, and I concur with those who have denounced the “verbal-centrism” that in general dominates the analysis of communicative interaction, and of legal interactions in particular (Moroni & Lorini, 2017, p. 319). Law operates through images, it is incorporated in images, and these images do not just represent the description of facts that are relevant for the law. These graphic rules “[do not] merely evoke or defer to other word-made regulations; graphic rules directly state prescriptions and influence possible behavior”; in traffic signs, “[f]or all practical purposes the arrow [sign] is the law” (Moroni & Lorini, 2017, p. 321).

The problem that the sign may or may not be a reliable instrument for describing reality is a non-issue in social regulation. The debate between iconism and anti-iconisms in modern semiotics, discussing whether images and symbols, in particular, really incorporate at least partly what is being depicted, is in fact almost reminiscent of the debate between naturalism/behaviorism and constructionism in the social sciences. Pictorial systems, just like sentential systems, make use of recurrent parts following systematic rules of combination (Camp, 2007; Westerhoff, 2005). Apories between pictorial rules are also possible, notwithstanding the debate on its linguistic nature, and it looks simply illogical to resolve the issue by downgrading graphic rules, as recently the Italian administrative courts seemed to do<sup>2</sup>, by stating that in case of contradictions, the written rule will prevail over the graphic rule (Moroni & Lorini, 2017, p. 327). Just as verbal language, pictorial signs may be interpreted and misunderstood, as recent research shows with regard to increased fatality risks for international tourists in the countries of destination (Choocharukul & Siroongvikrai, 2017, p. 4521).

I also take issue with an explicitly semiotic perspective (Pusceddu, 2017) that might reduce the normativity of signs to a problem of language. If according to semiotics, only a communication system with a discernible syntax may be linguistic (Pusceddu, 2017, p. 451), and such variable in some way in fact affects its normativity, I reply that then law is probably not (always) a communicative act.

Cognitive processes in fact do not need words, nor the thought of words, either verbal or written, just like they do not need images. And as Lorini and Moroni remind us, it is for this reason that the comprehensibility of the verbal language vs. the pictorial language should not be a defining issue (Moroni & Lorini, 2017, pp. 330-331). Evolutionary psychology and cognitive ethology have proved that pre-verbal and pre-pictorial understanding of the world, and of its physical and moral constraints, already exists in newborn children (Robinson *et al.*, 2007). Simple orders or directives may be conveyed just as clearly and certainly more quickly with pictures. As they are an analog mode of representation, pictures may also be potentially continuous and non-discrete, while sentential systems, with their highly symbolized and abstract symbols, cannot (Camp, 2007, p. 156).

For this reason, road signs, as well as other signs placed in public places of passage and traffic, have always made extensive use of explanatory images, accompanied when necessary by brief verbal instructions. These signs represent a specification and a contextualization of the

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<sup>2</sup> The principle, as recalled by Moroni and Lorini, and stated by the Italian supreme administrative tribunal (Consiglio di Stato, n. 673/2014) has been constantly reaffirmed in the recent Italian case-law (Consiglio di Stato, sect. IV, n. 2158/2013; Consiglio di Stato, sect. V, n. 4734/2003; Consiglio di Stato, sect. IV, n. 4462/2000; Consiglio di Stato, sect. V, n. 724/1995).

general rules of traffic laws, and are becoming increasingly essential to provide cognitive aid, given the speed of circulation and the variability of the surrounding conditions. It is on this cognitive aspect that I will concentrate in the following sections of the article, in order to understand the factual behavioral effects that the pictorial law has.

#### **4. How road signs affect behavior**

One of the most interesting aspects in terms of impact and effectiveness of rules that are incorporated into road signs, may be understood by focusing on the cognition process, and by on this cognition can be framed so that voluntary compliance is enhanced. Images play more on our cognitive “system 1”, that is, on our instinctual and automatic cognitive side, rather than on our “system 2”, that is, on its conscious and deliberate cognitive counterpart (Kahneman, 2011). This is almost necessary in the case of road signals, because these images have a message to relay in a short time-span.

Even if the effect of communication through pictures may be up to a certain point controlled, (Boehme-Neßler, 2010, p. 153), the use of *cognitive system 1* should ensure immediate and instinctive response to the stimulus. We know that even in deliberate decision-making contexts, such as in the courtroom, pictures may sway decisions: we discovered for example that brain-scan images presented as a proof in expert testimonies may effectively influence judges in their decisions on criminal cases (Baskin *et al.*, 2007).

In general terms, concrete and pictorial thinking prevents losing touch with reality. Images work directly with emotions and create “immersion effects” (Boehme-Neßler, 2010, p. 64). The capacity to react promptly to visual stimuli has been an evolutionary advantage for quite a lot of species, and therefore, complex animals have evolved a system of fast reaction to what images are prompting and to what can be captured at a glance. This is not what happens with text, which needs some level of consciousness, attentive processing and mental effort to be understood. In an experiment conducted with a test on 16 familiar road signs, at certain distances symbols were 50% more legible than written signs (Chan *et al.*, 2016). It is indubitable that symbolic signs are more efficient, in that they provide the information that is needed, without further distractions.

The different treatment that images and text receive from a cognition point of view in our brain has been described as “dual coding” (Paivio, 1971). Images, on the other hand, improve text understanding. In an experiment conducted on a computer-keyboard setting to measure reaction times to road signs, better results were obtained with a combination of graphics and text (Koyuncu & Amado, 2008, p. 108).

Even if they have different functions and in a sense compete between themselves as means of communication, images and texts are also complimentary and may blur into each other, when text for example assumes certain shapes and colors, or is sized differently according to its aim. The abstractness and formality of language does not free it completely from visuality and salience, although it preserves its superiority in terms of providing comprehensive and systematic descriptions of the world.

Overall, it's been demonstrated by empirical research that symbolic messages are generally more quickly recognizable and understandable, although this is not necessarily true for all symbols, at any distance and for any duration (Ells & Dewar, 1979, p. 167). When vision is restricted, the efficiency decrease in understanding is greater for verbal signs than for symbolic signs, which results in experimenters concluding that when there is no possibility to test on the field their efficacy, a symbolic sign should be preferred over text (Ells & Dewar, 1979, p. 168).

Numerous other factors at the individual level have to be taken into account. For instance, older drivers have higher levels of routinary behavior, need for clarity and aversion towards ambiguity, while younger drivers are associated with unlawful, anxious and distracted driving (Kaplan *et al.*, 2018, p. 420).

As I anticipated, it becomes essential to ascertain under which conditions road signals are more or less effective. As one might expect, flashing signs or visual signs that are activated on cue and by the passage of vehicles, produce notable reduction in speeds at junctions or dangerous curves, to the point that these cues are expected to exert an unconscious and automatic response in terms of higher prudence and control. Flashing warnings in general offer increased attentional conspicuity, if compared for example with the use of certain colors, such as red or yellow, that are traditionally associated with risk signaling (Charlton, 2006, p. 504).

Another interesting finding has been the noticeable effect in experienced drivers of the “priming” that happens with the repetition of road signs (Crundall & Underwood, 2001, p. 187). In other words, for drivers that are more familiar with it, a *priming* signal of generic hazard may be particularly effective in eliciting a timely reaction to the subsequent *probe* signal, that indicates the real hazard. As anticipated, the effectiveness of such priming seems to be linked with the level of experience: novices have not developed yet that familiarity with the context that makes them automatically receptive of those clues (Crundall & Underwood, 2001, p. 187). The additional precautions and limitation for newly licensed driver look then all the more reasonable, if novices take on average an additional 1,7 decimal of a second to correctly classify road scenes (Crundall & Underwood, 2001, p. 197). Novice drivers are not as apt in extracting visual information while driving, and therefore require greater cognitive energy to select and process all the relevant stimuli (Crundall & Underwood, 2001, p. 198). The transmission of information that allows driving behavior to be modified seems not straightforward and explicit. Drivers happen to modify their driving behavior thanks to traffic signs but without even realizing it (Crundall & Underwood, 2001, p. 196). Such a dynamic might be assimilated to an hypothesis of *nudge* (Sunstein, 2015; Thaler & Sunstein, 2009), and I am going to discuss some implications of this discovery in the next section.

These kinds of experiments, which are conducted most of the times in artificial settings, naturally have a potential problem of ecological validity with respect to the research context. The actual pressure that the driver is subjected to in the natural context could lead to reactions of a different nature or extension. However, these results have been substantially confirmed (especially in the Crundall experiments) even with the most realistic driving simulators. In the same way, another common method of investigation, that is interviewing the driver in a real road setting, is normally conducted with a temporal frame that does not exclude the presence of intervening factors that confuse and influence the results.

Legislation on road signs and traffic laws are not always a factor in the different degree of visual cognitive impact of road signs. Road signs are designed to take into account aspects such as visibility or size, but they do not acknowledge the subtle difference between automatically processed and deliberately processed information. In most cases, the physical features of signs are considered just as an aid for a better conscious perceptual activity, and not a constitutive or defining part in themselves.

The awareness of cognitive mechanisms and biases (Kahneman & Tversky, 2000) is now taking hold even in social and legal policies, and this is what is analyzed in the present section, expounding some experimental or relatively new forms of signals that factor into their design these behavioral insights. In a legal world of increasing complexity and over-regulation (Caterina, 2008), the plethora of norms is translated into a plethora of signs. However, excess of information causes a lack of attention on the part of drivers, who end up forgetting most of the signs (Kaplan *et al.*, 2018, p. 416). Speaking or listening also creates an ulterior motive for fatigue for the driver, and brings about unwise decisions. One of the single most worrying causes of accidents today is distraction due to the use of mobile phones or other multimedia

## 5. How road signs are evolving

equipment while driving (Chan *et al.*, 2016). The problem that was once a lack of information and not enough signage (and in some areas of the world it still is), today has probably turned into an overload thereof (Picture 1 and Picture 2). In this respect, road signs are expected to become more self-explanatory and adhere to the principles of “sustainable safety” (Wegman *et al.*, 2008): functionality and adherence to a hierarchical structure; homogeneity with regard to speed and directionality; predictability in terms of interpretative outcomes.



Picture 1



Picture 2

As Pardo and Patterson correctly point out, there is no such thing as “unconscious rule following”, but it’s true that certain behavior and attitudes may be oriented through signals that are mainly perceived through “cognitive system 1” (Pardo & Patterson, 2015, p. 178). A clear practical application of this latter insight is the increasing use of active speed warning signs, that is, those signs that actively respond to the driver’s conduct (Picture 3). Active signals of this kind obtained an average reduction of speed of 5,8 miles in correspondence with the sign, and of 2,9 miles after 0,2 miles. With subsequent intermittent police controls, this reduction was respectively 6,1 and 5,9 miles, with a decrease of 34,9% of those speeds exceeding by more than 10 miles per hour the limit (Bloch, 1998).



Picture 3

In some versions, active signals also spell the consequence of the driving behaviors, such as the possible penalties in the driving licence point-system (Picture 4), or provide a “social

feedback”, by thanking or smiling at the driver who is respecting the speed limit (Picture 5). These signs report in real time non-compliance with the standard, or they may say “thank you” in cases of compliance. Such signals have become particularly common when entering urban areas after a long stretch on a faster road.



Picture 4



Picture 5

Active systems should be particularly effective, as they do not only remind the driver of what their actual speed is: drivers could do this by looking at speedometer on the car’s cockpit, but it’s certainly easier to look at it without taking the eyes off of the road. What is even more effective in the second version, which provides a feedback to the adequacy of speed, is the feeling that problematic behavior might be exposed. It’s not necessarily the discomfort that comes from being recorded by “big brother”, because in these active systems, there is no direct recording of the actual speed, and no penalty or fine may be expected from the signaling system itself. It is rather the unconscious social pressure that one’s driving behavior is being watched that produces compliance. Behaviors oriented by rules always have a social dimension, in that we tend to act in concert with others, and to be affected unconsciously by what we think the others will think of us (Pardo & Patterson, 2015, p. 183).

This is the same collective logic behind the idea of the “watching eye”, that is, those traditional symbolic amulets that are recurrent in several cultures and picture a stylized eye image. While apparently these eye cues were supposed to work against sorcery or bad luck, it has been hypothesized that they also worked by making its bearer better-behaved (so avoiding creating enemies or inflicting self-harm through anti-social behavior). In many other contexts, there seems to be in fact a similar “watching eye effect” that makes people behave differently independent of deliberative evaluation of the costs and benefits of one’s action, and that increases law-abiding and cooperative behavior (Bateson *et al.*, 2006; Haley & Fessler, 2005). In the meta-research conducted by Dear and colleagues, unlawful behavior decreased by 35% in presence of eye cues, whereas CCTV cameras obtained a reduction in crime of just 16% (Dear *et al.*, 2019, p. 269). In the study by Haley and Fessler, “watching eyes” increased generosity in games of economic cooperation between 31% and 55%, depending on the clarity of the cue. Several other low-cost, low-intrusion campaigns working by the same principle have been put in place in order to prevent and reduce bicycle theft, petty crime on trains and littering by drivers, with seemingly good results (Dear *et al.*, 2019, p. 271).

The perception of collective control would therefore have stronger effects than actual control. One explanatory hypothesis behind such puzzling behavior may be derived from evolutionary

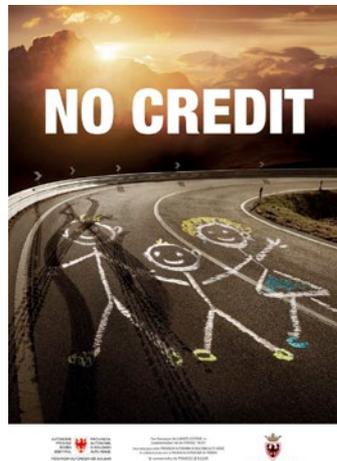
psychology (Barkow *et al.*, 1992): we evolved a pronounced sensitivity towards being watched, at first in order to protect us from predators, and subsequently to protect our reputation in wider social systems. Considering the relatively lower costs of these visual cues, of which the active-speed feedbacks described above represents the analogous function (Picture 5), it is surprising how these signals are not as widespread.

The same kind of measures might be expected to be implemented shortly for all road users, e.g. for the pedestrian or cyclists, in order to prevent jaywalking in dangerous areas or other forms of rule-breaking that might be particularly self-harming. Synthetic vision and artificial reconnaissance technologies should allow all this and make it cost effective, and any necessary means to anonymize such systems, so to preserve data privacy and human dignity, is already there to be put in place.

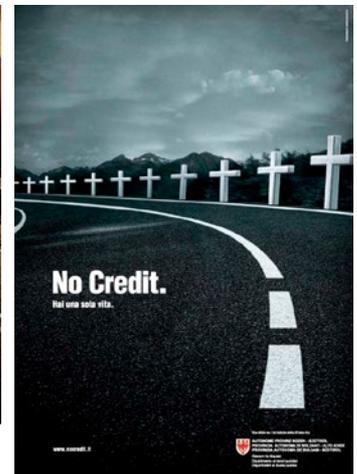
As previously suggested, these signs may be another form of “nudging”. They are relatively cheap, and they do not threaten drivers with ticket and fines. Nudges are in fact opposed to “command and control” types of regulations, because they do not imply the application of sanctions or material incentives. We are dealing here with nudges aimed at compliance. Punitive regulation shall continue to exist, but these signals persuade the user of the road, though unconsciously, that compliance with the rules is important and is in her/his interest. The same thing cannot be said for those semi-automated systems of coercion (in-built speed limitation, or the loud warnings playing in cars until everyone has fastened their seat-belt), which need sophisticated sensors to be installed, adding significantly to the cost of vehicles. The literature on nudges is now extensive (Baldwin, 2014; Barton & Grüne-Yanoff, 2015; Haugh, 2017; Wilkinson, 2013), and using road signs as a case in point, it seems interesting to point out the initiative of the province of Bolzano, in Italy, which uses suggestive images to target risky road behaviors (Picture 6, 7, 8). Pictorial nudges have been already widely used to discourage smoking (Rousu & Thrasher, 2013). These powerful and shocking messages recall the tragic and permanent consequences of what, without the advantage of hindsight, would appear as marginal acts of imprudence. They are placed at the roadside, on large billboards, just like any other road sign. Another example is the informative nudge that appears on the highway panels of the Italian motorway network, which provide statistics on accidents. In both cases, to our knowledge there are no studies on the impact of these measures.



Picture 6



Picture 7



Picture 8

A further development to be expected is that of the speed limit or hazard signals that adapt to environmental and traffic conditions (out-of-car Intelligent Transport Systems - ITS). With the necessary technological and regulatory innovations, the speed limits shown by these signs could be made dynamic, that is, variable according to the aforementioned conditions. Speed limits that are not linked inflexibly with a road section, but that may be adjusted to traffic, weather, visibility, or even to the driver's psychological status, may appear more "credible" and "logical in the given circumstances", and more easily followed as a result (Wegman *et al.*, 2007, p. 336). "In-car ITS" may also be programmed to automatically recognize road signs and speed limits, even when driven in manual mode, and act consequently.

In this article, I tried to delimit a field of investigation for possible empirical investigation on the effectiveness of road signs, by defining preliminarily some fundamental concepts in the field of road safety, and secondly by highlighting the issues that I considered relevant from the linguistic point of view. In so doing, I took a position on the limits of a purely semiotic perspective in the study of a social phenomenon such as that of compliance with rules. In this regard, I felt that a normative-semiotic perspective could be integrated by a cognitive perspective, meaning with this latter the overall multidisciplinary approach that seeks to outline a theory of behavior in relation to delimited social and normative contexts, so integrating insights from both the natural and the social sciences and achieving higher degrees of precision and predictability.

Road behavior is usefully analyzable, and therefore orientable, also through the tools of evolutionary psychology, behavioral psychology, and sociology. I believe that at this moment, research that looks at the ecological individual reaction with respect to the social context, can contribute greatly to the field, and I have illustrated this in the section dedicated to empirical research. It is true that in a few decades, the issues of safety and road signs might be a problem of the past, since it is likely that a risky activity such as driving vehicles on public roads, unless for recreational purposes, will be completely entrusted to automated intelligent systems. However, manual driving, or at least mixed forms between manual driving and automatic driving, will be with us for some time, and therefore it makes sense, given the current considerable human and economic impact of road accidents, to ask oneself about the problem of compliance with traffic laws.

Research on road signs becomes particularly relevant as a consequence of the recovery of visibility in modern communication. Indeed, one of the most interesting empirical hypotheses to verify will be that such forms of nudge or "emotional moral suasion", may prove in the end particularly effective when coupled with traditional forms of regulation and punishment. The request to reach quickly large masses of people has undoubtedly contributed to this. There is a need to reduce complexity and to communicate instructions and warnings effectively and rapidly. Focusing on the emotional aspect, however, does not necessarily mean appealing to the pure "populist" instincts (Boehme-Neßler, 2010, p. 137). I have argued that signaling harmful behavior by underlining risks in an individualized way, needn't be incompatible with human dignity, provided this hasn't direct consequences in terms of sanctions and punishment. Finding a balance between words and images is also a challenge for the law, as it is no longer reasonable to retain the idea that the latter is always inferior and subordinate to the former.

## 6. Conclusion

## REFERENCES

- Baldwin, R. (2014). From Regulation to Behaviour Change: Giving Nudge the Third Degree. *The Modern Law Review* 77(6). Doi: 10.1111/1468-2230.12094;
- Barkow, J.H., Cosmides, L., & Tooby J. (1992). *The Adapted Mind. Evolutionary Psychology and the Generation of Culture*. New York-Oxford: Oxford University Press;
- Barton, A, & Grüne-Yanoff T. (2015). “From Libertarian Paternalism to Nudging—and Beyond.” *Review of Philosophy and Psychology* 6(3): 341–59. doi: 10.1007/s13164-015-0268-x;
- Baskin, J.H., Edersheim J.G., & Price B.H. (2007). Is a Picture Worth a Thousand Words? Neuroimaging in the Courtroom. *American Journal of Law & Medicine* 33, 239–269;
- Bateson, M., Nettle D., & Roberts G. (2006). Cues of Being Watched Enhance Cooperation in a Real-World Setting. *Biology letters* 2(3): 412–414;
- Bloch, S. (1998). *Comparative Study of Speed Reduction Effects of Photo-Radar and Speed Display Boards*. *Transportation Research Record*, 1640, 27–36;
- Boehme-Neßler, V. (2010). *Pictorial Law. Modern Law and the Power of Pictures*. Heidelberg-Dordrecht-London-New York: Springer;
- Camp, E. 2007. Thinking With Maps. *Philosophical Perspectives* 21(1): 145–82. doi: 10.1111/j.1520-8583.2007.00124.x;
- Caterina, R. (Ed.) (2008). *I fondamenti cognitivi del diritto. Percezioni, rappresentazioni, comportamenti*. Torino: Mondadori;
- Chan, J., Gonzalez, P., & Melanie Perez, E.M. (2016). Designing Traffic Signs: A Case Study on Driver Reading Patterns and Behavior, *16th Philippine Computing Science Congress Conference* (March). Retrieved from: <https://www.researchgate.net/publication/299335052>;
- Charlton, S.G. (2006). Conspicuity, Memorability, Comprehension, and Priming in Road Hazard Warning Signs. *Accident Analysis and Prevention*, 38(3): 496–506;
- Choocharukul, K., & Sriroongvikrai, K. (2017). Road Safety Awareness and Comprehension of Road Signs from International Tourist’s Perspectives: A Case Study of Thailand. *Transportation Research Procedia*, 25, 4518–28. Retrieved on <https://www.sciencedirect.com/science/article/pii/S2352146517306555> (March 28, 2019);
- Cominelli, L. 2018. *Cognition of the Law. For a Cognitive Sociology of Law and Behavior*. Cham: Springer;
- Crundall, D, & Underwood G. (2001). The Priming Function of Road Signs. *Transportation Research Part F: Traffic Psychology and Behaviour*, 4(3), 187–200;
- Dahl, R. (2004). Vehicular Manslaughter: The Global Epidemic of Traffic Deaths. *Environmental health perspectives*, 112(11): A628–31. Retrieved on <http://www.ncbi.nlm.nih.gov/pubmed/15289183> (April 15, 2019);
- Dear, K., Dutton, K., and Fox, E. (2019). Do ‘Watching Eyes’ Influence Antisocial Behavior? A Systematic Review & Meta-Analysis. *Evolution and Human Behavior* 40(3), 269–80. Retrieved on [https://www.sciencedirect.com/science/article/pii/S1090513817303264?dgcid=raven\\_sd\\_via\\_email](https://www.sciencedirect.com/science/article/pii/S1090513817303264?dgcid=raven_sd_via_email) (April 7, 2019);
- Dudek, M. (2015). Why Are Words Not Enough? Or a Few Remarks on Traffic Signs. In M. Araszkiwicz, P. Banaś, T. Gizbert-Studnicki, & K. Pleszka (Eds.). *Problems of Normativity, Rules and Rule-Following*, Cham-Heidelberg-New York-Dordrecht-London: Springer International Publishing;
- . (2018). Can Informative Traffic Signs Also Be Obligatory? Polish Constitutional Tribunal and Supreme Court Versus Traffic Signs. *International Journal for the Semiotics of Law - Revue internationale de Sémiotique juridique*, 31(4), 771–85. doi: 10.1007/s11196-018-9541-5;
- Ells, J.G., & Dewar, R.E. (1979). Rapid Comprehension of Verbal and Symbolic Traffic Sign Messages. *Human Factors: The Journal of Human Factors and Ergonomics Society*, 21(2), 161–68;
- Goodrich, P. (2014). Devising Law: On the Philosophy of Legal Emblems. In A. Wagner and R.K.

- Sherwin (Eds.), *Law, Culture and Visual Studies*, Dordrecht - Heidelberg - New York - London: Springer;
- Haley, K.J., & Fessler, M.T.D. (2005). Nobody's Watching? Subtle Cues Affect Generosity in an Anonymous Economic. *Evolution and Human Behavior*, 26(3), 245–56;
- Haugh, T. (2017). Nudging Corporate Compliance. Retrieved on [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3004074##](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3004074##) (October 23, 2017);
- Kahneman, D. (2011). *Thinking, Fast and Slow*. New York: Farrar, Straus and Giroux;
- Kaplan, S., Bortei-Doku, S., & Prato, C.G. (2018). The Relation between the Perception of Safe Traffic and the Comprehension of Road Signs in Conditions of Ambiguous and Redundant Information. *Transportation Research Part F: Traffic Psychology and Behaviour*, 55, 415–25. doi: 10.1016/j.trf.2018.03.021;
- Koyuncu, M., & Amado, S. 2008. Effects of Stimulus Type, Duration and Location on Priming of Road Signs: Implications for Driving. *Transportation Research Part F: Traffic Psychology and Behaviour* 11(2): 108–25;
- Massaro, A. (2016). Omicidio stradale e lesioni personali stradali gravi o gravissime: da un diritto penale 'frammentario' a un diritto penale 'frammentato.' *Diritto penale contemporaneo*. Retrieved on <https://www.penalecontemporaneo.it/d/4705-omicidio-stradale-e-lesioni-personali-stradali-gravi-o-gravissime-da-un-diritto-penale-frammentario> (April 15, 2019);
- McMurtry, A.L. (1915). Automobile Warning Signals. *Transactions (Society of Automobile Engineers)*, 10, 220–42. Retrieved on <http://www.jstor.org/stable/44579720>;
- Moroni, S., & Lorini, G. (2017). Graphic Rules in Planning: A Critical Exploration of Normative Drawings Starting from Zoning Maps and Form-Based Codes. *Planning Theory*, 16(3), 318–38;
- Paivio, A. (1971). *Imagery and Verbal Processes*. New York: Holt, Rinehart and Winston;
- Pardo, M.S., & Patterson D. (2015). Philosophy, Neuroscience and Law: The Conceptual and Empirical, Rule-Following, Interpretation and Knowledge. In M. Araszkiwicz, P. Banaś, T. Gizbert-Studnicki, & K. Płeszka (Eds.). *Problems of Normativity, Rules and Rule-Following*, Cham-Heidelberg-New York-Dordrecht-London: Springer International Publishing;
- Pusceddu, R. (2017). “Verso una semiotica dei segnali stradali.” In eds. P.G. Lecis et al. (Eds.), *Verità, Immagine, Normatività*. Macerata: Quodlibet;
- Robinson, P.H., Kurzban, R., & Jones, O.D. (2007). The Origins of Shared Intuitions of Justice. *Vanderbilt Law Review*, 60(3);
- Rousu, M.C., & Thrasher, J.F. (2013). Demand Reduction from Plain and Pictorial Cigarette Warning Labels: Evidence from Experimental Auctions. *Applied Economic Perspectives and Policy*, 35(1), 171–84. Retrieved on <http://www.jstor.org/pros.lib.unimi.it/stable/23356427>;
- Studnicki, F. (1970). Traffic Signs, *Semiotica*, 2, 151–72;
- Sunstein, C.R. (2015). Nudges, Agency, and Abstraction: A Reply to Critics. *Review of Philosophy and Psychology*, 6(3), 511–29. doi: 10.1007/s13164-015-0266-z (October 8, 2017);
- Thaler, R.H., & Sunstein, C.R. (2009). *Nudge. Improving Decisions About Health, Wealth and Happiness*. London: Penguin Books;
- Weber, M. (1995). *Economia e Società. III. Sociologia del diritto*. Torino: Edizioni di Comunità;
- Wegman, F., Aarts, L., & Bax, C. (2007). Advancing Sustainable Safety. *Safety Science*, 46(2), 323–43;
- Westerhoff, J. (2005). Logical Relations between Pictures. *The Journal of Philosophy*, 102(12), 603–23. <http://www.jstor.org/stable/3655675>;
- WHO. (2018). *Global Status Report on Road Safety 2018*. Retrieved on <https://apps.who.int/iris/bitstream/handle/10665/276462/9789241565684-eng.pdf?ua=1>;
- Wilkinson, T.M. (2013). Nudging and Manipulation. *Political Studies*, 61(2), 341–55. doi: 10.1111/j.1467-9248.2012.00974.x (September 22, 2017).