



Proposal about the design and the choice of road signs

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Abstract

The road signs can be defined as a communication to the users of the road. In fact, as stated by Crundall and Underwood [1], the role of the road signs is to prepare the driver for a subsequent behaviour. Such communication can be an advice, an order, or, finally, a prohibition, and it is related to the driver's behaviour, with the aim to improve the safety of the traffic. Such contents are principally expressed by pictures accompanied, very often, by texts, which sometimes result to be very long and complex. If the length or the complexity of the inscription can be a problem, the fact that the text is written in the language of the Country where the road sign is placed, cannot be overlooked.

Aim of this paper is to propose a method able to support the translation of the texts, which are written below the road signs, in a graphical form. To the base of this idea there is the certainty that the graphic symbols are a universal communication form able to overcome both the language and the cultural differences.

1 Fundamental concepts about the communication

The start point of the study regards the communication process. It can be analysed in order to explain the fundamental elements required to support the correct develop of the message transmission and reception.

From a general point of view, in a communication process the following elements are recognizable:

- a) **Sender:** the organizer of the communication, who operates the association of the contents with the system of signs. The signs are the medium (the "vehicle") of the communication.
- b) **User:** The person or people who receives the system of signs and reconstructs the information contents wanted by the sender.
- c) **Message:** it is the information that, by following specific rules, "starts" from the sender and "reaches" the user.
- d) **Codex:** it is the structured connection between contents and signs that "transfer" the information (the contents).
- e) **Contact:** it is the sensorial channel (generally the sight and/or the hearing) that permits the reception of the message.
- f) **Context:** it is the environment where WHAT happens and that surrounds the communication.

In the same manner, the correct elements required to define the communication associated to road signs can be identified as follow:

- a) **Sender:** the authority responsible for the traffic safety;

- b) **Users:** all the road users, whether they are or not driving a vehicle, such as drivers, riders, bikers, passengers and pedestrians;
- c) **Message:** the communication of the information, of the order or of the prohibition, with the aim of improving the safety and the regularity of the traffic;
- d) **Codex:** the association between graphical signs and texts, supported by a road sign and directed to the road's users;
- e) **Contact:** principally the user sight and, more rarely (e.g. in the case of traffic lights with acoustic signal for blind people) the hearing, that are devoted to receive the message;
- f) **Context:** the road and the environment (the weather, the rural or the urban context, etc.) surrounding.

To design and perform a correct communication is necessary to follow four notions: the initial behaviour, the terminal behaviour, the structure of the concepts and the communication unit.

The term "initial behaviour" is related to the behaviour of the recipients, it identifies the requirements to receive the communication and can be expressed as the knowledge background required by the recipients before starting the communication act.

The "terminal behaviour" is strictly related to the capacity of comprehension of the human being, it identifies the objectives of the communication. It, in analogy with the initial behaviour, is expressed in terms of the knowledge that may be reached by the recipients at the end of the communication act.

The structure of the concepts to be transmitted represents the complex of the information contents, which are the amount of knowledge between initial and terminal behaviour. Those concepts have to be carefully

determined and structured in order to reach the target of the communication.

The communication unit is the part of the communication devoted to the transmission of each concept.

Thanks to the great number of road signs examples acquired by the authors during their studies [2], the application of the above sub-division was tested in the road signs communication field. An example of the application of the communication sub-division rules to the traffic signage system is explained in Table 1. It regards a prohibition signal with an inscription added in Italian language and placed below to the road sign. The prohibition regards the stop of the vehicles, while the meaning of the inscription is: "it excepts for the ascent and the descent of the passengers from buses".

Road sign	Communication step	Explanation of the step	Application to the road sign
	Initial behaviour	Knowledge necessary to use the communication	<ul style="list-style-type: none"> No visual important defects Knowledge of the Italian language Driver's license
	Terminal behaviour	Knowledge to be reached by the user with the communication	<ul style="list-style-type: none"> No stop permitted by drivers of private vehicles The bus drivers can stop only for the ascent and the descent of the passengers
	Structure of the concepts	Parts of the communication individuated by the analysis of the terminal behaviour	<ul style="list-style-type: none"> Stop for private vehicles not allowed Stop allowed only for the ascent and the descent of the bus passengers
	Communication unit	Association of the parts of the communication to the medium	<ul style="list-style-type: none"> Stop prohibited: picture Exception for bus drivers: text

Table 1. Application of the communication steps to a road sign.

2 General analysis of a road sign

The research conducted by the authors about the technical communication [3] have revealed that the message transmitted, even if based on a picture, can be considered as structured as a sentence and composed by the following parts: operation, complement, preposition, complement linked to the preposition. This sub-division can be applied for the communication structure of road signs and an example of its application is reported in the

	Example 1	Example 2	Example 3	Example 4
	in caso di nebbia	a semaforo spento o lampeggiante	uscita autocami	solo per autocami
	Italian	in caso di nebbia	uscita autocami	solo per autocami
	English	in case of fog	heavy vehicles	only for heavy vehicles
Components of the textual message	Operation	Drive	Give	No turn
	Complement	No more speed 80 km/h	Way	Attention
	Preposition	If	If	Left
	Complement linked to the preposition	Fog	Traffic lights is flashing or off	Because
			Crossing of trucks	Only
				Trucks

Table 2.

The sub-division of the sign meaning is expressed by both the graphical and the textual information. Here, the textual information expressed in the road sign is analysed in order to translate the information into a graphic form with an equivalent meaning.

	Example 1	Example 2	Example 3	Example 4
Textual message on the traffic sign	in caso di nebbia	a semaforo spento o lampeggiante	uscita autocami	solo per autocami
Italian	in caso di nebbia	a semaforo spento o lampeggiante	uscita autocami	solo per autocami
English	in case of fog	when the traffic lights is flashing or off	heavy vehicles	only for heavy vehicles
Components of the textual message	Operation	Drive	Give	No turn
	Complement	No more speed 80 km/h	Way	Attention
	Preposition	If	If	Left
	Complement linked to the preposition	Fog	Traffic lights is flashing or off	Because
			Crossing of trucks	Only
				Trucks

Table 2. Examples of the communication sentence analysis applied to the road signs.

It is important to observe that usually the operation and the complement are expressed in graphical form. The complement linked to the preposition is explained by means of the textual notation of the road sign, while the preposition is often understood, if it is not explained in the inscription.

3 Proposal of translation with known graphical signs

After the identification of the propositions and of the complements associated to them, it is necessary to define a set of symbols able to transmit the textual information so that they can substitute the inscription placed below the road sign. Table 3 presents some examples where the translation of the textual prepositions has been developed by means of well-known pictorial symbols.

Preposition	Textual message on the traffic sign Italian	Textual message on the traffic sign English	Textual example	Proposal of translation Before	Proposal of translation After
In	in centro	in the centre	Circulation of trucks in the centre of the town prohibited	in centro	➔
In	in galleria	in the tunnel	Speed limit of the vehicle applied in the tunnel	80 in galleria	➔

Table 3. Inscriptions translation of traffic signs by means of well-known symbols.

4 Proposal of translation with new graphical signs

Despite the existence of a multitude of known graphic symbols, it is possible that none of them could be suitable to satisfy the translation of the content of the inscription associated with the road sign. In these cases, it is necessary to study and select new symbols able to guarantee a good comprehension of the message transmitted to the recipients.

The effective capacity of a specific graphic sign to perform its function, i.e. to transmit the message, can be seen as the sum of many characteristics, such as the simplicity, the comprehensibility and the unambiguity. A way to select the most suitable symbol among different ones could be derived from the approach used in the methodical design for the choice of the "best in class" constructive solution [4] [5], for a product or a technical system, able to perform a given function. Such choice can be made through a system of matrixes where the rows report the different solutions and the columns report the characteristics of the specific solution with regard to the

function under analysis. The cells of the matrix include, finally, the evaluation of the behaviour of the solution in relation to the specific characteristic [6]. Following this method, all the symbols able to transmit the required message are compared on the basis of the selected characteristics and the most suitable is the one that reaches an evaluation greater than the others under analysis.

The practical application of the procedure to choose the more appropriate symbol, for the road sign message required, could be explained in math mode through the following steps. The behaviour v_{ij} of the i-th symbol is evaluated for any j-th characteristic obtaining an evaluation matrix where the symbols are reported along the rows and the characteristics along the columns.

For every characteristic used to compare the symbols it is defined a weight w_j chosen in relation to the context where the symbol will be adopted.

Finally, the judgment S_i , for the choice of the "best in class" symbol, is obtained by the sum of the multiplications between the weight and the value of each selected characteristic, as reported in the following equation [7]:

$$S_i = \sum_{j=1}^m v_{ij} w_j$$

where m is the number of the characteristics under evaluation.

Some different graphic symbols can be selected for the comparison and their adequacy to transmit the content of the message was evaluated with regards to some characteristics, such as: simplicity of the symbol, completeness of the content, unambiguity, comprehensibility of the symbol in case of bad visibility and readability of the symbol to distance.

For each characteristic can be defined a weight serving to identify its importance for the message transmitted. The weight values are defined in relation to the specific requirement of the communication and they could be different for each signal.

Following this approach, some symbols have been chosen and adopted in the proposal of translation for road signs. In Table 4 are presented some examples.

Textual message on the traffic sign		Concept	Proposal of translation	
Italian	English		Before	After
non illuminata	not lighting	Tunnel without lighting		
paracarri mobile	temporary kerbstone	Temporary kerbstone		

Table 4. Some new symbols proposed for the translation of textual messages.

5 Complex road signs

A particular effort has been paid to the translation of road signs that include many textual inscriptions. In these cases, the number of the messages included in the road sign could bring to a reduction both of the quality and of the comprehension of the transmitted information. This difficulty is more evident in the road signs that must be read in short time. As example, the road sign in Table 5

invites the driver to pay attention to the road, because it has many dangerous curves, there are no guard rail, there are crumpling near the walls and the surface of road is rough. It is to observe that the abundance of the messages included in this road sign and the requirement that they must be read in very short time by the driver of a running vehicle, make the information transmitted very complex. For this reason, it seems to be more useful to propose a modification of the road sign, so as to make it easier. It should make up of a general warning sign and some symbols added to indicate the specific dangers.

Textual message on the traffic sign		Proposal of translation	
Italian	English	Before	After
SERIE DI CURVE	SERIES OF CURVES		
tratti senza parapetti	verge without parapet		
muri pericolanti	unsafe walls		
STRADA DISSESTATA	ROUGH ROAD		

Table 5. Road new symbols proposed for the translation of textual messages.

6 Discussion and conclusion

The authors believe that the proposal of substitution of textual information with graphic signs could be a meaningful contribution to the safety of the road traffic. This consideration is based on the following reasons:

1. The graphic sign is independent from any language and, therefore, it is comprehensible for people of all countries. This property is very important in the current period of time, characterized by a strong and increasing multi-ethnicity in every country.
2. The graphical information, in relation to the textual message corresponding, require a more short time for reading them, with a significantly improvement of the safety.

The authors believe also that the general principles stated in the present paper could be a useful basis to discuss and to propose new road signs, exclusively in graphical form, able to guarantee the transmission of the right information in short time and independently by the countries of origin of the recipients of the message.

Also, the same criteria proposed could be applied to all those cases where the message must be immediately transposed, particularly in those places attended by a great number of people, such as train or coach stations, airports, markets, offices and so on. In these cases, also, this replacement can be a contribution for the general safety and the public order.

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