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Environmental Changes and Dynamics of a Network of Social Representations

Carine PIANELLI

PsyAction – Consulting firm on psychosocial risk assessment and management

Farida SAAD

French institute of science and technology for transport, development and networks (IFSTTAR)

Laboratory of Social Psychology, University of Aix-Marseille

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ABSTRACT

This research aims to study the transformation of a network of social representations (representations of Speed, Speed Limit and the emerging representation of a driving aid: the LAVIA system) following the occurrence of an irreversible event: the introduction of Automatic Speed Controls (ASCs) in France. Two surveys were carried out, before and

Correspondence should be addressed to Carine Pianelli (pianelli@psyaction.fr) or Farida Saad (farida.saad@ifsttar.fr).

after the introduction of ASCs, on a representative sample of drivers living in the LAVIA experimental area. The questionnaire included free and hierarchical associations (Study 1: N=1005; Study 2: N=281). The findings indicate that the structuring of the emerging representation of LAVIA and its acceptability by drivers depend on pre-existing representations within the social environment: the representations of Speed and Speed Limit. The introduction of ASCs results in the adoption of new driving practices that lead to the transformation of each representation belonging to the same network of social representations.

Keywords: Social representations, Anchoring process, Representational dynamics, Acceptability, Speed, Intelligent speed adaptation, Automatic speed controls.

Although social representation is a common sense knowledge that has a great capacity to resist change, its contents and its structure can be transformed by irreversible modifications of the environment (Flament, 1994). Most of studies on the dynamics of social representations were focused on the transformation of only one representation, but what about the dynamics of a network of social representations? This article aims to describe the main findings of two surveys carried out to study the structural transformation of a network of social representations following irreversible changes in the environment.

THEORETICAL FRAMEWORK

The dynamics of social representations

Social representations are "images" people have of a social object. According to the social representations theory (Moscovici, 1961), all reality is represented and appropriated by

individuals and groups, reconstructed in their cognitive systems and integrated in their value systems, which depend on their origins and the social and ideological context that circumscribes them. This appropriated and restructured reality constitutes reality itself for them. Any representation is collectively produced and engendered; it is the result of a set of specific social interactions (Moscovici, 1984). Hence, any representation is shared by individuals in the same group; it denotes the specificity of that group and contributes to differentiating it from others.

The behaviour of individuals and groups is directly determined by the representation they have of an object or of the situation in which they find themselves (Abric, 2001b). Social representations guide attitudes, judgments and social practices (e.g. Abric, 1976; Jodelet, 1989). Hence, if one wants to understand and explain the behaviour patterns of individuals, it is essential to discover their social representations.

According to the structural social representation approach (Central Core Theory; Abric, 1976, 1984, 2001b), 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. The peripheral system allows preserving the stability of the central core. The Central Core Theory has an essential methodological consequence: the study of a social representation entails identifying and analysing its contents and structure through the use of specific tools (cf. Method, Procedure and Tools).

Despite the great stability of the social representations, their contents and structure can be transformed by environmental changes (Flament, 1994). Environmental transformations can lead individuals to adopt new practices that will generate alterations in the corresponding social representation. In effect, any contradiction between social representations and practices necessarily results in the transformation of one or the other (Abric, 1993).

Environmental transformations are defined as any social or physical change that alters the living conditions of individuals and groups (Moliner, 1998). Nevertheless, in order for structural transformations to appear, it is necessary for the group to be strongly involved in the event and for the situation to be perceived as *irreversible* (Flament, 1994; for a book review in English, see Echebarria Echabe, 1994). When the situation is perceived as *reversible*, representations are only altered superficially, at a peripheral level.

Three types of structural transformation have been identified (Abric, 1993; Flament, 1989). The transformation is *progressive* when the new practices do not conflict with it and are not incompatible with the central beliefs underlying the representation. There is a reorganisation of the representation through the integration within the central core of elements that were peripheral, followed by fusion and the constitution of a new core (e.g. Social representation of Hunting; Guimelli, 1989).

The transformation of a social representation is *resistant* when new practices appear that conflict with it but are rendered compatible with what the central system prescribes through the intervention of rationalisation mechanisms that are integrated in the peripheral system (Rouquette & Guimelli, 1995). The multiplication of these rationalisations eventually leads to the transformation of the central core (e.g., Social representation of Gypsies; Mamontoff, 1996).

Lastly, there is a *brutal* transformation when the permanence, importance and irreversible nature of the new practices result in a direct and complete transformation of the representation's central core. This type of transformation may occur in the wake of legislative changes that have a drastic effect on a particularly important object (e.g. Abolition of slavery in Brazil in 1888; Flament & Rouquette, 2003).

Most of these studies on the dynamics of social representations explored the transformation of the representations of isolated objects. However, recent research has shown that each representation is related to other representations that constitute individual's symbolic and social environment (Abric, 2001a). A *network of social representations* is defined as a set of inter-related social representations which are socially shared by a given group, structured by common values and ideology and characterised by lexical congruence (Pianelli, Abric & Saad, 2010). Three types of relationship between representations have been identified (Abric, 2001a): the relationship of *reciprocity* characterised by reciprocal influence between representations (e.g. Social representations of Money and Work; Abric & Vergès, 1996; Vergès, 1992); the *interlocking* relationship based on the dependence of one object of representation on another (e.g. Social representations of Money, Banking and Lending; Abric & Vergès, 1994, 1995); and the relationship of *antonymy*, which specifically concerns objects of representation that have an antonymic definition (e.g. Social representations of Security and Insecurity; Guimelli & Rouquette, 2004).

Little research has looked at the transformation of networks of social representations. The few studies carried out in this area have essentially entailed inducing representational change experimentally. However, these studies have made it possible to show that, when two social representations are linked, changing one of them can lead to the transformation of the other.

One early study thus showed that introducing a message questioning the representation of Hunting induced changes in the organisation of this representation, but also indirectly resulted in a transformation of the representation of Ecology (Brandin, Choulot & Gaffié, 1998). Similarly, a second study showed that performing an attractive action that brought into question an element of the representation of Human Rights induced changes within this representation but also within the representations of Democracy and Institutions (Valence & Roussiau, 2006).

These two studies highlight the fact that the dynamics of social representations do not affect an isolated representation but several inter-related representations. Nevertheless, in both these studies the representational changes were induced experimentally. So what is the impact of environmental transformations on a network of social representations?

We make the assumption that irreversible changes in the environment are going to lead individuals to adopt new practices that conflict to a greater or lesser extent with one or several social representations. The multiplication of these new practices is eventually going to generate a modification of one or more corresponding social representations. Furthermore, these transformations are also going to have repercussions on other representations comprising the same social universe and will thus alter the existing relationships between these social representations.

In order to validate our assumption, we decided to study the social representations linked to speed within the framework of road safety research.

Speed, LAVIA system and Automatic Speed Controls

Speed is the primary cause of death on the road. It is both a factor that causes accidents and a

factor that exacerbates the consequences (Nilsson, 1993; Taylor, Lynam & Baruya, 2000).

In order to encourage drivers to comply with speed limits, the French Ministry of Transport launched the LAVIA project in 2001. This project was aimed at testing and evaluating a new driving aid: the LAVIA system (Saad, 2005). This system tells the driver whenever he or she is speeding, either by displaying a message on the dashboard or by limiting the vehicle's speed to the prevailing speed limit. The system can operate in three different modes that impose varying degrees of constraint on the vehicle: informational mode (message on the dashboard), active voluntary and active mandatory modes (action on the throttle pedal; cf. Saad, 2005).

The LAVIA project is part of the European research effort devoted to the evaluation of ISA systems (Intelligent Speed Adaptation Systems; for a review of the literature, see Jamson, Carsten, Chorlton & Fowkes, 2006). Driver support systems such as ISA represent new objects that have to be integrated in the social norms and values associated with motoring and in driving practices that are well established, assimilated and structured with experience (Saad, 2006, 2007). In France, the LAVIA system was evaluated in terms of the four classic dimensions usually employed to evaluate a new system: usability, acceptability, utility and safety (Lassarre & Saad, 2006). Basically, acceptability is regarded as the intention to use a device or system, which is to say as a predictor of the decision to use it in the future (Schade & Schlag, 2003). According to Nielsen (1993), the acceptability of a technical system breaks down into social acceptability and practical acceptability. The acceptability of a system will thus depend both on symbolic and social dimensions (beliefs, attitudes, norms, etc.) and on functional dimensions characterising the system and its usage (utility, reliability, ease of learning and appropriation, etc.). Since social representations determine attitudes, judgments and behaviour in relation to the object of the representation (Abric, 1993; Guimelli, 1999; Rateau 2000), the social acceptability

of LAVIA was evaluated by studying social representations of this system. However, since drivers knew little about LAVIA before the study and had no experience of using it, we made the assumption that the representation of this system was emergent, poor and non-structured. In order to understand and quickly assimilate this new object, drivers would integrate it in familiar and existing knowledge. This *anchoring process* would allow the elaboration of the new representation (Jodelet, 1984; Moscovici, 1961). Consequently, we made the assumption that the elaboration and the structuring of the social representation of the LAVIA would be determined by the extent to which this system would be *anchored* in pre-existing social representations within the social environment: the social representations of Speed and Speed Limit. These two objects related to the system were already at the heart of communications between individuals and between groups. They were strongly involved in social practices and raised issues such as social, economic and political challenges for drivers. Therefore, the LAVIA system should be the subject of the same important issues and challenges for the drivers.

A first survey carried out from May to July 2003 (Study 1, N=1005; Pianelli, Abric & Saad, 2010) showed that the contents and the structure of the emerging representation of LAVIA were indeed determined by the social representations of Speed and Speed Limit. The new representation of LAVIA was *embedded* into these both representations. As a result, the judgments made about this system and its acceptability did not depend on the object itself but on these two superior objects.

Initially, the experimental plan of the LAVIA project was to measure the acceptability of the LAVIA system after using it in a real driving situation (8 weeks), and to assess the effects of its use on driving behaviour and social representations. Unfortunately, an event, which was not planned, has obliged us to modify our experimental plan: the introduction of Automatic Speed

Controls (ASCs) in France. Indeed, the French authorities introduced ASCs in November 2003 in order to improve road safety. Nearly 900 fixed automatic cameras and 600 mobile automatic radar units were installed along the road network in France. Numerous studies have demonstrated the effectiveness of this type of device on the speeds practised by drivers. The results show that speeding was massively reduced in zones where there were fixed cameras, resulting in a substantial drop in the numbers of accidents in these areas (Pérez, Marí-Dell'Olmo, Tobias & Borrell, 2007). In France, the multiplication of speed controls and the deployment of fixed speed cameras have also had an effect on drivers' behaviour. There was a drop in speeds practised at the level of fixed cameras, but also over the whole of the road network. Between 2002 and 2005, the average speed at which motorists drove during the day fell by more than six km/h, while personal injury accidents declined by 19% and fatal accidents by 28%, on all road networks taken together (according to the National Inter-ministerial Road Safety Observatory[1]). The authorities responded to this spectacular drop in the accident rate by continuing to install more automatic speed cameras each year in France.

Since the introduction of Automatic Speed Controls is an irreversible event that induces the adoption of new practices by drivers, we make the assumption that the behavioural changes are going to generate transformations in the contents and structure of the representations of Speed and Speed Limit. As a result, the structural transformation of these both representations should generate changes in the structuring process of the emerging representation of LAVIA, and consequently, changes in the acceptability of this system to drivers.

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[1]Observatoire national interministériel de Sécurité Routière : *Impact du contrôle sanction automatisé sur la sécurité routière*, ONISR, march 2006.

Thus, we decided to carry out a second survey, not planned initially by the project, in order to identify and measure possible changes in the representations of Speed, Speed Limit and LAVIA. The French Ministry of Transport, which funded the project, agreed to finance this second study in order to control the effects of this event on our results. Hence, following the introduction of Automatic Speed Cameras, we carried out a second survey to identify possible changes in these three representations and to determine the *a priori* social acceptability of LAVIA system (study 2, N=281).

This article presents a comparison between these two studies carried out before and after the introduction of Automatic Speed Controls in France in order to measure the effect of this irreversible change on this network of social representations.

METHOD

Overview

The first survey was carried out from May to July 2003 (Pianelli, Abric & Saad, 2010). It entailed analysing the contents and structure of the representations of Speed, Speed Limit and LAVIA, defining a typology of drivers with different representations, and establishing to what extent these representations affected the *a priori* social acceptability of LAVIA.

The second survey was carried out from October 2004 to February 2005 (Pianelli, 2008; Pianelli, Abric & Saad, 2008). This survey was a means for taking account of the introduction of Automatic Speed Controls in November 2003, and for testing its potential effect on drivers' representations and acceptability of LAVIA system.

Participants

Both surveys were carried out on two different samples of drivers holding a basic driving licence and living in the LAVIA experimental area in the west of Paris[2] (N_{Study1}=1005; N_{Study2}=281). Due to time, financial and technical constraints, the sample size of the study 2 was less important than in the study 1. However, this sample was sufficiently large to obtain a significant data collection which allowed a significant statistical comparison between the both surveys. Moreover, these two samples were representative of the population living in this area in terms of gender (Study 1: 499 Women, 506 men; Study 2: 147 Women, 134 men), age (M_{Study1}=42.4 years, SD=15.3; M_{Study2}=40.6 years, SD=15.1) and socio-professional category (see Figure 1). There was no significant difference between these two samples regarding these three variables.

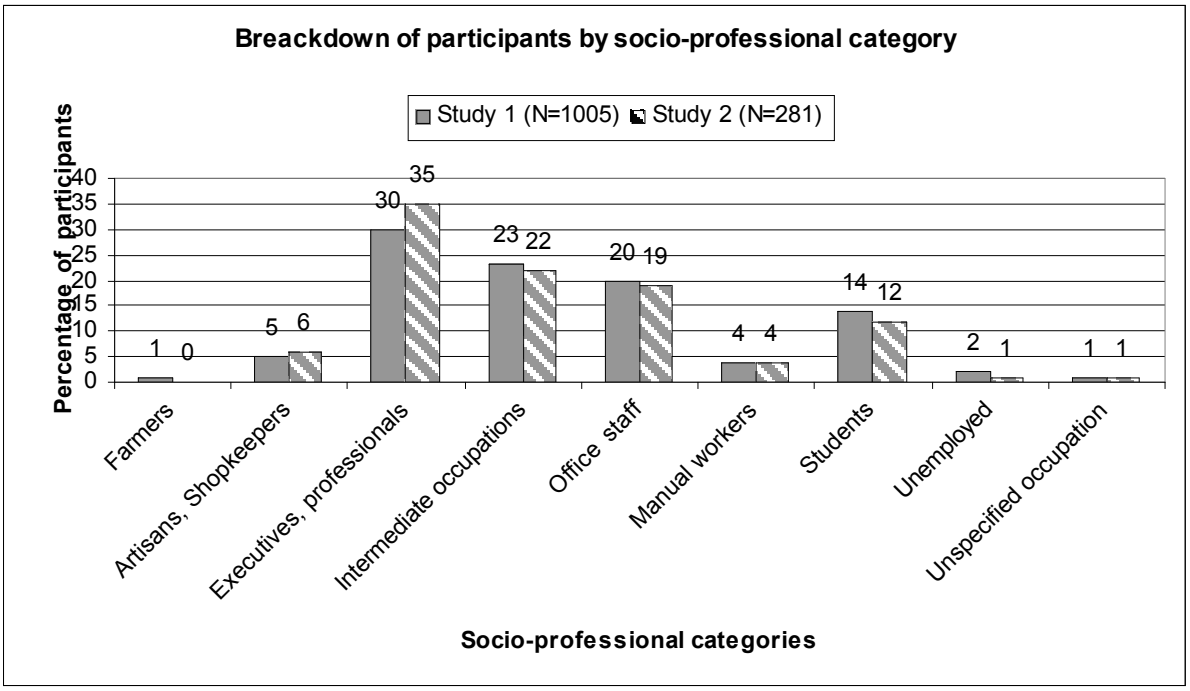

Figure 1. Surveys 1 and 2: Breakdown of participants by socio-professional category

[2] Saint Quentin en Yvelines, Versailles, Le chesnay, Virolflay, Vélizy (Yvelines department).

Procedure and tools

In the both surveys, participants were recruited from their place of work or their place of residence in the LAVIA experimental area (west of Paris). They completed a face-to-face questionnaire during 35–40 minutes.

In order to make a comparison between surveys 1 and 2, we used the same questionnaire in both surveys. This questionnaire included questions on drivers' declared driving practices (annual mileage, practised speeds, sanctions for speeding), drivers' acceptability of LAVIA system and their socio-demographic characteristics (gender, age, profession, number of children). This questionnaire included also a specific tool framed in accordance with the structural approach: the "free and hierarchical associations" (Abric, 2003) used on the stimulus-words Speed, Speed Limit and LAVIA system.

The stimulus-words Speed and Speed Limit were selected following an exploratory qualitative study that aimed to determine the social objects related to the new system LAVIA according to the drivers (Pianelli, 2008). This exploratory study consisted in twelve semi-structured individuals interviews and three focus groups with 5 participants. The interview guideline included open-ended questions on three main topics: the driving task, the driving speed and the LAVIA system (preceded by a description of the system). The analysis of the interviews and focus groups consisted in identifying and classifying the main ideas and themes expressed by the participants for each topic. Since the LAVIA system was designed to help drivers to comply with speed limit by limiting their driving speed, the analysis of the interviews and focus groups showed that the drivers discourse regarding the LAVIA system was mainly constituted and determined by their discourse and reported practices regarding driving speed (high-speed pleasure or danger, vehicle control) and regarding the laws which regulate it (speed limits, police

enforcement). Thus, we chose to focus our research on the representations of these two social objects.

The *free and hierarchical association method* used is based on a two-stage questionnaire. The first stage is a free association phase. Starting from an evocative word, it involves asking the subject to indicate three words or expressions that come to mind (e.g. *"Which are the three words or expressions that come to mind when you hear the word* Speed*?").* The spontaneous character of this phase allows quick and easy access to the elements that constitute the semantic universe of the objects studied. The second stage is a hierarchical structuring phase. Each subject is invited to rank his own answers as a function of the importance he attaches to each term for defining the object in question. Thus, for a given population, we have a body of items – the contents of the representation – and two quantitative indicators for each element produced: the frequency with which it appears and the average degree of importance that subjects attach to the item. Through the role it plays in the representation, a central element has every chance of being very present in the subjects' statements. The frequency with which it appears (its "saliency") is thus an indicator of centrality. It is complemented by more qualitative information: the importance the subject attaches to it.

Two different statistical analyses were performed on these data: the Prototypical Analysis and the Correspondence Analysis.

The Prototypical Analysis (Abric, 2003; Bonnec, Roussiau, & Vergès, 2002) provides an identification of the status of the elements of the representation for a given population. This method consists in crossing the two sets of information gathered (ranking and frequency) in order to identify the status of the central and peripheral elements of the representation.

The zone of the "central core" is constituted by elements with high frequency and high average degree of importance. These elements may be "central" but can be also stereotypes or prototypes associated with the object. The zone of "the contrasted elements" includes elements enunciated by few people who consider them as very important. Thus, certain minority sub-groups may share a specific representation comprising one or more elements appearing in this zone. The zone of the "first periphery" contains the most important elements of the peripheral system. The less important elements of the representation appear in the zone of the "second periphery".

The correspondence analysis (Benzécri, 1973; Greenacre, 1984) is a data analysis used to study links between various social representation elements but also to shed light on the relationship between these elements and individuals' integration into various groups (Doise, Clémence & Lorenzi-Cioldi, 1993; Wagner, Duveen, Farr, Jovchelovitch, Lorenzi-Cioldi, Markovà & Rose, 1999).

These two statistical analyses were performed on the data collected with the free and hierarchical associations on the stimulus-words Speed, Speed Limit and LAVIA system during the both studies.

In order to measure the differences between the both surveys**,** student test t was carried out at the same time on the frequency of evocation and the average ranking of importance of each element. These two dimensions were analyzed simultaneously thanks to a specific data coding: non-evoked element was coded 0, evoked element judged as the least important was coded 1, evoked element judged as fairly important was coded 2 and evoked element judged as the most important was coded 3.

RESULTS

Changes in drivers' declared driving practices

To gauge the possible effect of Automatic Speed Controls, we relied first and foremost on drivers' declared behaviour as regards speeding fines, reported speeds and speeds considered "safe" (Table I).

Table I. Surveys 1 and 2: Average reported speeds and average safe speeds for the whole population (km/h)[a]

	Urban area		Road		Highway	
	Survey 1	Survey 2	Survey 1	Survey 2	Survey 1	Survey 2
Reported speeds	53.1[a]	51.9[b*]	97.2[a]	95.7[b**]	135.5[a]	131.3[b***]
Safe speeds	49	49.5	93.2	94.1	133.5	132.9

[a]On one and the same line and for each type of road network, the average speeds with a distinct exponent are significantly different between surveys 1 and 2 (Student test t: * p<.05 ; ** p<.01 ; *** p<.0001).

The percentage of drivers caught for speeding had significantly increased between the two studies (M_{Study1} = 12% vs M_{Study2}= 17,6%; t=-2,424; p<.01). Consequently, since the introduction of Automatic Speed Controls, around two-thirds of drivers said they looked more often at their speedometer (78%) and at speed limit signs (73%; study 2, N=281). Hence, the tightening of speed controls led drivers to pay increased attention to regulatory speeds and to compliance with them. Similarly, 65% of drivers said they have been driving less quickly since the introduction of automatic speed cameras. Compared with the first survey and whatever the type of road network, the average reported speeds by participants have significantly decreased

(average reported speeds on urban area: $t=2.111$; $p<.05$; road: $t=3.128$; $p<.01$; motorway: $t=4.755$; $p<.0001$; cf. Table I).

However, compared with the first survey, there was not any significant difference between the speeds regarded as "safe". In both surveys, the speeds that drivers said they practised were still higher than the “safe speeds”, and this difference persisted despite the introduction of speed cameras (cf. Table I). Although the differences between the speeds practised and the "safe" speeds tended to decrease, the "safe" speeds were still higher than regulatory speeds on roads and motorways. Thus, the introduction of Automatic Speed Controls did not have any effect on the perception of safe speeds.

Dynamics of the social representation of Speed

Before the introduction of Automatic Speed Controls, the free and hierarchical association starting from the word “Speed” allowed to obtain a corpus of 3015 words and expressions (1005 subjects x 3 words/subject). This corpus of words was simplified by gathering the synonymic words under the same term (gathered words are indicated by footnotes). A Prototypical Analysis was carried out on the data (see Method part). Table II shows the ten words most frequently evoked by the participants (fq. $\geq .10$).

Table II. Study 1: Social representation of Speed[3] (N=1005)

		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)

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*[4] 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

3 In the both surveys, the frequency threshold was fixed at 10% (.10) and the importance threshold was fixed at the average rank (2). For each item, numbers in parenthesis are the frequency of evocation and the average ranking of importance.

[4] Under the word *Imprudence* were gathered the elements *Imprudence*, *Unconsciousness* and *Irresponsibility*.

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*[5].

In the second periphery, One finds an element associated with the social rules: *Enforcement*[6], as well as an element linked to their transgression: *Speeding*.

As expected, changes in driving practices following the introduction of automatic speed controls brought transformations in the social representation of Speed. However, these transformations appeared only in the peripheral system (Table III).

The element *Enforcement* was mentioned more frequently by the whole population in the survey 2 ($Enforcement_{Study1}$ (.09/2.3[7]) vs $Enforcement_{Study2}$ (.16/2.1): t=-6.781; p<.0001[8]). Hence, the enforcement dimension of Speed became more important following the introduction of automatic speed controls. However, this element did not have a sufficiently high ranking of importance to be integrated in the central core of the representation of Speed; it remained in the first periphery. In the same way, the element *Vigilance* was mentioned more frequently by the

[5] Under the word *Vigilance* were gathered the elements *Attentive, Concentration, Vigilance*.

[6] Under the word *Enforcement* were gathered the elements *Speed camera, Sanction, Police* and *Enforcement*.

[7] Numbers in parenthesis are the frequency of evocation and the average ranking of importance.

[8] Student test t was carried out on data which included the frequency of evocation and the average ranking of importance. Data coding: Non-evoked element=0, Evoked element judged as the least important=1, Evoked element *judged as fairly important*=2, Evoked element judged as the most important=3.

whole population in the second study (*Vigilance*$_{Study1}$ (.06/1,9) vs *Vigilance*$_{Study2}$ (.09/1,8): t=--2.103; p<.05). However, this prescriptive element remained in the zone of "the contrasted elements".

Table III. Study 2: Social representation of Speed (N=281)

		Average ranking of importance	
		Top ranks (≥2)	Bottom ranks (<2)
Frequency	High (≥.10)	Danger (.65/1,7)	Pleasure (.24/2,1) Enforcement (.16/2,1) Imprudence (.13/2,1) Motor sport (.10/2,1) Rapidity (.13/2)
	Low (<.10)	Vigilance (.09/1,8) Speed limit (.05/1,9)	Gaining time (.09/2) Speeding (.06/2)

Conversely, there was a reduction in the value attached to a positive and functional aspect of speed in survey 2: *Gaining time* (*Gaining time*$_{Study1}$ (.15/2.1) vs *Gaining time*$_{Study2}$ (.09/2): t=2.027; p<.05). Following the introduction of automatic speed controls, the frequency with which this element was mentioned decreased to the extent that it moved from the area of the first periphery to the second one.

Dynamics of the social representation of Speed limit

Before the introduction of Automatic Speed Controls, the free and hierarchical association

starting from the word "Speed limit" allowed to obtain a corpus of 3015 words or expressions (1005 subjects x 3 words/subject). The Prototypical Analysis was carried out on these data. Table IV shows the eleven words most frequently evoked by the participants (fq. ≥.10).

Table IV. Study 1: Social representation of Speed limit (N=1005)

		Average degree of importance	
		Top ranks (≥2)	Bottom ranks (<2)
Frequency	High (≥.10)	Safety (.36/1,6) Danger (.19/1,9) Vigilance (.24/1,9) Traffic Rules (.10/1,6) To decelerate (.17/1,8) To comply with (.12/1,8)	Enforcement (.30/2,2) Constraint (.12/2,2)
	Low (<.10)		Necessary (.05/2) Speeding (.05/2) Roadsigns (.05/2,3)

For the population as a whole, the central core of the representation of Speed limit was constituted by six elements: *Safety, Danger, Vigilance, Traffic Rules, "To decelerate"* and *"To comply with"* (Table IV). Hence, the safe, regulatory and functional aspects of the speed limits took precedence and were shared by the whole population.

The first periphery was constituted by two elements: *Enforcement* and *Constraint*. These both peripheral elements referred to the constraining and "negative" aspects of the Speed limit.

In the second survey, after the introduction of automatic speed controls, the element *Enforcement* was mentioned more frequently by the whole population (*Enforcement*$_{Study1}$ (.30/2.2) vs *Enforcement*$_{Study2}$ (.34/2.2): t=-2.145; p<.05; Table V). Hence, the regulatory aspect of the Speed Limit became more important following the introduction of automatic speed controls. However, this element did not have a sufficiently high ranking of importance to be integrated in the central core of the representation. This element remained in the first periphery.

Table V. Study 2: Social representation of Speed limit (N=281)

		Average degree of importance	
		Top ranks (≥2)	Bottom ranks (<2)
Frequency	High (≥.10)	Safety (.33/1,6) Danger (.23/1,9) Vigilance (.34/1,7) Traffic Rules (.13/17) To decelerate (.15/1,7) To comply with (.11/1,6)	Enforcement (.34/2,2) Constraint (.12/2,1)
	Low (<.10)		Necessary (.04/2) Roadsigns (.05/2,2)

In the same way, the element *Vigilance,* central in the study 1, was mentioned more frequently by the whole population in the second survey (*Vigilance*$_{Study1}$ (.24/1,9) vs *Vigilance*$_{Study2}$ (.34/1,7): t=-2.072; p<.05). This prescriptive element became, with the element Safety, the most evoked and important element in the social representation of Speed limit according to the drivers.

Dynamics of the social representation of the LAVIA system and its a priori acceptability

In the first survey, only 33% of drivers said they knew the LAVIA system. In order for all participants to have an identical vision of the object of representation, the questions concerning LAVIA were preceded by a brief description of the system[9]. In view of the drivers' lack of knowledge about the system and its novelty, their new and emerging representation of LAVIA was quite poor and unstructured.

Before the introduction of Automatic Speed Controls, the free and hierarchical association starting from the word "LAVIA system" allowed to obtain a corpus of 3015 words and expressions (1005 subjects x 3 words/subject). Table VI shows the eight words most frequently evoked by the participants (fq. ≥.10).

Table VI. Study 1: Social representation of LAVIA system (N=1005)

		Average degree of importance	
		Top ranks (≥2)	Bottom ranks (<2)
Frequency	High (≥.10)	Safety (.16/1,6)	Aid (.10/2,1) Constraint (.11/2,1)
	Low (<.10)	Comply with speed limits (.08/1,3)	Vigilance (.08/2,1) Monotony (.06/2,4) Peace of mind (.06/2,1)

[9] The definition of LAVIA that appeared in the questionnaire was as follows: "The speed limiter is called LAVIA (limiter that adapts to the authorised speed). It is a device that limits your vehicle's speed as a function of the speed limits encountered during a journey. The system knows the speed limit in force at any moment and adjusts your vehicle's speed to that limit. However, if need be, you can override that limit by kicking down more sharply on the accelerator pedal."

The Prototypical Analysis carried out on the data showed that the new representation of LAVIA depended directly on the representations of Speed and Speed Limit. For the population as a whole, the representation of LAVIA was organised around a central core comprising a single element: *Safety* (Table VI). Thus, such as for the representations of Speed and Speed limit, the theme related to the risk is central (*Danger, Safety*). Moreover, there were many lexical correspondences with the representations of Speed and Speed limit in the peripheral system: the elements *Constraint, Comply with speed limits* and *Vigilance* were present in the contents of the representation of LAVIA system. However, this representation comprised also elements which were specific to this system: *Aid, Peace of mind* and *Monotony*. Hence, the representation of LAVIA was constituted by elements related to the regulatory, safe and positive aspects of this system, but also by elements related to its restrictive and negative aspects.

After the introduction of Automatic Speed Controls, the representation of LAVIA was more positive and more complete than in the first study. One sees an increase in the value attached to the positive and functional aspects of LAVIA (Table VII). The functional and positive elements *Safety*, *Peace of mind* and *Vigilance* were more evoked and more important for the drivers ($Safety_{Study1}$ (.16/1.6) vs $Safety_{Study2}$ (.42/1.9): t=-10.958; p<.0001; $Peace\ of\ mind_{Study1}$ (.06/2.1) vs $Peace\ of\ mind_{Study2}$ (.16/1.9): t=-4.893; p<.0001; $Vigilance_{Study1}$ (.08/2.1) vs $Vigilance_{Study2}$ (.13/1,6): t=-2.161; p<.05). The elements *Peace of mind* and *Vigilance* had a sufficiently high ranking of importance to be integrated in the central core of the representation of LAVIA. The emerging representation of LAVIA is thus structurally different after the introduction of Automatic Speed Controls.

Table VII. Study 2: Social representation of LAVIA system (N=281)

		Average degree of importance	
		Top ranks (≥2)	Bottom ranks (<2)
Frequency	High (≥.10)	Safety (.42/1,9) Peace of mind (.16/1,9) Vigilance (.13/1,6)	Aid (.12/2) Constraint (.13/2,3) Comply with speed limits (.11/2,1)
	Low (<.10)	Comfort (.06/1,9) To decelerate (.06/1,9)	Monotony (.05/2,6)

Although transformations appeared in the representation of LAVIA, the acceptability of this system did not differ between surveys 1 and 2 (Table VIII). Nearly two-thirds of the participants would have accepted the LAVIA in their car and nearly a quarter would not have accepted it. Over half the drivers remained hesitant about this system with which they were not very familiar.

Table VIII. Surveys 1 and 2: *A priori* acceptability of LAVIA[10]

Groups	Survey 1	Survey 2
Favourable (Yes, definitely)	24%	22%
Hesitant (Yes, perhaps)	45%	45%
Opponents (No)	31%	33%

[10] Question asked: "Would you accept the LAVIA system in your car?" Three possible answers: "Not", "Yes, perhaps" and "Yes, certainly".

Relationships between the social representations of Speed, Speed limit and the LAVIA system

In order to highlight the relationships and the articulation between the social representations of Speed, Speed limit and LAVIA system, a Correspondence Analysis (CA) was carried out in the both studies on the words belonging to the contents of the representations of Speed, Speed limit and LAVIA system (fq. ≥.05; list of the 27 words in the annexe 1). Moreover, in order to study intergroup differences within the population, we introduced 8 illustrative variables: the socio-demographic characteristics of the participants (gender, age, profession, number of children), their driving practices (annual mileage, practised speeds, sanctions for speeding) and their acceptability of the LAVIA system (8 variables detailed in the annexe 1).

Before the introduction of Automatic Speed Controls, results of the Correspondence Analysis showed two main factors accounting for 70% of the total variance. The first factor (horizontal axis) was very important, accounting for 57% of the inertia; the second factor was less important, accounting for only 13% (vertical axis). The figure 2 represents the two first factors of the correspondence analysis. Only appear the evoked words that have a relative contribution higher than the average.

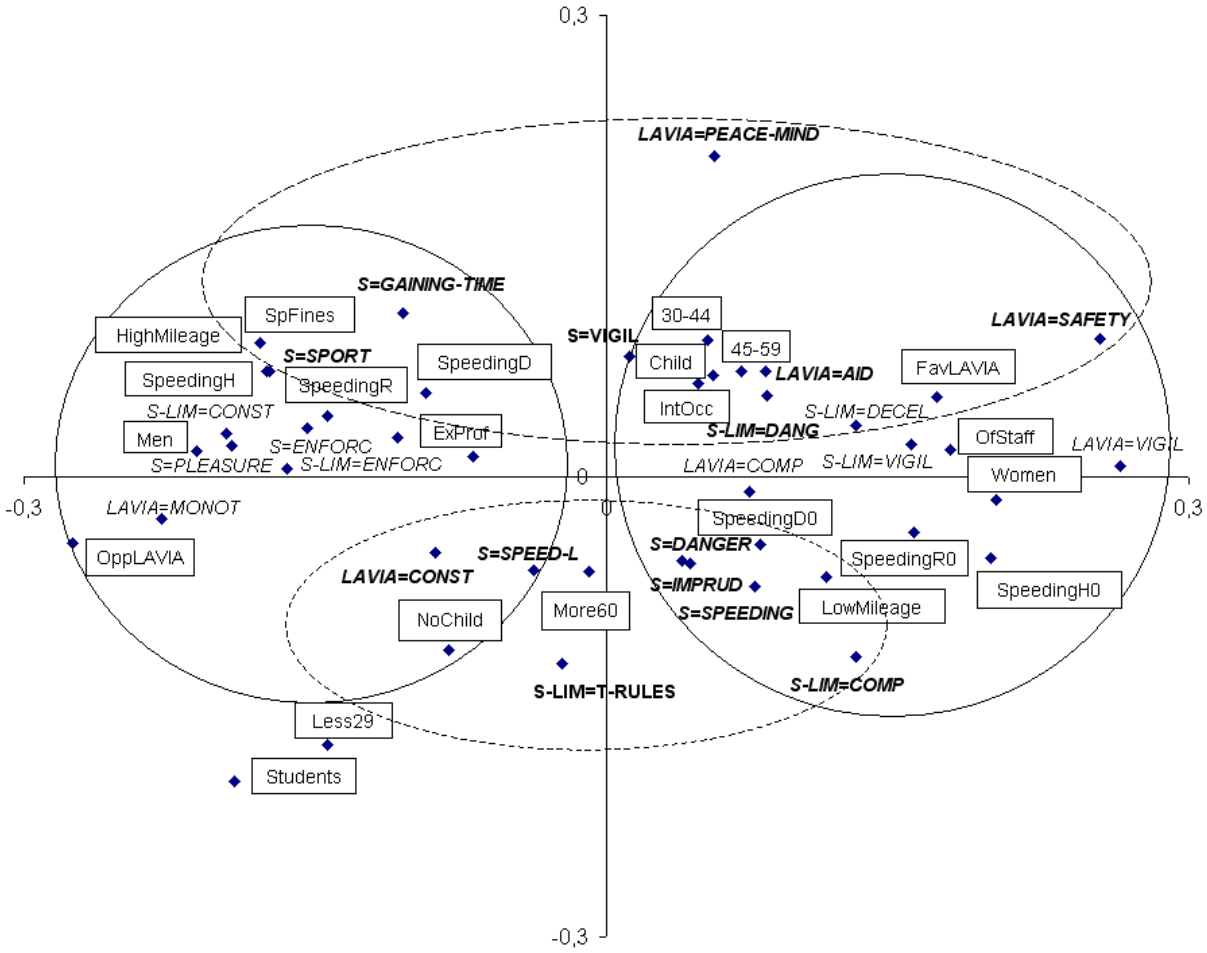

Figure 2. Study 1: graphical representation of the two first factors of the correspondence analysis on Speed, Speed limits and LAVIA (cf. legend, Annexe 1)

The first factor was labelled "safe-seeking versus pleasure-seeking dimension". This factor opposed on the safe-seeking pole (positive pole of the axis), the dangerous aspect of the Speed associated with the safe and functional aspects of the Speed limit and LAVIA system; and on the pleasure-seeking pole (negative pole of the axis), we found the positive and functional aspects of the Speed, its *Enforcement*, and the restrictive and negative aspects of the Speed limit and LAVIA system.

The second factor, less important, was called "Law-abiding versus watchfulness dimension". This factor opposed on the watchfulness pole (positive pole of the axis), the watchfulness aspect of the Speed associated with the useful aspects of the LAVIA system; and on the Law-abiding pole (negative pole of the axis), the regulatory and lawful aspects of the Speed and Speed limit.

The results of the Correspondence Analysis revealed the existence of two main groups of drivers projected on each pole of the first factor. On the "safe-seeking" pole were projected the women, the drivers with a low annual mileage, the drivers complying with the speed limits and the "favourable" to the LAVIA system. On the opposite, we found on the "pleasure-seeking" pole the men, the drivers having executive jobs, the drivers with a high annual mileage, exceeding the speed limits, having speeding fines and the "opponents" to the LAVIA system.

For each group, there is a similar articulation between the three social representations: the more the representation of Speed is centred on its positive aspects, the more the representations of Speed limit and LAVIA are centred on their negative aspects. Conversely, the negative aspects of the Speed were positively linked to the positive aspects of the Speed limit and LAVIA.

After the introduction of Automatic Speed Controls, results of the Correspondence Analysis showed two main factors accounting for 49% of the total variance. The first factor (horizontal axis) accounted for 32% of the inertia; the second factor was less important, accounting for 17% (vertical axis). The figure 3 represents the two first factors of the correspondence analysis.

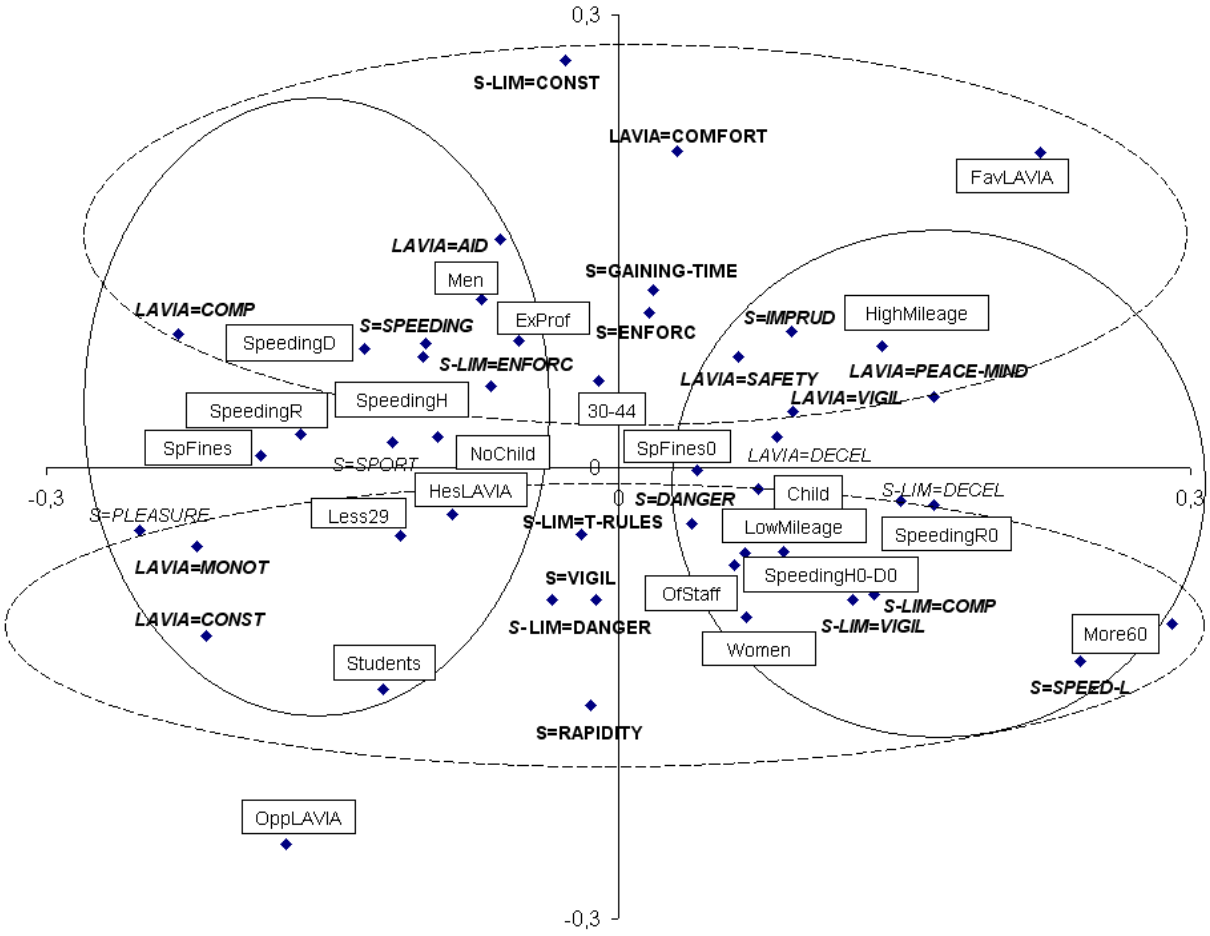

Figure 3. Study 2: graphical representation of the two first factors of the correspondence analysis on Speed, Speed limits and LAVIA (cf. legend, Annexe 1)

The two main factors of this correspondence analysis were similar to those of the first CA, however, each factor included elements related to the speed limits enforcement and regulation.

The first factor was named "pleasure-restricted versus safe-seeking and law-abiding dimension". This factor opposed on the positive pole of the axis ("safe-seeking and law-abiding" pole), the dangerous and regulatory aspects of the Speed associated with the regulatory, safe and

prescriptive aspects of the Speed limit and LAVIA system; and on the negative pole (pleasure-restricted" pole), we found the positive aspects of the Speed and its transgression, associated with the restrictive and regulatory aspects of the Speed limit and LAVIA but also the useful aspects of this system.

The second factor was labelled "repressive versus watchfulness dimension". This factor opposed on the positive pole of the axis ("repressive" pole), the functional aspects of the Speed, the restrictive and repressive aspects of the Speed and the Speed limit, and the functional aspects of the LAVIA system*;* and on the negative pole ("watchfulness" pole), we found the watchfulness related to the Speed and the Speed limit, associated with the functional but restrictive aspects of the LAVIA.

Thus, after the introduction of Automatic Speed Controls, the two main factors of the CA included elements related to the regulatory aspect of the Speed and the speed limits enforcement. Moreover, each pole of the both factors included positive elements related to the LAVIA usefulness. However, regarding the acceptability of the LAVIA system, the correspondence snalysis shows that the "favourable" to the LAVIA were projected in the top right quadrant of the graph. This quadrant was bounded by two half-axes : the "safe-seeking and law-abiding" pole and the "repressive" pole. On the contrary, the "opponents" to the LAVIA were projected in the bottom left quadrant of the graph; this quadrant was bounded by the « pleasure-restricted" pole and the "watchfulness" pole. Therefore, despite the increased speed enforcement and the positive and functional "representation" of LAVIA, the acceptability of this system by the drivers was still partly determined by their relationship to the danger related to the Speed: the "safe-seekers" accepted more the LAVIA system than the "pleasure-seekers".

DISCUSSION AND CONCLUSIONS

In the both studies, results highlighted that the representations of Speed and Speed limit maintained together a relationship of antonymy. Indeed, their representational contents were crossed by antonymous words, many lexical correspondences and a common theme related to the risk. However, each representation was autonomous with a central core comprising specific items for each object. The new object LAVIA was integrated and *anchored* in the representations of Speed and Speed limit. Without practice of the LAVIA, the representation of this object was poor, unstructured and not autonomous; it was *embedded* into the representations of Speed and Speed Limit. Thus, the elaboration, the structuring and the contents of this new representation depended directly on these "upper" representations. Consequently, the acceptability of the LAVIA system did not depend on the object itself but on these two superior objects.

Strengthening speed controls and installing automatic speed cameras in France led to the adoption of new driving practices, and in particular a reduction in the speeds practised and in the incidence of exceeding speed limits. These new practices engendered transformations in the contents of each representation associated with speed (Speed, Speed Limit) and subsequently had a direct effect on the structuring of the social representation of the new object LAVIA. In accordance with the research carried out by Guimelli, our findings confirm that social thinking is "organised thinking" (Guimelli, 1999). In fact, social representations have both a hierarchical internal organisation and are structured in networks of social representations. Our research shows that transformations that follow an irreversible environmental change do not involve an isolated social representation but the whole network of social representations within the social environment concerned. Consequently, one of the properties of a network of social

representations is its *networking mechanism:* any transformation of a representation belonging to a representational network can lead to the transformation of one or several representations belonging to this same network. As a result, we can make the assumption that the dynamics of a representational network could lead to *relational transformations* between representations, which could be defined a*s* the transformation of the relationship between two or several representations belonging to the same representational network following the transformation of at least one of these representations.

However, despite the *irreversibility* of the environmental changes, it should be stressed that the transformations of the representations of Speed and Speed limit were not "structural" because their central core did not change. After the implementation of Automatic Speed Controls, the regulatory and watchfulness aspects of the Speed and Speed Limit became more important but did not have a sufficiently high ranking of importance to be integrated in the central core of the both representations. These elements remained in the first periphery. Only the representation of LAVIA was structurally modified after the introduction of ASCs. This lack of structural transformations may be due to the lapse of time possibly too short between the both studies to generate important changes in the representations of Speed and Speed limit. The new practices generated after the implementation of ASCs were sufficient to generate structural transformations of the representation of LAVIA which was a new, unstable and not autonomous representation involved in a structuring process. However, these new practices were not sufficient to modify structurally the stable representations of Speed and Speed limit. Thus, these results illustrated the property of the peripheral system, which is to integrate the transformations in order to preserve the stability of the central core (Abric, 1976). It is thus a matter of determining what level of speed enforcement, and consequently what level of new practices, is

required to lead the structural transformations of the representations of Speed and Speed limit. Their resistance to change could also explain the stability of the LAVIA's acceptability, which remains rather low. It is thus a question of establishing to what extent social representations of Speed, Speed Limit and LAVIA must change in order to bring about a modification in the *a priori* acceptability of the LAVIA system. Thereby, it would be interesting to carry out the same study today, several years after the implementation of the ASCs, in order to measure if the new practices are now sufficient to generate structural transformations in the social representations of Speed and Speed limit, and thus, modifications in the *a priori* acceptability of the LAVIA system.

Our findings highlight the importance for any research devoted to the dynamics of social representations of not studying an isolated representation but all the representations belonging to the same social environment. However, this raises numerous methodological and theoretical questions. Firstly, one finds that it is essential to develop a tool that makes it possible to better define and specify the type of relationship that exists between representations. It is difficult, in effect, to determine to which other representation a given representation is related. The methodology we used in our study has certain limitations, the first ones being that it is based on a qualitative study and it depends in part on our own interpretation. Thereby, we perhaps missed other social objects which could also be related to the representation of the LAVIA system. A methodology derived from the Basic Cognitive Schemes (BCS) method (Guimelli & Rouquette, 1992), especially the forced BCS method (Fraïssé, 2000; Milland, 2002), could be a promising tool for determining to which other representation a given representation is related, but also for defining the type of relationship that exists between them.

Furthermore, our findings raise the question of the place that representational networks

occupy in social thinking. What influence does Ideology have on the contents, structure and functioning of these networks? Our findings show that common values run through representations belonging to the same network, which suggests that representational networks are governed by the same authority. Hence, the coherence, structure and functioning of these networks could be determined by individuals' ideology. We would point out that ideology "relates to a class of objects and thus can be positioned at a higher level of generality enabling *families* of representations to be identified" (Guimelli, 1999, p. 106). As a result, these ideologies could govern other networks of representations belonging to other social environments.

In our research, we showed that the network of social representations linked to speed (Speed, Speed Limit, LAVIA) has a common theme running through it: the relationship to Danger. It is the relationship with danger and the pleasure that danger procures which structure these social representations and determine the acceptability of the LAVIA system. We can make the assumption that this relationship with danger may determine and organise individuals' social representations of other social objects, especially objects related to risky behaviour, such as consuming drugs, tobacco, alcohol or practising extreme sports. For example, a study of the social representation of drugs (Dany & Apostolidis, 2002) found that taking drugs encouraged the emergence of "positive" social representations in which the notion of *Danger* was strongly associated with the notion of *Pleasure*, whereas, conversely, subjects that were little exposed to drug use had a "negative" representation embodying a plethora of morbid terms (*Danger, Death, Disease, Wretchedness*). In this representation, therefore, there are again divergences between individuals in terms of their relationship with risk and the pleasure of risk. Consequently, it would be interesting to compare our results with the *sensation-seeking* scale developed by Zuckerman (1990). Zuckerman conceives sensation-seeking as a personality trait defined by the

quest for varied, novel and intense impressions and experiences, in association with a propensity to take physical, social, legal and financial risks to that end (Zuckerman, 1994). The *sensation-seeking* scale makes it possible to distinguish between the so-called *high-sensation-seekers*, who pursue a high level of sensation-seeking, and *low sensation-seekers*, who have a low level of sensation-seeking. The use of this scale would enable us to study the link between personality traits and social representations.

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BIOGRAPHIES

CARINE PIANELLI obtained her PhD at the University of Aix-Marseille and the European PhD on Social Representations and Communication under the supervision of Pr. Jean-Claude Abric and Farida Saad. Her thesis was financed by the French institute of science and technology for transport, development and networks (IFSTTAR). Afterwards, she was a researcher in IFSTTAR. Her main research interests focus on anchoring process and dynamics of the social representations. She founded PsyAction, consulting firm on psychosocial risk assessment and management in 2012. Contact Email : pianelli@psyaction.fr.

FARIDA SAAD is associate researcher at the Laboratory of Social Psychology of the University of Aix-Marseille. She was Research Director in the French institute of science and technology for transport, development and networks (IFSTTAR) until 2013. Her main research interests focus on behavioural adaptations to advanced driver support systems, analysis of road situations and drivers'activities from the cognitive psychology and ergonomics viewpoint, studies on mobility and safety in urban areas. She was involved in many national and international research projects, such as LAVIA (national project) and AID (european project). Contact Email : farida.saad@ifsttar.fr.

Annexe 1: Legend of the figures 2 and 3

In the Figures 2 and 3, the variables contributing to the definition of the first factor are in italic, the variables contributing to the definition of the second factor are in bold, the evoked words are in capital letters and the illustrative variables are framed.

27 words belonging to the contents of the representations of Speed, Speed limit and LAVIA

Social representation of Speed:

S=ENFORC: Speed=Enforcement

S=DANGER: Speed=Danger

S=GAINING-TIME: Speed=Gaining time

S=IMPRUD: Speed=Imprudence

S=PLEASURE: Speed=Pleasure

S=RAPIDITY: Speed=Rapidity

S=SPEEDING: Speed=Speeding

S=SPEED-L: Speed=Speed limit

S=SPORT: Speed=Motor sport

S=VIGIL: Speed=Vigilance

Social representation of Speed Limit:

S-LIM=CONST: Speed limit=Constraint

S-LIM=COMP: Speed limit=Compliance wih speed limits

S-LIM=DANGER: Speed limit=Danger

S-LIM=DECEL: Speed limit=Decelerate

S-LIM=ENFORC: Speed limit=Enforcement

S-LIM=SAFETY: Speed limit=Safety

S-LIM=T-RULES: Speed limit=Traffic Rules

S-LIM=VIGIL: Speed limit= Vigilance

Social representation of LAVIA:

LAVIA=AID: LAVIA=Aid

LAVIA=COMFORT: LAVIA=Comfort

LAVIA=COMP: LAVIA=Compliance wih speed limits

LAVIA=CONST: LAVIA=Constraint

LAVIA=DECEL: LAVIA=Decelerate

LAVIA=MONOT: LAVIA=Monotony

LAVIA=PEACE-MIND: LAVIA=Peace of mind

LAVIA=SAFETY: LAVIA=Safety

LAVIA=VIGIL: LAVIA=Vigilance

Socio-demographic characteristics

Gender:

Men: Men

Women: Women

Age:

Less29: Less than 29 years old

30-44: between 30 and 44 years

45-59: between 45 and 59 years

More60: More than 60 years old

Profession:

ExProf: Executives, professionals

IntOcc: Intermediate occupations

OfStaff: Office staff

Students: Students

Number of children:

Child: Child

NoChild : No child

Driving practices

Practised speeds:

SpeedingD: Speeding in downtown

SpeedingD0: No speeding in downtown

SpeedingR: Speeding on road

SpeedingR0: No speeding on road

SpeedingH: Speeding on highway

SpeedingH0: No speeding on highway

Sanctions for speeding:

SpFines: Sanctions for speeding

SpFines0: No sanction for speeding

Annual mileage:

HighMileage: High annual mileage

LowMileage: Low annual mileage

Acceptability of LAVIA system

FavLAVIA: Favourables to the LAVIA

HesLAVIA: Hesitant to the LAVIA

OppLAVIA: Opponents to the LAVIA