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THE USE OF INTERMEDIATE VARIABLES TO PREDICT OFFENSES AND ACCIDENTS

We would like to focus in this presentation on Basic Driving Behavior as a research tool in the evaluation of accident and traffic offense prevention. Firstly we try to define precisely the notion of Basic Driving Behavior ("B.D.B."). Our second point will consist of assessing the value of "B.D.B." as an intermediate variable for predicting accidents or offenses. Thirdly we would argue about the interest of "B.D.B." as a research tool for the evaluation of legislative preventive actions regarding road user behaviour.

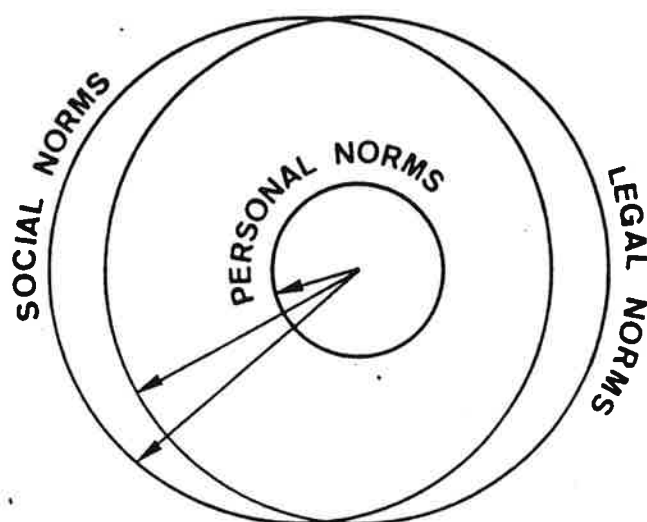
1. The concept of "Basic Driving Behavior"

The idea of Basic Driving Behavior first appeared in the seventies, in the results of an experimental work on risk-taking in the course of a journey (Monseur, Malaterre 1970) or when crossing junction (Monseur, Malaterre 1971) using the speed as indicator of the behavior. It appeared from these studies that the behavior of the majority of drivers is characterized by some "inertia" or "rigidity" corresponding to the poor variability of the "basic speed" at which they drive. Then the idea was put forward in 1980 in a pilot study (Biecheler, Monseur 1978) which explored the usual behavior of road-users in the most frequent driving situations by using the sample survey technique. The pilot study showed that behaviour fluctuations occur in a variety of situations in relation to a "personal norm" which could, however, take different forms in the different driving situations encountered. This led us to consider the habitual behavior of road users in a variety of situations as though it was organized according to a system of norms that stem from three levels of reference (Figure 1): the laws, the social norms, and the personal norms.

For each driver and each driving situation there would appear to be, through these different levels of reference a personal synthesis of only minor variability; the concept of "Basic Driving Behavior" defines this fairly stable set of habitual driving practices in different driving situations.

- laws, or legal norms - of national nature - regulating the use of the road,
- social norms attesting the social cultural integration of the legal dimension (variable from one reference sub-group to another),
- personal norms linked to the pleasure of driving and personal characteristics in this act.

Figure 1. The reference system of the driver



2. "Basic Driving Behavior" as a criterion for predicting the probability of an offense or accident.

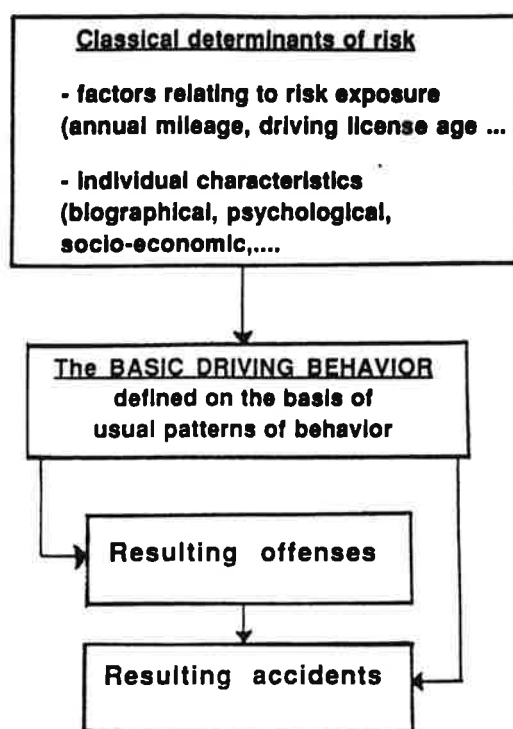
We will report the questionnaire used to describe the user's BDB and outline the method used to determine the specific features of dangerous and illegal driving. Then we will present the results and conclude by discussing the predictive value of the concept of BDB.

We set out to determine whether the notion of "B.D.B." can be justifiably used as an intermediate variable for predicting accidents and offenses, and whether the resulting predictions are as statistically powerful as those obtained by other authors.

As shown in Figure 2. Basic Driving Behavior can be situated in relation to other risk variables: it integrates a number of variables generally recognized as correlated with high accident risks: risk exposure variables or individual characteristics and proves to be more directly linked to driving performance in terms of offenses or accidents.

Figure 2.

The BASIC DRIVING BEHAVIOR
 an intermediate variable
 for predicting road accidents and offenses



2.1. Survey and methodology

A questionnaire survey was carried out on a sample of 1002 motorists. To describe the "B.D.B." we have used the statements of drivers in a series of 17 typical driving situations. The items were selected so as to cover the principal laws in force in the most common situations: speeding, giving way, overtaking, driving under the influence of alcohol and so on. They have been classified as follows along the type of behavior concerned:

Items of Basic Driving Behavior

speeding

- exceeding speed limit in daytime (sp.d.)
- exceeding speed limit at night (sp.n.)
- accelerating when light has just turned to amber (amb.l.)
- exceeding speed limit in built-up areas (sp.cit.)

territorial violation

- crossing a continuous white lane (wh.l.)
- not stopping at a stop sign (st.)

alcohol

- driving with blood alcohol level over the legal limit (al.l.l.)
- driving home after drinking at a meal with friends (al.fr.)
- driving after consuming rather more alcohol than usual (al.us+)

dangerous overtaking

- overtaking from third position (ov 3)
- cutting in on a motorist who embarrassed you (cut in)

risky overtaking

- overtaking when one feels one can "just" make it (ov.j.)
- not using indicator to signal when about to change direction

right of way

- forcing other motorists to let one pass when one has right of way
- not giving way at junction when vehicle from the right is not moving very fast (rw ref.sl)

seat-belt

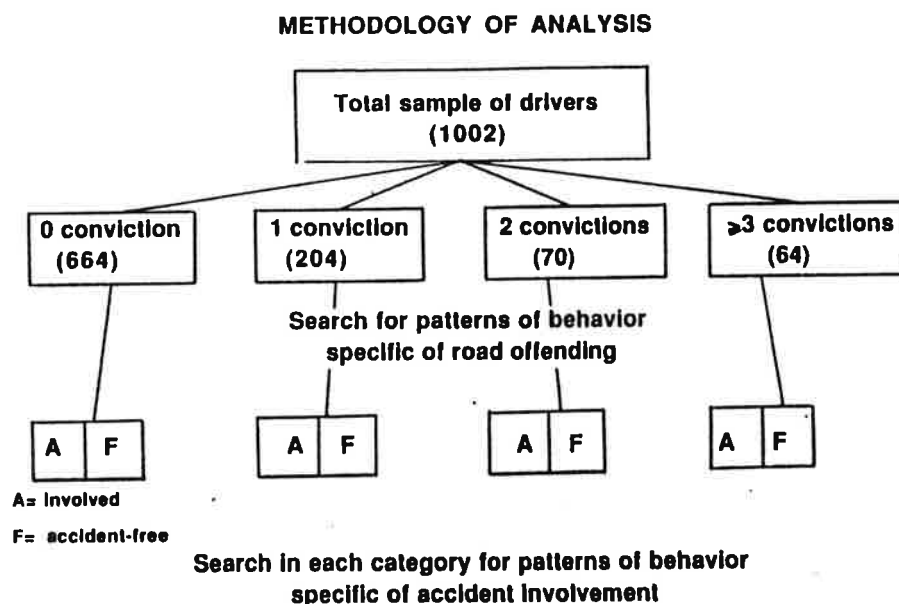
- driving without seat-belt fastened (s-b.)
- at night driving without seat-belt fastened in built-up areas (s.b.cit)

Drivers were asked to situate their behavior on a ten-point scale: the bottom pole of the scale indicated what drivers would "never ever" do; and the top one what they do whenever the circumstances allow them without risk. At the end of the questionnaire, the drivers were asked to answer some questions about various biographical and socio-

economic variables, including characteristics of their vehicle and its utilization. We collected also self reported data about the accidents in which the drivers had been involved and their convictions for traffic violations. We defined "illegal driving" on the basis of the number of traffic violations for which a driver was prosecuted, and "dangerous driving" on the basis of the number of accidents in which a driver was involved.

We looked for items of behavior which were most likely to explain the differences by using a procedure described on Figure 3. We used a qualitative discriminant analysis technique (Saporta, 1977) or the usual X^2 test. As the discriminant analysis program eliminates those who have the strongest correlation with those already selected in the successive choices of discriminant variables, we must take the items which are the most strongly correlated into account in the interpretation of a selected variable.

Figure 3.



2.2. Results

After successively identifying the patterns of behavior characteristic of illegal driving on the one hand and those characteristic of dangerous driving on the other hand we examined the value of B.D.B. as a predictive criterion for offenses and accidents.

The features specific of "illegal driving" (Figure 4.)

The dynamic patterns of behavior (1) and (2) mentioned on Figure 4 are those which appear to be the more discriminant; they can be grouped under the general heading "tendency to arrogate the road space to himself". This type of behaviour is related to a tendency to drive under the influence of alcohol. Then not wearing safety-belt represents a specific feature, which is paradoxically associated with driving at high speed.

Figure 4

"ILLEGAL DRIVING" results of the discriminant analysis

results: discriminant items and correlated items	interpretation: features specific of "illegal driving"
- excessive speed (<u>amb.l</u>, sp.d, sp.n, sp.cit) - right of way (rw.forc, rw.ref)	1 maintaining speed
- dangerous overtaking (<u>ovj</u>, ov3, cut in) - excessive speed - alcohol more than usual	2 encroaching on the driving territory of other drivers
- not wearing safety-belt (s-b daytime)	3 not wearing safety-belt
- exceeding the legal blood alcohol level (<u>al.l.l</u>) - excessive speed - territorial violation (wh.l)	4 dangerous driving under alcohol influence

The features specific of "dangerous driving" (Figure 5.)

The alcohol factor emerges as greatly preponderant in the discriminant analysis: any behavior but absolute abstinence from alcohol before driving constitute the best predictor of accident risk in the class of users who have never been convicted for an offense. Safety belt use is the second most important factor. Driving at excessive speed would rather represent a factor of increased risk.

Figure 5.

"DANGEROUS DRIVING"
results of the discriminant analysis

results: discriminant items and correlated items	interpretation: features specific of dangerous driving
- exceeding the legal blood-alcohol level (<u>al.l.</u>) - speeding offenses	1 driving under alcohol
- not wearing safety-belt (<u>s-b.night, urban areas</u>) - speeding offenses	2 not wearing safety-belt
- crossing a white line (<u>wh.l</u>) - unusual drinking (us+) - overtaking (ovj, ov3) - speeding offenses	3 encroaching on the driving territory of others (associated with D.U.I.)
- not giving way (<u>rw.ref</u>) - amber light - speeding - just overtaking	4 dynamic violations in urban areas

The value of B.D.B. as a predictive criterion for offenses and accidents

The discriminant analysis enabled us to classify individual drivers on the basis of the discriminant function values calculated. The two following tables (Table 1. and Table 2.) show the classifications we arrived at.

Table.1 Involvement in an accident: predictive value of BASIC DRIVING BEHAVIOR (population of drivers with no previous convictions)

Estimated number of accidents calculated by discriminant analysis		
	0	> 1 accident
0	70 %	30 %
1	42 %	58 %

n = 664

$X^2 = 45$ (significant at .001 probability level)

% correctly classified: 66 %

Table 2 **Number of convictions for traffic offenses: predictive value of BASIC DRIVING BEHAVIOR**

Estimated number of convictions calculated by discriminant analysis						
	0 conviction	1 conviction	2 convictions	> 3 convictions	Total	Number
0	<u>45</u> %	19 %	21 %	14 %	100 %	664
1	31 %	<u>30</u> %	21 %	18 %	100 %	204
2	23 %	9 %	<u>50</u> %	19 %	100 %	70
> 3	13 %	14 %	22 %	<u>52</u> %	100 %	64

n = 1 002

$\chi^2 = 111.8$ (9 f.d.), significant at .001 probability level

% correctly classified: 43 %

An analysis of these tables lead us to make the following remarks:

- driving performance as calculated on the basis of the two discriminant functions is closely related to the number of offenses and accidents admitted by the drivers
- the percentage of correctly classified drivers on the basis of B.D.B. is 66 % in the case of accident performance and 43 % in the case of offense performance
- B.D.B. does have a significant power for predicting involvement in accidents comparable to that provided by criteria based on complex observation techniques (Greenshields and Platts, 1967; Shuster et al 1962; Mc Connel & Hagen, 1980).

Conclusions and discussion

1. Findings

We are justified to distinguish between "illegal (or unlawful) driving" and "dangerous driving". Illegal driving appears to be more related to the tendency of encroaching on the driving territory in a more or less competitive manner (sp, rw, ov, cut in). Dangerous driving seems characterized by a refusal of constraints associated with safety: primarily in terms of reducing the consumption of alcohol but also in terms of not wearing safety-belt at night in urban areas (associated with speeding). These findings coincide with the results of Mc Bride, Peck, and Kwan in the eighties.

2. Additional remarks

The consumption of alcohol is a predominant factor in dangerous driving with tendency to commit offenses in built up areas but police reporting of these two types of

behavior are relatively rare and arbitrary so that it is not surprising that these factors show up less in offense records than in accident records. The alcohol level for prosecution in France (legal limit 0.8) is probably above the threshold of real dangerousness (in view of the alternation it makes to the driver's capacity to make judgements and take action). The question opened here is: to what extent can prosecutions and convictions for traffic offenses give an idea of the differences between "dangerous" and "illegal driving"? This question is itself connected with either the legislator's failure to discriminate the dangerousness of different offenses or the authorities' tolerance for certain traffic offenses (e.g. alcohol and safety-belts).

3. B.D.B. as a research tool for evaluation of prevention

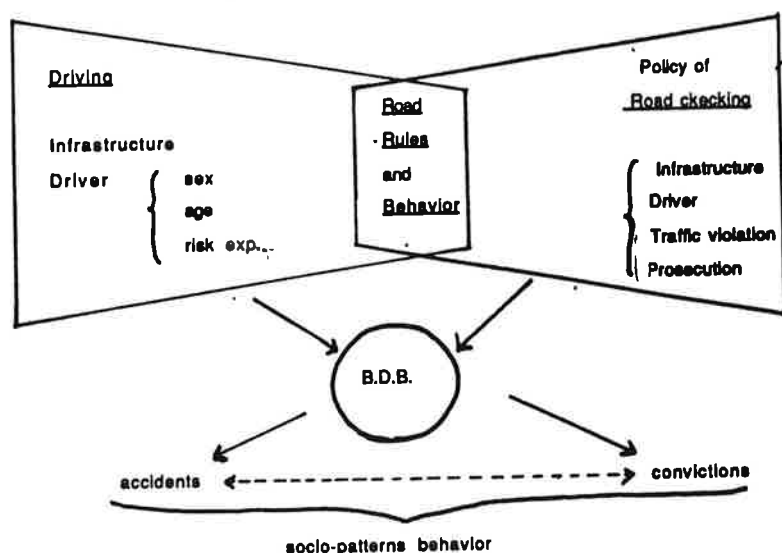
B.D.B from a quantitative point of view is as efficient (in predicting accidents) as criteria normally utilized. From a qualitative point of view it seems to us to be a key notion in the field of "Evaluation of Prevention". General prevention has been mainly based on legislation and legal rules, and has for corollary a policy of road checking and reporting of offenses: but we don't know how to assess the efficiency of this system because we have no evaluation tool.

In research terms B.D.B. is a valuable tool if one wants not only to assess risk but also to determine the nature of risk and identify the main causes - both at an individual and social level. One of our hypotheses is that social patterns of behavior are probably a good criteria. We are now developing at INRETS a research to set out new criteria and questions about the link between road user behavior, accidents and road offenses and convictions (see Figure 6.). B.D.B. appeared to be connected with the social regulation of behavior on the road.

In terms of prevention two main areas can be opened by applying the notion of B.D.B.:

- 1 - The road checking and the reporting of offenses could be made more effective within the limits of available resources.
- 2 - A scale of offenses within the framework of a point-system could be established with optimal results since the most dissuasive penalties would be imposed on the offenses which are potentially the most dangerous.

Figure 6. The B.D.B as an intermediate criteria between the system of regulation on road and accidents or convictions.



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