Le conducteur sous l'influence des passagers et de l'alcool

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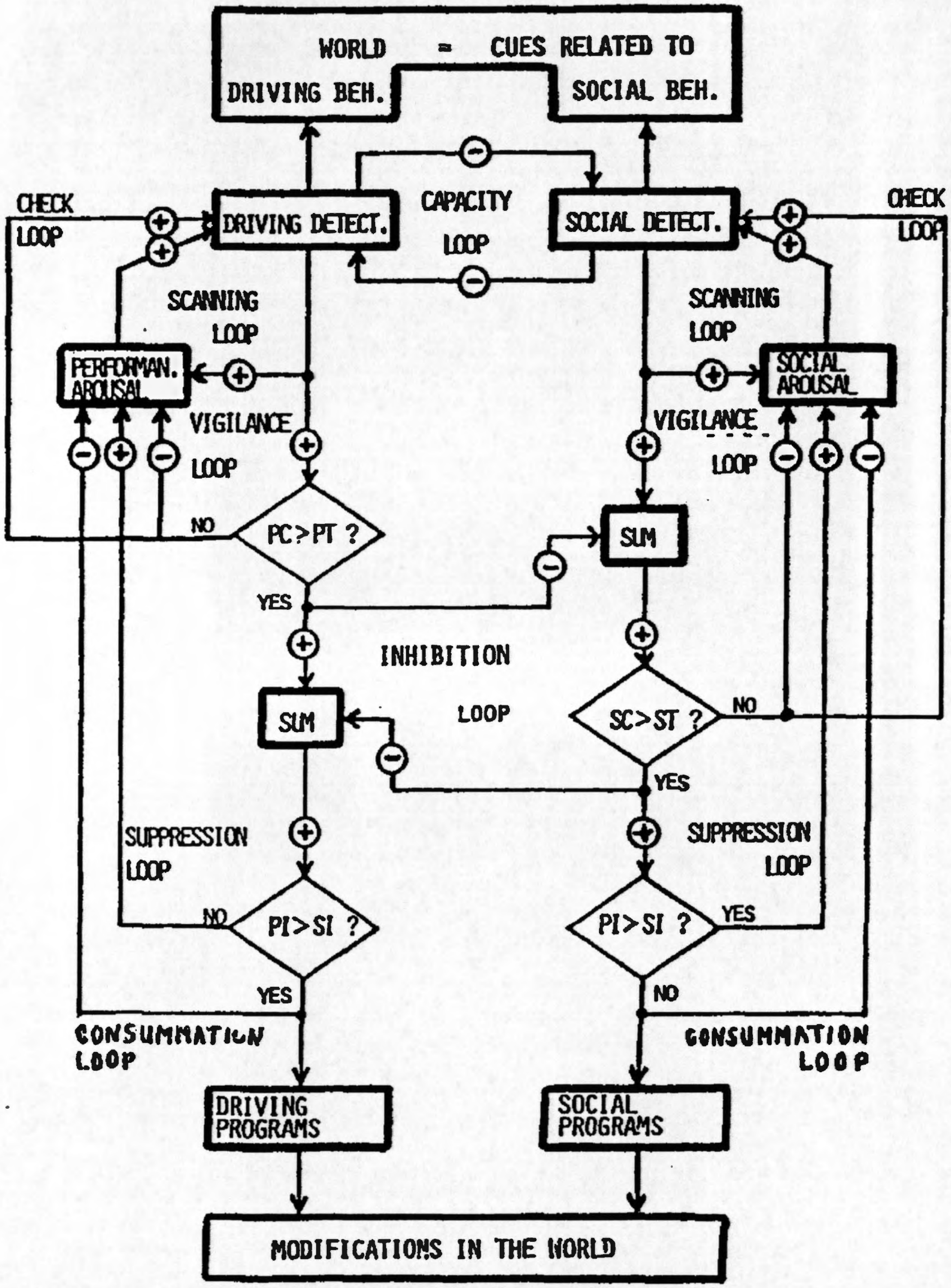
The fact that driving takes place in a social context is becoming more and more accepted. First, an increasing number of studies are investigating in what way and to what extent the "social context" of passengers and/or other subjects outside the car influences the driving performance. Secondly, the heading "social context" includes the research on factors which modify this socially related behavior of drivers. Thirdly, the term "social context" takes into account the macro aspects of sociological and political conditions which influence the driving behavior.

Our research is basically concerned with the influences that passengers exert on the more or less successful outcome of car driving. Additionally, we are trying to reveal which conditions modify this influence. Taking into account our research and results from social psychology, sociophysiology, pharmacopsychology, and traffic research we have developed a socio-ecological model of driving performance to understand this interaction between driving and social behavior (Figure 1).

The outside world is seen as an ensemble of cues which are primarily related to driving and of cues eliciting social interest which may or may not be connected to driving. These cues are permanently screened by our sensory system. The fact that this system is an active one, that it does not "see, but look for, not hear, but listen for" (Bruner) is idealized in the model through two specialized detectors (screening phase).

The outcome of the driving detector is called a "performance challenge" (PC). Because of the limited capacity of our sensory system a detection of

Figure 1. The socio-ecological model of driving performance



a relevant cue is in fact an inhibition of the other detector (capacity loop) — without assuming a neural basis of this process. Then, the PC is fed back to the performance arousal element. This element is not seen as an energy pool — the energy balance of the system would demand another representation — but it is seen as something like interest or directed attention. Therefore, the performance arousal element is positively connected to the driving detector. This loop yields a self-reinforcing scanning behavior if the number or intensity of driving related cues increases.

Then, the PC is compared to a "performance threshold" (PT) to decide whether a reaction to PC is needed or not. If not, in a "check loop" the still remaining activity of PC is positively fed back to the driving detector. This loop takes into account the fact that the PC's activity was greater than zero and therefore must be proved in its further development. But at the same time this PC activity is negatively fed back to the performance arousal. This "vigilance loop" yields, in the case of no significant cues, a permanent decrease in the performance arousal.

If PC is greater than PT the system enters into the preparation phase by transforming the performance challenge into a performance intention (PI). The first consequence is an active inhibition of the social system which itself consists of the same elements and loops as the performance subsystem. The "inhibition loop" takes into account the fact that successful driving needs a clear hierarchy between the two subsystems. If a driving reaction is needed the social subsystem must be suppressed at the earliest possible point. Therefore, the preparation of a driving reaction must inhibit the analyzing phase of the social system. If the "social challenge" SC is, despite the inhibition by PI, strong enough to exceed the threshold ST a conflicting "social intention" SI is formed which, by means of the second branch of the inhibition loop, inhibits the PI.

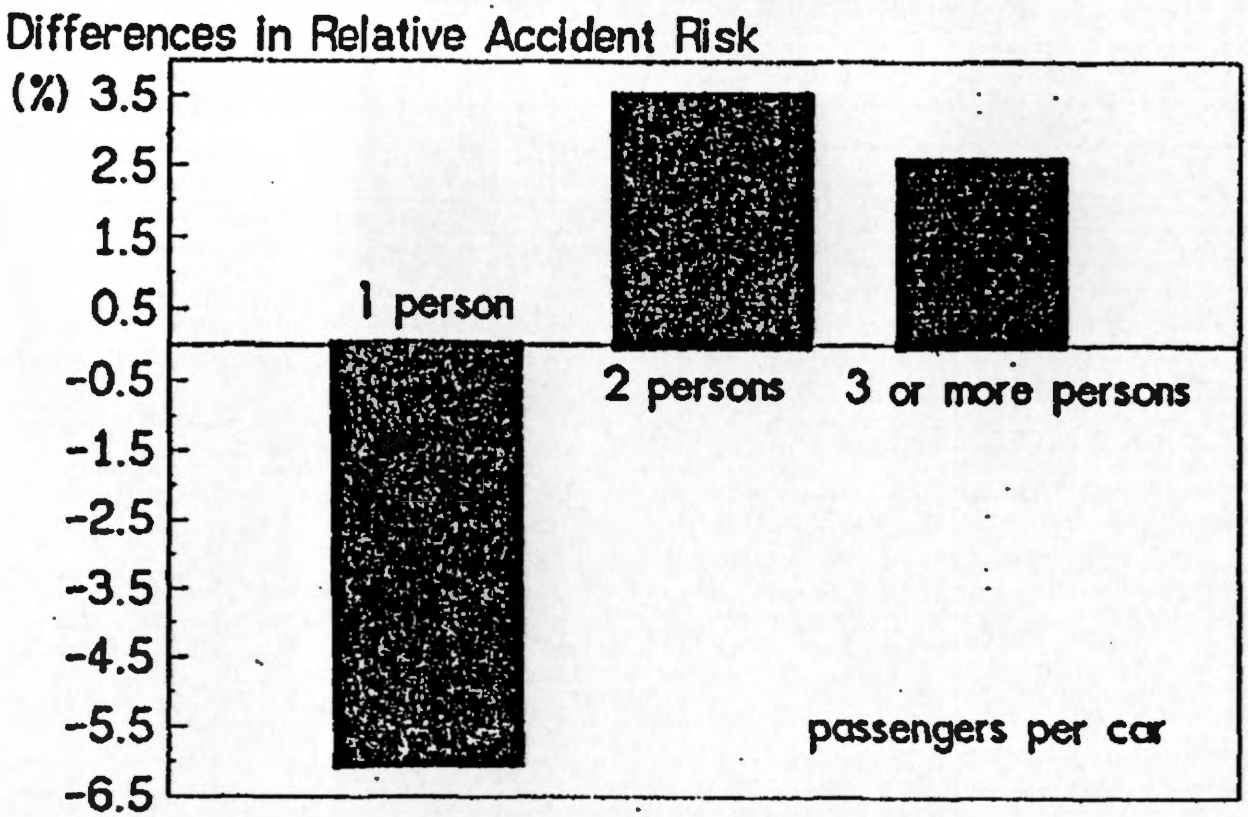
In the deciding phase the two intentions PI and SI are compared. The stronger one will dominate the other and will start the respective motor program. In the "consummation loop" this behavior is negatively fed back to the respective arousal element. The suppressed intention is readdressed to its arousal element.

Despite its simplicity the model is able to make a large body of empirical data comprehensible. Take the assumption that the tuning process between performance and the social subsystem is not perfect and may be disturbed. Then, a first derivation of the model is that the driving performance level must be lower when passengers are in the car. As a result, the probability of causing an accident should increase.

To prove, this hypothesis, we first have to estimate how often in normal traffic (without accident) cars with one, two, three or more passengers are found (incidence or exhibition rates). These data give the reference for the comparison with the accident data. Information from very different sources — traffic counts, observations, estimations, interviews — converges within a small range to give the following result : in 70% of all cases there is one person, in 22 percent there are two persons, and in 8 percent there are three or more persons in the car.

The accident data for comparison come from North Bavaria (Mittelfranken) for the years 1981 to 1987 (N = 144404). Classifying the accidents involving sober drivers according to the number of passengers leads to the result in Figure 2 : solo accidents are underrepresented with more than 5%, and accidents with two or more passengers are markedly overrepresented. Therefore the "co-task passenger" interferes significantly with the driving task. In practice, this result should initiate a new aspect of educational work : the passengers and their behavior must be integrated into the information about driving security.

Figure 2. Over and underrepresentation of accidents when compared to incidence rates of number of passengers in the car

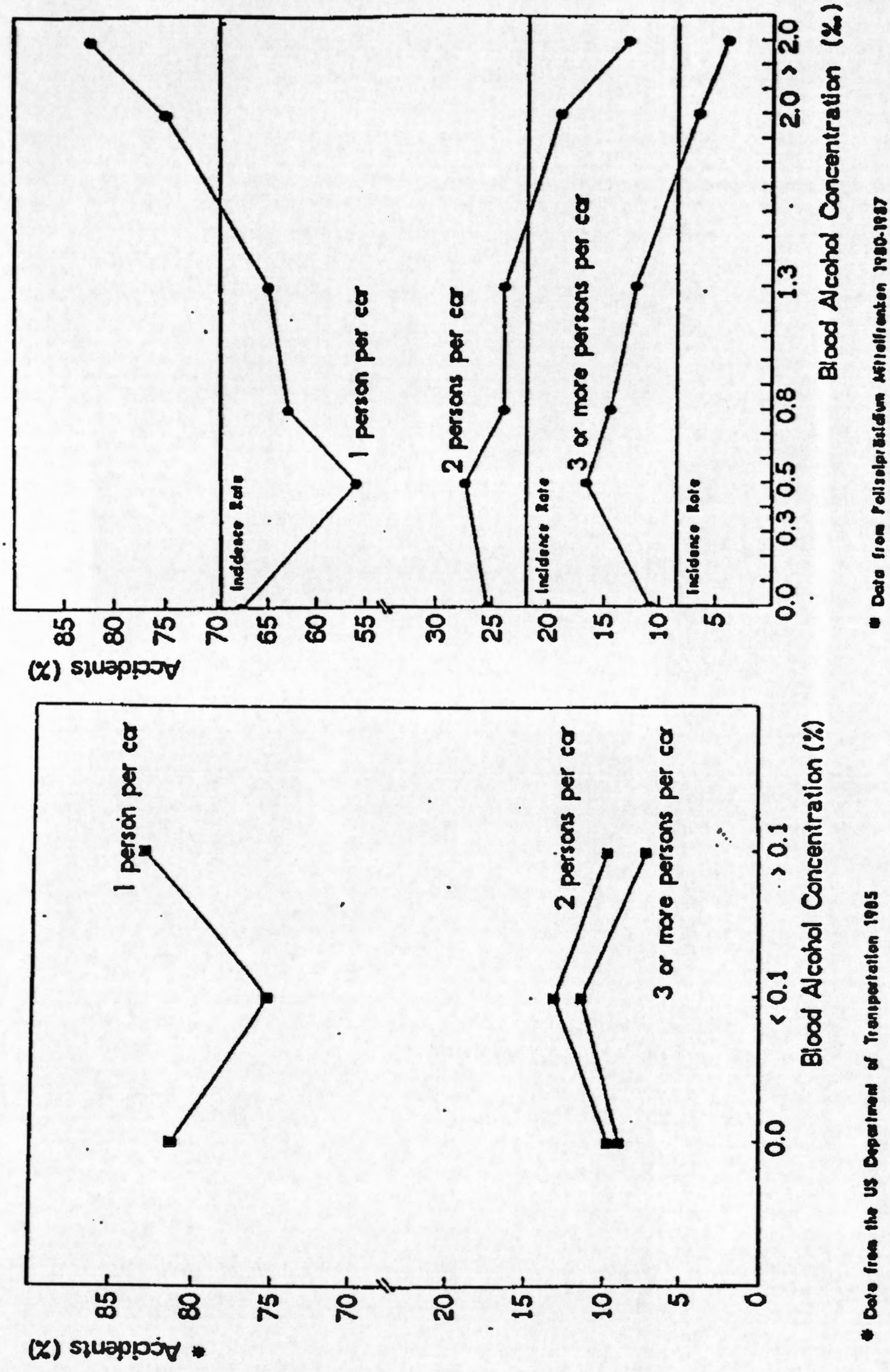


Despite its conformity with the socia-ecological model presented above, this result may also be an effect of a nonspecific increase in environmental information. A more convincing proof should demonstrate that the social nature of the additional cues affecting the driver is the real and specific cause of his disturbance. Figure 2 seems to support this interpretation. The relative accident risk with three or more persons in the car is smaller than the risk with only one passenger. The more persons in the car the easier it is for the driver to disengage himself from the social context. A simple model which only accumulates the environmental information would fail to explain this result. However, a stronger proof of the model would be if the "passenger effect" reported varies when social conditions change.

One of the best-documented effects of the psychoactive drug alcohol is its anxiolytic and thereby extraverting feature : in fact this is the most important reason for consumption. A lot of experiments show that alcohol directly modifies social behavior itself. Inversely it has been shown that social conditions have a strong impact on drinking behavior. That means : alcohol and social conditions interact in a synergistic way. This synergy appears together with blood alcohol concentrations up to 0.1% (see for example Stitzer et al., 1981). Other studies (Babor et al., 1983, or Smith et al., 1975) show a decline in socially oriented behavior when BAC exceeds this limit.

Evidently, the consumption of alcohol depends on the social company, and vice versa. The result of social drinking is a combination of social stimulation and drug effects which together influence the driving performance. With this synergistic drug action in mind, we can use alcohol in our model check as an amplifier for social stimuli. Therefore, the passenger effect shown in Figure 2 must increase with alcohol up to a certain limit where the anti-social, introverting decline in the alcohol effects starts. Thus the hypothesis is : within low to moderate alcohol dosages the "passenger effect" is stronger than in sober conditions. Figure 3 shows on the left side the data from Germany as describe above, on the right side the 1985 data from FARS. The upper part of the figure shows the results of one-person accidents, the middle part those of the two-persons accidents, and in the lower part the accident percentages for more than two persons are depicted. The result is convincing : up to 0.08% the accident risk increases if passengers are in the car. This effect is more marked in the lower BAC class up to 0.05%. In classes with BACS higher than 0.13% the effect goes in the opposite direction. The reasons are — first — a negative correlation between number of passengers and BAC (the higher the BAC the fewer passengers are in the car). Secondly, strongly intoxicated drivers mostly cause their accidents by falling asleep. A passenger may prevent the driver from falling asleep, thus gaining a protective function.

Figure 3. Accident rates in the FRG and in the USA stratified for number of passengers and BAC



Thus alcohol in low to moderate dosages has a twofold effect : it increases "social arousal", decreases "performance arousal". Thereby, the whole system becomes more sensitive to social cues. At the same time, there is a lowering of the threshold which has to be exceeded on the way from the "socially challenging situation" to an intended "socially oriented action". Proofs can be found in the lowered threshold for aggressive acts which is well documented in the literature. This effect is not explained by an increase in aggressiveness but in a reduced inhibition of aggressive behavior. This is what is meant by a lowered social threshold. Because of the simultaneous rise of the performance threshold (the "nonchalance" effect of alcohol) socially oriented behavior is facilitated to the same extent as a successful driving performance is inhibited.

More extensive evaluations of accident data revealed that the passenger effect is not only affected by such transient influences as alcohol. More time-stable variables like "youth of the driver" and "driving experience" are also important sources of variations. The socio-ecological model uses these variables as important modifiers of its system elements.

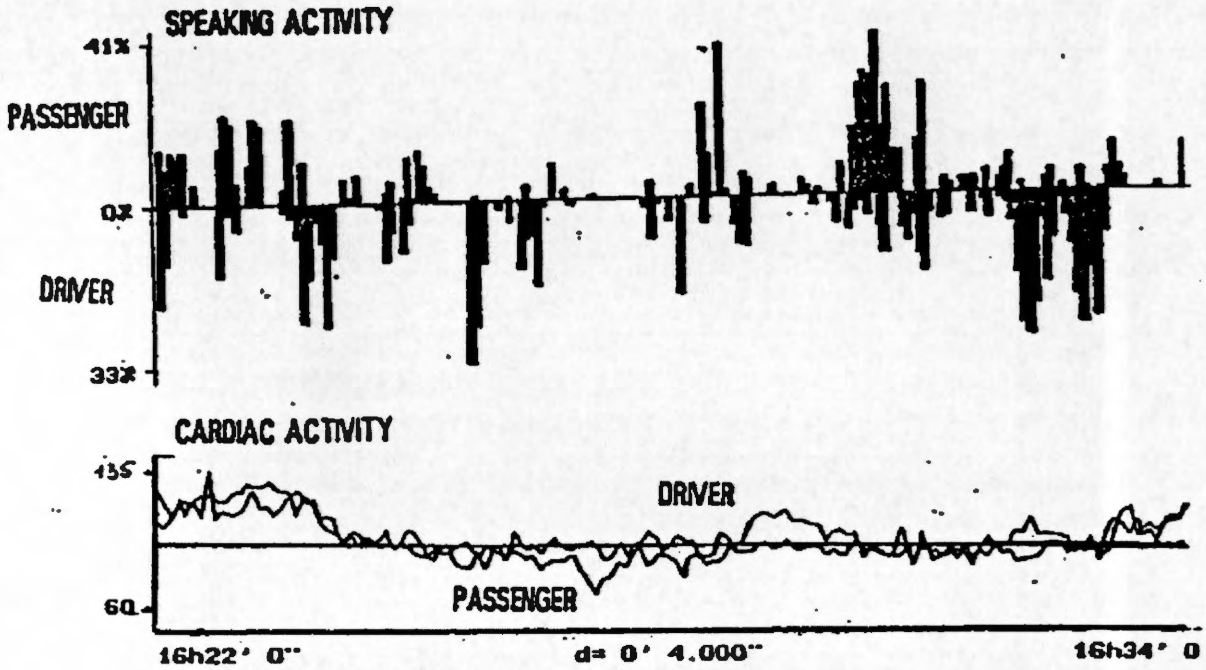
Though the accident data yield evidence for our socio-ecological model of driving performance, additional and more refined research has to be done in controlled studies where the variations are induced by the experimenter. Keeping in mind the limitations of pure laboratory research we are trying, using apparatus, to obtain, objective measures for psychophysiological stress of the driver as well as for social interaction in the car during real traffic situations.

In a first attempt we used the Logoport, a piece of apparatus developed by the author (Krüger, 1989). It continuously records speech activity (with a time resolution of 8 milleseconds, i.e., every 8 ms one measurement, either "on" or "off") as well as cardiac activity measured as beat-to-beat time. The device is self supporting for a recording time of about 24 hours. The subject can lead his/her normal life, in particular he/she may use the road as driver or passenger. With synchronized Logoports the interaction between two persons can be measured as is shown in Figure 4.

Here a young couple drove between 16.22 : 00 and 16.34 : 32 in a car. In the upper part of the figure the speaking activity is depicted as bars with a width of 4 seconds. Bars above the abscissa reflect the activity of the female passenger, bars below abscissa the activity of the male driver. The ordinate values are percentages of time spoken, e.g. 30% means that the subject spoke in the interval of 4 seconds (width) in 30% of the time, that is 1.2 seconds.

The figure gives an impression of speaking behavior, especially of the mutual activity switching between the two partners. It is immediately evident that

Figure 4. The result of a Logoport measurement. Upper part speaking activity, lower part cardiac activity. Bars above the abscissa indicate speech activity of the passenger, below the abscissa the speech activity of the driver. The upper pulse curve is from the passenger, the lower from the driver.



the Logoport yields efficient measures. There is a refined methodology to evaluate the speed and quality of the synchronization between the two partners. A first question will be whether this "rhythm of dialogue" (Jaffe & Feldstein, 1970) is covarying with the traffic situation as was hypothesized by Krüger (1988). Thereafter the amount and quality of the alcohol-induced changes in this synchronization will be investigated.

The pulse curves and their covariation are interesting in themselves (lower part of Figure 4). In all our measurements up to now we have found astonishingly high correlations between the pulse curves of driver and passenger. Regularly, these correlations are higher than those correlations both partners show in other common situations, such as in watching TV, chatting together and so on. Table 1 summarizes the lower and upper quartile and the median of the heart rate correlations in different situations. Car riding takes the first place in synchronizing the heart rates of the partners.

Table 1. Correlations between pulse course of two partners depending on the social situation.
(Mdn = Median, LQu = Lower quartile, UQu = Upper quartile).

Situation	N	Lower quartile LQu	Median Mdn	Upper quartile UQu
Partners separated	16	−.35	−.07	+.05
Television	13	−.07	+.10	+.55
Chatting	19	+.02	+.13	+.23
Discussion	20	−.01	+.15	+.32
Car riding	12	+.06	+.25	+.38

Evidently the "common destiny" of driver and passenger produces marked pulse covariations — a result promising new access to measuring situational and behavioral features in road traffic.

To sum up, one can say that our empirical studies as well as our evaluations of accident data reveal a significant influence of passengers on driving safety. Further research must be done. Firstly, a more detailed analysis of accident data is necessary : does the "passenger effect" depend on other classical accident risks (e.g. night time, road and weather conditions) ? How important are the passengers' age, sex, and psychophysical condition (e.g. intoxication with alcohol) as modifying factors ? Secondly, we have to gather synchronous data about a) actual driving difficulties, b) amount and quality of social interaction within the car, and c) driving performance. This data set will enable us to estimate the amount of mutual interaction of social and driving performance. Future research has to establish a clear-cut catalogue indicating the situations where passengers help the driver to do his job more safely. And this catalogue has to point out under which conditions and by what means a passenger co-acting with the driver will increase the danger of an accident.

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