DRIVER CHARACTERISTICS; DRIVING PERFORMANCE

Group Composition and Driver Minority Status

Kelly Baker, T.

Pacific Institute for Research and Evaluation

Abstract : Background/Introduction
Driver and passengers' BACs were examined among homogeneous and heterogeneous groups. Results indicate that drivers in heterogeneous groups (mixed sex) have significantly lower BACs than drivers in homogeneous groups (all female or male). Interestingly, passengers in heterogeneous groups have higher BACs than those in homogeneous groups. This is contrary to past findings on group drinking behavior which indicate that all-male groups are more likely than either all-female or mixed groups to drink higher in amounts.

Objectives
To exam group gender composition and driver minority status (i.e., sex) using driver and passengers' BAC levels.

Methods
Groups of participants were randomly surveyed as they crossed south from San Diego into Tijuana. Drinking histories and plans for the evening were obtained. Participants were also surveyed as they returned to San Diego and BACs were measured.

Results
Four groups were examined. Two included homogeneous groups (same sex driver with same sex passengers) and two included those in which the driver is the minority sex in the group (i.e., female driver with majority of male passengers; male driver with majority of female passengers). Analysis revealed that for groups where the driver is the minority sex, passengers have significantly higher BACs than do passengers of groups where the driver is the same sex. This is particularly true for male passengers with female drivers.

Discussion
Passengers with a minority sex driver drink significantly more than do passengers with a driver of the same sex. It is hypothesized that in many drinking and driving situations, the minority sex driver assumes the role of “guardian” or “caretaker.”

Conclusion
Results of these analyses reveal that having a caretaker in a group may free passengers to drink more.

A New Experimental Paradigm to Prove Sedative Effects of Psychoactive Substances

Tietze, H., Hargutt, V., Hoffman, S., Vollrath, M.

Center for Traffic Sciences

Abstract

Effects on low doses of psychoactive substances are quite weak and difficult to measure. Furthermore, if sedative effects or vigilance reduction are to be investigated a methodological and practical issue is to induce the effect rather than wait for it. Therefore, a new rationale is introduced that adds high effort episodes into normal tasks. We term this approach "MaxMin" method. In this approach we give subjects the chance to remain vigilant by operating more actively. This self-activation is possible in early stages of fatigue only, whereas at the last stage subjects tend to reduce the stress. In our experimental design subjects had to drive a monotonous route in a simulator and were instructed to stress themselves at predefined episodes by driving as fast as possible. After each trip (about 25 min monotonous route and 5 min driving with high demands; 11 trips overall) subjective ratings and BAC were measured. Subjects of one group consumed alcohol aimed to reach a peak BAC of 0.5 ‰ and were compared to the non-alcohol group. The alcohol group drove faster within the periods of high demand. Their lane deviation was increased during the fast trips as well as during the normal epochs. Physiological data on EEG and eyelid closure will be presented to confirm the hypothesis of the self-activational process.

Sociological Characterisation of Convicted Drunken Drivers

I. Vavró, T. Varga*

Ministry of Justice, Budapest
*Department of Forensic Medicine, University of Szeged, Hungary
H-6724 Szeged, Kossuth Lajos sgt. 40. P.O. Box 92. Hungary

Abstract
The sociological characterisation of convicted drunken drivers were investigated based on the ten years statistic of the Ministry of Justice. It was found the sociological pattern of the convicted drunken drivers are similar to the people who were found to be guilty in other crimes.

Introduction
Both the improvement of the objective external factors and the subjective factors play an important role in the prevention of road accidents. As among the causes of road accidents human faults are the dominating ones, prevention also has to focus on improvement of the behaviour of those participating in the traffic. Moreover, most of the improvement of the external circumstances, e.g. the modernisation of the road system, the improvement of the protective equipment of the vehicles, etc. are also aimed at eliminating the emergency situations resulting from human neglect and to decrease the extent of damages.

All over the world, including Hungary, drunken driving is among the main causes of road accidents. When selecting the prevention methods it is crucial which social layers these drivers come from, to what extent they can be expected to spontaneously follow the traffic regulations and what role their legal liability may play together with the general prevention methods.

In our article we examine the demographic characteristics of drunken drivers by analysing the data available in the statistical system of the Ministry of Justice and compare them with the relevant data of drivers causing accidents in sober condition and those of perpetrators in public prosecution.

Material and Method
The Hungarian judicial statistical system keeps records of the validly convicted people by registration. They register the personal data of the perpetrators (sex, age, marital status, education), the committed crime, its legal classification as well as the legal consequences. If a person is found guilty of committing more than one crime by the court, his listing is done on the basis of the most serious crime he committed. The personal data of those who are found guilty of committing offences against the traffic laws are similar to those who did not commit more serious crimes. During the analysis we examined the data of the last 10 years in order to

eliminate the distorting effects of the possible annual variations even in case of offences of a low number of offenders.

In our present report we analyse the demographic data (sex, age, marital status, education, possible previous criminal records, characteristics of the offence, possible drunkenness) of 189,580 (3,635 youngsters and 185,945 adults) validly convicted offenders in the period between 1990 and 1999 with statistical methods. For each factor we compared the data of the offences of those who were sober and who were drunken with the demographic data of those 594,711 (68,438 minors and 526,228 adults) offenders who committed other crimes in the same time interval. In the register the degree of drunkenness is not indicated, therefore, no distinction can be made in this respect. According to the current Hungarian legal regulations those drivers whose blood alcohol concentration is above 0.8 g/litre and those who cause any road accidents under the influence of alcohol are registered as drunken drivers.

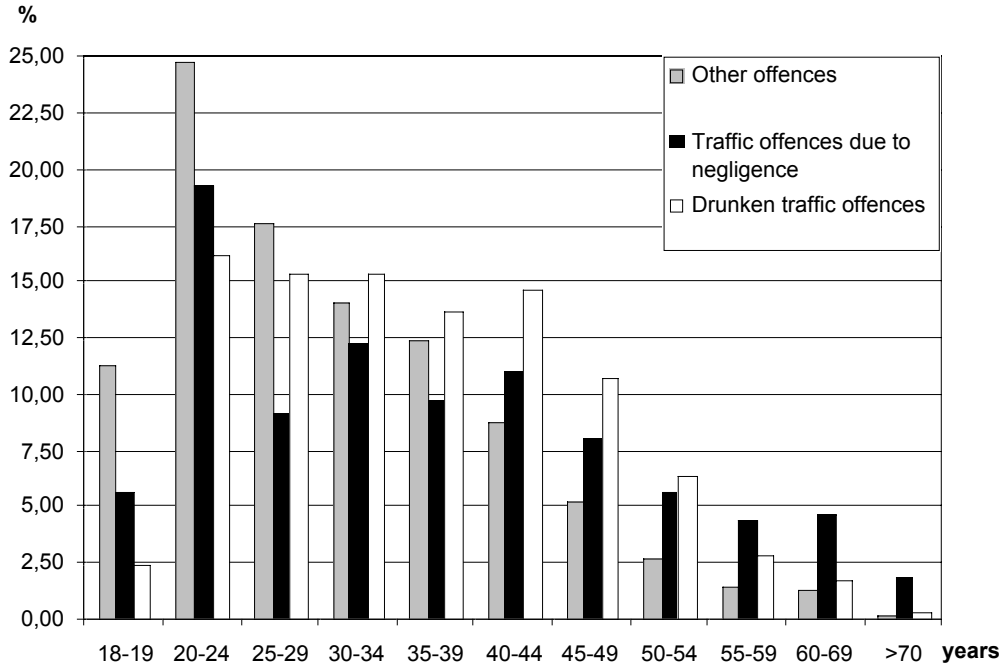
Results and discussion

The distribution of those convicted of committing traffic offences differ from the ratio of those convicted in public prosecution. Difference can be seen in the proportion of youngsters and adults as well as in that of men and women. 1.92% of the people convicted of traffic offences are youngsters whereas it is 11.52% in other public prosecution cases. A major difference can be seen in the structure of juvenile and adult delinquency. In the examined time period 5.04% of the juvenile delinquents committed traffic offences on the average, whereas 26.11% of the adults were convicted for the same reason. Among the adults the ratio of women was 4.46% for traffic offences and 11.66% for other crimes in the given time period.

Considering the internal ratios of the traffic offences, 74.60% of all cases were due to drunken driving when the offence meant that the driver's blood alcohol concentration was above 0.8% g/litre while driving a car and 13.36% of all cases were road accidents caused by negligence. Among female offenders 37.37% of all female drivers were convicted of drunken driving, which is nearly half of the male frequency of 76.29%. For this reason the ratio of men convicted of road accidents by negligence was 12.01% and 42.27% among women. All this means that the demographic data characteristic of the traffic offences committed in the state of drunkenness mainly indicate the values of adult males.

The age differences of those convicted of traffic offences differ from those of adults who were convicted in public prosecution. Here the occurrence of the 18-19-year-olds is significantly lower, whereas in case of those who are older than 30 an opposite phenomenon can be seen. The distribution does not correspond to the generally experienced principles of criminology that is also observed in Hungary but rather it can be deducted from the financial situation that is connected to the possession of a car and the role played in traffic. There is no significant age difference between committing a traffic offence in sober and drunken conditions. The only exception is the low occurrence in the generation of 18-19-year-olds, which may be explained by the habits of alcohol consumption and the acquisition of a provisional driving licence after the 17th birthday for the duration of two years. The peak values for the generation of 40-49 year-olds may be explained by the chronic alcoholism becoming frequent in this age. (Figure 1)

Figure 1: Distribution of adults validly convicted of traffic offences and other crimes according to age



When examining the marital status of the convicts it cannot be disregarded that in Hungary the birth rate has been fluctuating considerably since the First World War. Its consequence is that the age distribution of the population changed significantly in a historically short time period. Considering the fact that the dominant age from the point of view of marriages and divorces differs, it is understandable that the number of population categories of different marital statuses, marriages and divorces are higher than in countries of evenly distributed age groups and births. The decrease in the number and occurrence of marriages can also be detected, which makes it very difficult to analyse the distribution according to marital status. This statement refers both to the entire population and those having deviant behaviour, therefore, to the offenders as well.

Due to the difference in the age structure the distribution of the convicted people on the basis of their marital status differ from the same type of distribution of those who are convicted in public prosecution. The ratios of bachelors and spinsters are lower and are higher for married offenders. The same trend can be seen in road accidents due to drunken driving and negligence. The exception is the group of divorced (separated) people whose ratios approach and in some cases even exceed the values of the offenders convicted in public prosecution. In the examined decades the spontaneous law-abiding behaviour of those living in a family has been improving regarding causing road accidents by drunken driving. It proves that regarding the distribution on the basis of marital status their ratio among the ratio of drunken drivers decreased from 56.30% to 46.24% (Chart 1). This is also considerable if we take into account the changes that occurred in the distribution of age and marital status within the population.

Chart 1.a: Distribution of validly convicted adults in public prosecution (excluding those convicted of traffic offences)

Marital status	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Single	46,19	44,73	43,45	44,33	45,41	46,21	47,64	48,68	49,79	50,54
Married	33,34	33,93	36,49	36,66	36,37	36,45	35,20	34,82	34,05	33,29
Widow	1,16	1,20	1,42	1,36	1,44	1,46	1,43	1,38	1,38	1,53
Divorced	19,45	17,67	16,37	15,64	14,69	14,13	14,10	13,63	13,47	13,45
Separated	2,86	2,46	2,26	2,01	2,09	1,74	1,62	1,49	1,32	1,20
	100,00	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

Chart 1.b: Distribution of validly convicted adults of committing road accidents due to negligence

Marital status	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Single	33,12	31,48	32,71	33,62	34,59	34,57	34,46	36,73	37,81	34,98
Married	58,96	59,96	57,59	57,51	57,20	56,41	57,07	53,64	52,93	55,93
Widow	1,48	1,44	1,63	1,67	1,32	1,73	1,36	1,85	1,61	1,89
Divorced	6,31	6,83	7,24	6,73	6,24	6,70	6,58	7,49	7,13	6,76
Separated	0,13	0,30	0,82	0,46	0,64	0,59	0,53	0,29	0,51	0,44
	100,00	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

Chart 1.c: Distribution of validly convicted adults of committing road accidents in a drunken state

Marital status	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Single	28,64	29,11	28,62	29,89	31,66	33,49	33,36	34,62	35,38	36,19
Married	56,30	55,34	55,12	53,49	51,79	49,74	49,85	48,46	46,92	46,24
Widow	1,05	1,05	1,08	1,14	1,23	1,25	1,09	1,30	1,62	1,32
Divorced	12,81	13,45	14,26	14,36	14,20	14,45	14,53	14,61	15,14	15,37
Separated	1,20	1,05	0,93	1,13	1,12	1,08	1,18	1,01	0,93	0,89
	100,00	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

The differences that could be indicated in the distribution of age and marital status can be observed in the analysis based on the education. Here the close relationship between the level of education and the law-abiding behaviour is remarkable. The data of road accidents due to negligence harmonise with the distribution of the level of education of the Hungarian population and reflect the changes that happened in this field in the past decades. Accordingly, the number of people with secondary and higher education increased by the end of the decade. In the group of those who committed a traffic offence in the condition of drunkenness the people with secondary and higher education is underrepresented and these data are approaching the data of the offenders convicted in public prosecution (Chart 2). The conclusion can be drawn from this that the connection between the level of education and the relationship with the social norms can be detected in case of traffic accidents as well (among other fields of crimes).

Chart 2.a: Distribution of validly convicted adults in public prosecution (excluding those convicted of traffic offences)

Education	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Illiterate	2,36	2,14	2,04	1,85	1,90	1,86	1,73	1,49	1,50	1,57
Primary school	80,77	79,84	77,57	76,83	76,40	75,41	74,22	72,59	71,96	70,49
Secondary school	15,23	16,54	18,77	19,67	19,97	20,77	21,80	23,47	23,94	25,17
University	1,64	1,48	1,62	1,65	1,74	1,96	2,25	2,45	2,60	2,77
	100,00	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

Chart 2.b: Distribution of validly convicted adults of committing road accidents due to negligence

Education	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Illiterate	0,06	0,04	0,22	0,04	0,08	0,04	0,21	0,04	0,24	0,08
Primary school	47,04	44,28	41,70	41,38	39,74	39,91	34,46	36,16	33,56	32,85
Secondary school	42,27	44,50	45,75	45,49	48,20	48,16	51,81	50,14	52,66	52,79
University	10,63	11,18	11,33	13,08	11,98	11,89	13,53	13,66	13,55	14,27
	100,00	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

Chart 2.c: Distribution of validly convicted adults of committing road accidents in a drunken state

Education	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Illiterate	0,23	0,18	0,16	0,15	0,17	0,19	0,19	0,15	0,17	0,14
Primary school	63,41	61,70	57,47	56,94	57,76	55,53	53,83	52,75	53,54	51,36
Secondary school	30,80	31,57	35,41	36,06	35,39	37,21	38,95	40,27	39,02	41,20
University	5,56	6,55	6,56	6,85	6,67	7,07	7,02	6,83	7,27	7,30
	100,00	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

From the aspect of past record there is also a major difference between those who were convicted of traffic offences and other crimes. In case of adults convicted of other crimes in public prosecution the average ratio of people of previous criminal record was 43.58% and 20.71% in cases of traffic offences. While the majority of those who commit an offence by negligence have no criminal record, in case of offences committed in the condition of drunkenness is also nearing the data of people who commit other crimes (Chart 3).

Chart 3.a: Distribution of validly convicted adults in public prosecution on the basis of previous criminal record (excluding those convicted of traffic offences)

Previous criminal record	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Clean record	50,53	54,29	57,14	56,65	57,52	58,32	57,52	56,86	56,71	55,37
One previous crime	21,14	21,25	22,82	25,39	26,74	26,89	27,80	29,27	30,63	32,35
Recidivist	28,33	24,46	20,04	17,95	15,74	14,78	14,47	13,88	12,66	12,28
	100,00	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

Chart 3.b: Distribution of validly convicted adults of committing road accidents due to negligence

Previous criminal record	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Clean record	95,36	93,65	94,69	93,55	93,01	92,16	93,50	92,64	92,32	91,76
One previous crime	4,38	5,94	5,16	5,97	6,77	7,55	6,29	7,24	7,48	8,04
Recidivist	0,25	0,41	0,15	0,08	0,22	0,29	0,20	0,16	0,20	0,20
	100,00	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

Chart 3.c: Distribution of validly convicted adults of committing road accidents in a drunken state

Previous criminal record	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Clean record	77,90	78,60	79,16	77,07	77,47	75,62	74,17	72,92	73,08	73,72
One previous crime	17,93	17,97	17,79	19,84	19,87	21,64	23,24	24,57	24,49	24,48
Recidivist	4,16	3,43	3,02	3,09	2,65	2,74	2,60	2,51	2,43	1,81
	100,00	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

In summary the analysis of the demographic data of drunken drivers show that in many respects (marital status, education, criminal record) this group differs from the group of those who commit traffic accidents by negligence and comply with the demographic data of other perpetrators of deviant behaviour. Our results show that in our case apart from the general means of prevention penal sanctions cannot be set aside either.

References

1. Hungarian Yearbook of Statistics. Central Statistical Office. Budapest, 2000.

2. Józan, P.: Health behavioral study. Central Statistical Office. Budapest, 1994.

3. Vavró, I.: Crimes and legal consequences. 4. Traffic crimes. Ministry of Justice. Budapest, 2001.

Comparison Between Behavioural Signs of Drug Impairment and Driving Performance

M. Vollrath and H.-P. Krüger

Center for Traffic Sciences (IZVW), University of Wuerzburg, Germany

Keywords
Illegal drugs, behaviour, driving simulator

Abstract
The effect of illegal drugs on driving safety receives an increasing attention. A major problem in this area is the detection of drug use. On the one hand, screening tests (using urine, sweat or saliva) are being developed. On the other hand, drug recognition programs are introduced. This latter approach focuses on behavioural signs of drug use detected by experts. In this paper, the effectiveness of this approach is examined and compared to measuring certain aspects of driving performance in a simple driving simulation.

The data were obtained in 1998 when a field study funded by the BAST was conducted with drivers at discotheques. Subjects were contacted and asked to participate in a short interview concerning drugs and driving. Subjects who had consumed drugs and were driving at this evening or at similar occasions were asked for an extended interview, a driving-simulator test and for a medical examination including a behavioural check as well as taking blood, urine and saliva samples. Additionally, sober control subjects and subjects under the influence of alcohol were included.

Due to the patterns of drug consumption, the analyses are constrained to the use of amphetamines, cannabis and alcohol. Moreover, the drug concentrations were relatively small as only subjects who drove or indicated that they would drive under similar circumstances were included. Thus, small drug effects can be expected. With this caveat in mind, the following results were found: (1) Certain behavioural signs are quite well suited to detect illegal drug use. However, when alcohol is consumed additionally, the effect of alcohol dominates. (2) Using driving performance as an indicator, the consumption of illegal drugs is detected quite well even when alcohol is present. However, when some drugs in low concentrations are consumed a deterioration of performance cannot be shown. It is concluded that simple behavioural test which can be conducted at roadside are a valuable tool to improve the detection of illegal drug drivers.

Introduction

While driving under the influence of illegal drugs is prosecuted in Germany, a deterring effect of this legal measure can only be expected if illegal drug drivers are detected. However, this poses a serious problem as simple and reliable screening devices like the breath alcohol measurement for

detecting alcohol consumption are still missing or are just being developed. Thus, a careful examination and observation of suspicious drivers by police officers is the most important method to detect illegal drug drivers. In order to improve the police officers' abilities, special training programs are being used. For example, Möller et al. have developed a training program for German police officers (1) which is currently being evaluated by the BAST. Within this program, a major concern is the use of behavioural observations (like pupillary reactions to a sudden bright light) or simple behavioural tests (like touching the nose with a finger). However, these tests are valuable only if the illegal drug used changes the behaviour examined. This will depend on the type of drug consumed and the drug concentration. The aim of this paper is to examine which kinds of drugs lead to certain behavioural changes and to evaluate whether an observation of these behavioural signs is suited to detect drug consumption. Moreover, certain aspects of the driving ability were assessed by means of a simple driving simulator. While the effects of drugs and alcohol on driving ability will not be presented in detail here (see 2, 3) it will be examined how well drug consumption can be detected using this performance score. Both methods (checking behavioural signs and examining performance) will then be discussed.

Methods

The study was conducted in three larger cities in Bavaria, Germany (Munich, Nuremberg and Wuerzburg) between July and November of 1998 between 10 p.m. and 4 a.m. Two researchers conducted short interviews with potential subjects in order to select participants for the intensive investigation. One researcher performed an extended interview, another attended the driving simulator. A fifth researcher provided coordination between the different researchers. A medical doctor took blood, urine and saliva samples and conducted a short medical examination including the check of behavioural signs (see below).

In order to find the subjects of interest, different selection criteria were defined: First of all, when researchers contacted a group of incoming or leaving people, they asked who the driver was and selected him or her for the short interview. If no driver was present, people were asked if anybody was driving regularly at comparable events (but just at the evening of the study). Thus, either a driver or a potential driver was selected for the short interview.

In the short interview, subjects were asked about their drug use and driving under the influence of drugs. The answers provided the basis for the second step of the selection process. First of all, subjects under the influence of drugs were selected. Additionally, different control groups were selected. For the extensive investigation subjects were rewarded with DM 60 (about $30 US).

Overall, 3081 subjects were selected for the short interview and 2779 participated (90.2% responder rate). From these, 832 were asked to participate in the extensive investigation and 503 took part in at least some parts of the investigation. For the present paper, only those subjects were selected who had consumed either cannabis or amphetamines / ecstasy (a distinction between these two drugs was not possible due to sample size), where a blood sample could be used to analyze drug concentration and where the behavioural observation was conducted. For cannabis, three groups were distinguished: The first group included all subjects where only THC-COOH was found but not THC. In this group cannabis consumption had occurred some time ago. The second and third group included subjects with either a low (between 0.5 and 2 ng/ml) or a high (above 2 ng/ml) THC concentration. For amphetamines / ecstasy, two groups were defined with regard to drug concentration. In the low concentration group, the sum of the active

substances was between 0.01 and 0.05 mg/l. In the high concentration group, concentrations were larger than 0.05 mg/l.

Table 1 gives the group sizes and the substance concentrations for the different groups examined. Overall, N = 161 subjects met these criteria described. In 87 of these, alcohol was found with moderate to large BACs of about 0.06 g/dl. Only in the group with amphetamines / ecstasy in high concentration BAC was lower (0.028 g/dl). With regard to the combination of both drugs only some combinations could be examined as not all combinations occurred in the drivers examined.

Table 1: Group size and substance concentrations in the different groups examined

	Group size		No Alcohol			Alcohol			
Group	No Alc.	Alc.	THC	THC-COOH	Amph. / Ecst.	THC	THC-COOH	Amph. / Ecst.	BAC
	n	n	ng/ml	ng/ml	mg/l	ng/ml	ng/ml	mg/l	g/dl
No drug use	25	21	-	-	-	-	-	-	0.066
Cannabis only:									
THC low	6	14	1.06	18.70	-	1.08	22.18	-	0.071
THC high	5	18	6.49	71.58	-	4.19	42.38	-	0.080
THC-COOH	9	16	-	21.80	-	-	14.35		0.063
Amph. / Ecst. only:									
Amph. / Ecst. low	6	4	-	-	0.03	-	-	0.02	0.066
Amph. /Ecst. high	7	9	-	-	0.23	-	-	0.19	0.028
Both drugs:									
THC-COOH and Amph./Ecst. high	7	-	-	4.7	0.27	-	-	-	-
THC (low and high) Amph./Ecst. high	9	5	1.67	32.98	0.25	4.58	32.97	0.20	0.063
Overall	74	87							
	161								

In order to gain an accurate view of the performance decrement due to drug effects, a driving simulator developed by Reiss & Krueger (4) was adapted by Vollrath (3). For the aims of the present paper, the parameters measured in these situations were combined. In a first step, a factor score for three factors is computed: ‘speed’ (mainly average speed), ‘lateral position’ (mean and standard deviation of the deviation from the lane) and ‘reaction in secondary tasks’ (the percentages of accidents at crossroads, with peripheral warning and at stop signs and the simple reaction time). For computing the factor scores, the mean and standard deviation of the sober control group was computed for every parameter. Afterwards, the parameter values for each subject were z-standardized using these means and standard deviations. The factor scores were computed by averaging the appropriate z-values. Finally, a mean of the three factors was computed for each subject describing overall performance in the simulator.

With regard to the behavioural signs, medical doctors checked whether the subjects were sweating or trembling and if they were unkempt. Three simple tests were performed: (1) Finger-Finger-Test (the index fingers of both hands were positioned to both sides of the head and should be brought together with eyes closed), (2) Finger-Nose-Test (from the arms held at the side of the body, the index finger was to be brought to the nose with eyes closed), (3) Rotation Nystagmus (the subject is turned 5 times around his axis within 10 seconds. Afterwards, the subject is to fixate the doctor's index finger held approximately 25 cms from the subject's eye and the duration of the nystagmus is measured). Using a pocket beam, the reaction of the eyes to sudden light was analysed (normal or slow). After these tests, the following behavioural signs were evaluated by the doctors: prolonged reactions, slurred speech, sleepy, excited, undue happy, shuffling along, swagger, red eyes, watery / shiny eyes.

For each behavioural sign and the test score from the driving simulator, two measures were computed: (1) sensitivity (percentage of drug users which display this sign), (2) predictive value (percentage of subjects with this sign who have been using drugs). While the first measure indicates how well drug users are detected by the behavioural sign, the second measure shows if the positive test result is specific to the substance or if it may also occur in subjects without having used drugs. Thus, both measures evaluate different aspects of the ability of the measures to detect drug consumption. Both measures were computed separately for subjects without and with alcohol, because alcohol alone also leads to signs of impairment which should, however, be separated from the effects of drugs.

Results

At first glance, a high sensitivity seems most important in order to be able to detect drivers under the influence of illegal drugs. However, as very negative consequences result from the suspicion of driving under the influence of illegal drugs (a blood sample is drawn, if necessary, without consent of the driver), it should be avoided that drug negative drivers are falsely suspected of being under the influence of drugs. From this point of view, the emphasis should be put on a large predictive value of a measure. For the following comparison, a very strict criterion was chosen: Only measures with a predictive value of 100% (all subjects showing this sign were drug positive) and a sensitivity of at least 20% for at least one drug were included. For the performance in the driving simulator, the cut-off-value for assigning a subject as showing a performance decrement was chosen so that the predictive value for all drugs combined was 100% (larger performance decrements did not occur in subjects without drugs). Again, this criterion was computed separately for subjects with and without alcohol. Table 2 gives the results.

When THC in either low or high concentration is present, 33% and 20%, respectively, of the subjects are undue happy. In 20% of the high concentration subjects red eyes are found. When alcohol is consumed additionally, the predictive value of both signs is strongly reduced. That means that undue happiness and red eyes also occur with alcohol alone. In the driving simulation, 7% of the subjects with a low THC concentration and alcohol and 22% of the subjects with a high THC concentration and alcohol can be detected while a detection for THC positive subjects without alcohol is not possible with the driving simulation. For THC-COOH, other behavioural signs are important in subjects who have not consumed alcohol: 22% of these subjects show slowed reaction and slurred speech and 14% a slowed reaction of the eye to light. Again, without alcohol these subjects cannot be detected with the driving simulation but 13% show a clear deterioration when THC-COOH and alcohol are combined.

Amphetamine / ecstasy changes more behavioural signs: 14% of the subjects with high concentrations display trembling and slowed reaction, 17% have red eyes and 29% a slowed reaction to light. In low concentrations, red eyes are found in 33% and slowed reaction of the eye to light in 17%. In the driving simulation, 30% of the subjects with high concentrations display a deterioration of performance. When alcohol is consumed additionally, trembling remains a sensitive sign with 22% of the high concentration subjects. Red eyes and slowed reaction of the eye to light also appear in subjects with alcohol, only, and are thus not suited because of their low predictive value. In the driving simulation, 50% of the subjects with low concentrations and 11% of those with high concentrations (note: alcohol concentration in this group is much lower than in the other groups) show clear deterioration of performance.

When THC-COOH and amphetamines / ecstasy in high concentration are combined, red eyes and slowed reaction of the eye to light remain good predictors with a sensitivity of 33% and 60%, respectively. In the driving simulation, 43% of these subjects show a clear deterioration. Behavioural signs for this group with alcohol could not be examined as not enough subjects were found.

Table 2: Sensitivity (SE) and predictive value (PV) for behavioural signs with a predictive value of 100% and for the performance score from the driving simulation. If a sign did neither occur in control subjects nor in drug users, sensitivity was 0% and the predictive value could not be computed ('-'). As not enough subjects within the group THC-COOH, amphetamines / ecstasy and alcohol were found, values could not be computed in this group

Without alcohol:	THC low		THC high		THC-COOH		Amph. / Ecst. low		Amph. / Ecst. high		THC-COOH + Amph. / Ecst. high		THC + Amph. / Ecst. high	
	SE	PV	SE	PV	SE	PV	SE	PV	SE	PV	SE	PV	SE	PV
Trembling	0	-	0	-	0	-	0	-	14	100	0	-	11	100
Slowed reaction	0	-	0	-	22	100	0	-	14	100	0	-	0	-
Slurred speech	0	-	0	-	22	100	0	-	0	-	0	-	0	-
Undue happy	33	100	20	100	0	-	0	-	0	-	0	-	0	-
Red eyes	0	-	20	100	0	-	33	100	17	100	33	100	14	100
Reaction to light	0	-	0	-	14	100	17	100	29	100	60	100	50	100
Driving Simul.	0	-	0	-	0	-	0	-	30	100	43	100	33	100
With alcohol:														
Trembling	0	-	0	-	0	-	0	-	22	100			0	-
Slowed reaction	23	50	18	50	20	50	0	0	0	0			0	0
Slurred speech	21	60	17	60	13	50	0	0	0	0			0	0
Undue happy	29	50	0	0	0	0	0	0	0	0			0	0
Red eyes	36	46	25	40	21	33	0	0	22	25			40	25
Reaction to light	23	60	6	33	31	67	0	0	40	50			33	33
Driving Simul.	7	100	22	100	13	100	50	100	11	100			0	-

Finally, the combination of THC and amphetamines / ecstasy in high concentrations can be detected by trembling (11% sensitivity), red eyes (14%) and slowed reaction of the eye to light (50%). In the driving simulation, 33% of these subjects display a deterioration of performance. When alcohol is consumed additionally, red eyes and slowed reaction to light remain sensitive measures but with low predictive values. Thus, these behavioural signs also occur with alcohol alone. In the driving simulation, no strong deterioration in this group (as compared to subjects with alcohol, only) can be shown.

Discussion

Different behavioural measures and performance in a driving simulation were examined in their ability to detect illegal drug use (cannabis and amphetamines / ecstasy). The interpretation of the results is limited by two factors: First, with regard to cannabis, relatively low concentrations were found. However, this reflects drug use while driving at least in the sample of the study presented. Second, with regard to amphetamines / ecstasy, sample sizes are relatively small. With these caveats in mind, the results may be summarized as follows: (1) When subjects have not consumed alcohol, some behavioural measures show a predictive value of 100%. That means, all subjects displaying this sign have consumed an illegal drug. (2) However, the sensitivity of these measures is relatively low (around or below 30%). (3) Overall, the results are comparable in magnitude when using a performance score from a driving simulation. Only when amphetamines / ecstasy in high concentration alone or combined with THC / THC-COOH are found, sensitivity increases above 30%. (4) When alcohol is consumed additionally, the effect of alcohol on the behavioural signs is hardly separable from the combined effect of alcohol and illegal drugs. While the sensitivity of only some measures increases somewhat, the predictive value decreases to below 60%. That means that these behavioural signs are also present when alcohol alone is present. (5) Using a performance score from the driving simulation, the combined effect of illegal drugs and alcohol can be detected with a high predictive value. However, the sensitivity remains relatively low (below 20% with the exception of amphetamines / ecstasy in low concentrations).

Overall, the approach to detect illegal drug use by a close observation of behaviour may be regarded fairly positively. At least when alcohol use can be excluded (which is possible by taking a breath alcohol sample) some behavioural signs give a good indication that cannabis or amphetamines / ecstasy have been consumed: Trembling (amphetamines / ecstasy alone or with cannabis), red eyes (high concentrations of THC, amphetamines / ecstasy or both drugs combined), slow reaction of the eye to light (THC-COOH, amphetamines / ecstasy or both drugs combined), slowed reaction (THC-COOH and amphetamines / ecstasy in low concentration) and slurred speech (THC-COOH).

However, when alcohol has been consumed additionally, the effect of alcohol is hardly distinguishable from the effect of alcohol and illegal drugs combined (at least with the measures examined here). In a driving simulation, an increased deterioration of performance as compared to performance decrements with alcohol alone can be shown for some of the drivers. This points to the dangerous effects of this combination of illegal drugs with one another or with alcohol. Thus, even when alcohol has been found it could be worthwhile to additionally check for illegal drugs. However, different behavioural measures have to be developed in order to obtain an indication of drug use when alcohol has been consumed.

References

1. Möller M et al. Drogenerkennung im Straßenverkehr. Berichte der Bundesanstalt für Straßenwesen, Mensch und Sicherheit M 96. Wirtschaftsverlag NW, Bremerhaven, 1998.

2. Krüger H-P, Vollrath M. Effects of cannabis and amphetamines on driving simulator performance of recreational drug users under natural conditions. In: Laurell H, editor, Alcohol, Drugs and Traffic Safety, T2000. Ekonomi-Print, Stockholm, Schweden, 2000.

3. Vollrath M, Löbmann R, Krüger H-P, Schöch H, Widera T, Mettke M. Fahrten unter Drogeneinfluss – Einflussfaktoren und Gefährdungspotential. Berichte der Bundesanstalt für Straßenwesen, Mensch und Sicherheit M 132. Wirtschaftsverlag NW, Bremerhaven, 2001.

4. Reiss JA, Krüger H-P. Accident risk modified by passengers. In: Kloeden CN, MCLean AJ, editors, Alcohol, drugs and traffic safety, T'95, NHMRC Road Accident Research Unit, Adelaide, 1995, pp 213-221.

5. Krüger H-P, Kohnen R, Diehl M, Hüppe A. Auswirkungen geringer Alkoholmengen auf Fahrverhalten und Verkehrssicherheit. Bundesanstalt für Straßenwesen, Bericht 213, Wirtschaftsverlag NW, Bremerhaven, 1990.

6. Berghaus G, Schulz E, Szegedi A. Cannabis und Fahrtüchtigkeit. Ergebnisse der experimentellen Forschung. In: Berghaus G, Krüger H-P, editors, Gustav Fischer, Stuttgart, 1998, pp 73-98.

7. Berghaus G, Krüger H-P, Vollrath M. Beeinträchtigung fahrrelevanter Leistungen nach Rauchen von Cannabis und nach Alkoholkonsum – eine vergleichende Metaanalyse experimenteller Studien. In: Berghaus G, Krüger H-P, editors, Gustav Fischer, Stuttgart, 1998, pp 99-112.

8. Schulz E, Vollrath M, Klimesch C, Szegedi A. Fahruntüchtigkeit durch Cannabis, Amphetamine und Cocain. Berichte der Bundesanstalt für Straßenwesen, M 81, Wirtschaftsverlag NW, Bremerhaven, 1997.

Appendix: Overview of other behavioural signs

Table 3: Sensitivity (SE) and predictive value (PV) for behavioural signs with a predictive value below 100%. If a sign did neither occur in control subjects nor in drug users, sensitivity was 0% and the predictive value could not be computed ('-'). As not enough subjects within the group THC-COOH, amphetamines / ecstasy and alcohol were found, values could not be computed in this group

	THC low		THC high		THC-COOH		Amph. / Ecst. low		Amph. / Ecst. high		THC-COOH + Amph. / Ecst. high		THC + Amph. / Ecst. high	
Without alcohol:	SE	PV	SE	PV	SE	PV	SE	PV	SE	PV	SE	PV	SE	PV
Sweating	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Unkempt	0	-	0	-	0	-	0	-	0	-	14	100	0	-
Finger-Finger	20	17	40	29	14	17	80	44	43	38	14	17	22	29
Finger-Nose	20	33	0	0	0	0	20	33	0	0	14	33	0	0
Turn Nystagmus	67	31	20	10	33	18	20	10	86	40	29	18	22	18
Sleepy	0	-	0	-	11	100	0	-	14	100	14	100	0	-
Excited	0	0	0	0	33	75	17	50	0	0	14	50	33	75
Shuffling along	0	-	0	-	13	100	0	-	0	-	0	-	0	-
Swagger	0	-	0	-	0	-	0	-	14	100	0	-	0	-
Watery Eyes	0	0	0	0	33	75	17	50	0	0	17	50	14	50
With alcohol:														
Sweating	0	0	0	0	6	50	0	0	0	0			20	50
Unkempt	0	0	0	0	0	0	0	0	0	0			0	0
Finger-Finger	36	36	29	36	33	36	0	0	25	18			20	10
Finger-Nose	14	50	13	50	13	50	0	0	11	33			0	0
Turn Nystagmus	46	29	78	48	60	38	100	21	100	38			16	17
Sleepy	0	0	6	25	0	0	100	20	0	0			0	0
Excited	0	-	0	-	0	-	0	-	0	-			0	-
Shuffling along	0	-	0	-	6	100	0	-	0	-			0	-
Swagger	14	40	11	40	19	50	0	0	11	25			0	0
Watery Eyes	0	0	6	25	7	25	0	0	22	40			20	25

Social Influences on Driving Under Psychoactive Substances

Widera, T., Krueger, H.-P.

Center for Traffic Sciences

Abstract
Social influence was examined in two field studies with young drivers at discotheques. In the first study, a half-standardized interview concerning attitudes toward driving under psychoactive substances (alcohol and illegal drugs) was conducted with N = 359 drivers. In the second study, N = 114 subjects were questioned in a social situation involving same and mixed sex couples. Compared to drivers under the influence of alcohol (DUI) drug-impaired drivers estimated the risk induced by drugs as lower. Moreover, drug-impaired drivers were convinced that drugs had positive effects on driving and believed in compensation strategies. Accordingly, these drivers did not wait as long as DUI drivers after consuming the drug, did not show any tendencies to restrict their DID trips to certain routes or times, and did not negotiate about which member of a group would have to drive and remain clear of drugs. These behaviours were supported by a lower expectation of sanctions, a stronger social acceptance and by the willingness of friends to also drive drug-impaired. The second study extended these results towards social interaction in couples. Although male drivers who had their girlfriend along were more likely to refrain from drug-impaired driving and avoided drug-impaired driving themselves, they did not resist to drive with a drug-impaired driver and thus reinforced the risky driving pattern of men. Social approval was confirmed in this study as the most dominant moral dimension in the decision to drive. These results show that for drug-impaired driving social influences play an even more important role than for DUI driving and that the pattern of influence is quite different. This has to be taken into account by driver training programs and other countermeasures. Most important, the reinforcement of drug-impaired driving by social influences has to be changed.