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DRUID
Driving under the Influence of Drugs, Alcohol and Medicines

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German smartphone survey

Part II

Person-related characteristics of drug users and drug drivers compared to controls

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6th Framework Programme

Deliverable D 2.2.2

German smartphone survey

Part II

Person-related characteristics of drug users and drug drivers compared to controls

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1. Executive summary

The present study was conducted within Work Package 2 (Epidemiology) of the EU-funded project DRUID (Driving under the influence of drugs, alcohol, and medicines) in order to estimate the prevalence of psychoactive substances within the German driver population and to identify preventive and promotive circumstances of drug driving. The results serve as major input to the discussion on drug driving, rehabilitation, and prevention.

The final sample consists of 195 drug users[1] and 100 controls out of the normal driving population, stratified for sex, age (18-24-year-olds, 25-29-year-olds, and 30-39-year-olds), and residence (rural, urban, and city area). To capture real-time data about drug consumption and driving, a repeated-entry diary technique was applied. A questionnaire was installed on smartphones and was filled in daily for 28 consecutive days. All activities were listed in chronological order. The synchronisation of the reported information about drug use and driving enabled the identification of drives under influence. Furthermore, an extended diagnostic part was included in the study to gather person-related driver characteristics (e.g. socio-demographic information, relevant previous experiences, major mental diseases, psychometric performance measures, personality variables, information about the social context, attitudes, knowledge about legislation, and information about the subjective sanction severity).

Prevalence rates estimated by the survey results of the present study and identified situational factors of drug driving were reported in Walter, Hargutt and Krüger (2011). The methodological procedure is also described there. This report focuses on person-related factors of drug driving, i.e. the characteristics of drug impaired drivers.

To assess any psychological problems of the subjects, the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) was conducted (Wittchen, Zaudig & Fydrich, 1997). In addition, the subjects were queried about previous psychological health problems diagnosed by physicians. The number of diagnoses per person (Substance Use Disorders excluded) was marginally higher for users compared to controls (particularly due to a higher frequency of Major Depression with Recurrent Episodes, Bipolar Disorders, AD(H)D, and Borderline Personality Disorder). The users were more often diagnosed with Lifetime Drug Abuse or Drug Dependence. Heavy and excessive users especially reported more clinically significant impairment or distress due to substance use and expressed a higher intention to change/stop substance consumption. In general, users reported being less satisfied with their personal life situation and being less aware of a healthy way of living as compared to controls.

Because alcohol and cannabis were quite often used by the subjects of the present study, it was tried to specify distinct consumption patterns that affect the probability that someone drives under influence. The basic idea was that if someone restricts his consumption to weekends and nights, the probability that this person would drive under influence should be rather low. For cannabis as well as for alcohol, it was possible to show

[1] Originally 200 users, 5 were excluded from all analysis because they did not use cannabis within the study period.

this relation. What the consumption pattern of a person looks like, is to a great extent connected to the consumption intensity. Excessive and to some part heavy users more often consume at all times of the day and on all days of the week, whereas moderate users restrict their consumption for the most part to weekends and evenings/nights.

The psychometric performance of driver aptitude was assessed by the application of the computer-based Act & React Test System (ART) 2020 Standard test battery, developed by the Austrian Road Safety Board (ARSB). Seven sub-tests of the test battery were applied, which measure the following performance dimensions: coordination capacity (LL5, PVT, SENSO), concentration and attention capacity (Q1), reaction capacity (RST3), stress resistance (RST3), memory capacity (GEMAT3), and intelligence (MAT). Five of the seven tests can be assigned to the performance dimensions listed in the German Driver's Licence Ordinance ("Fahrerlaubnis-Verordnung", FeV). The analysis produced only small effects, indicating that acute cannabis intoxication partly affects the psychometric performance of driver aptitude and that negative long-term performance effects of heavy lifetime drug use exist (while light lifetime drug use has no negative impact). It has to be pointed out that, of the 39 parameters measured by the applied tests, only five turned out to be significantly different between the study groups. Another seven only showed trends. Furthermore, the recommended evaluation procedure according to the "Guidelines for Expertise on Driver Aptitude" ("Begutachtungs-Leitlinien zur Kraftfahrereignung"; Lewrenz, 2000) resulted in high overall failure rates of 58% to 69%, no matter which study group is considered (control group included). This indicates that the recommended evaluation procedure is neither sensitive nor specific enough to make clear assumptions about a possible relation between the degree of drug use – as operationalised in the present study – and psychometric performance.

According to evidence from a literature review that was conducted prior to the study (Walter et al., 2011), questionnaires that specify personality dimensions with a supposed relevance to the context of drug use and drug driving were applied. It turned out that drug use seems to be associated with some crucial personality dimensions (e.g. sensation seeking, hyperactivity/impulsivity, less self-control, rather unconventional behaviour, etc.) and drugs seem to be misused to solve personal problems (e.g. psychological and social problems due to hyperactivity/impulsivity, feelings of distress). A less precise but similar difference was found for users who commit many drives under influence compared to users who never or only sometimes drive under influence. Users at high risk of driving under influence reported more symptoms of hyperactivity/impulsivity in their childhood as well as more negative psychological and social after-effects of hyperactivity/impulsivity, and that psychoactive substances have a relieving effect on these symptoms. Users who committed many drives under influence expressed to have less positive coping strategies and believe much more pronounced that life and the occurrences therein rely on fate and fortune compared to users who rather seldom drive under influence.

Social learning and Social Control Theory stress the influence of parents and peers on the development of problematic behaviour (Bahr, Hoffmann & Yang, 2005). By the present study it could be demonstrated that the higher the subjects grade their parents' alcohol consumption, their peers' and partner's drug use, and their peers' impaired driving, the more they themselves are involved in drug use and drug driving, respectively. Further on, subjects who often drive under influence say that their friends have a less adverse attitude towards impaired driving compared to subjects who do not drive under influence or do it rather infrequently. Users surveyed in the present study indicated that their rela-

tionship to their parents is worse compared to controls, especially those who commit impaired driving quite often. These findings are in line with Social Control Theory (Hirschi, 1969, cited in Bahr et al., 2005) which stresses the positive impact of a good relationship between parents and children on the development of conventional values and the rejection of deviant behaviour. Users also stated that their parents' way of raising them was too lenient or lenient compared to controls. According to their statements, the users' fathers' have a higher job position which could indicate that they were less involved in bringing up the child. Moreover, the users more often stated that their parents lived apart or were divorced compared to controls. These findings indicate a decreased supervision by the parents and suppose a lack of strength in parenting which in turn is associated with a higher tendency of children to behave delinquently (Bahr, Maughan, Marcos, & Li, 1998; Hirschi, 1969, cited in Bahr et al., 2005).

Based on Ajzen's (1985) theory of planned behaviour, prevention measures should focus on attitudinal changes because attitudes influence behaviour. Drug users have a less adverse attitude towards drug driving compared to controls, especially when it comes to driving under the influence of cannabis and stimulants. For controls it was found that a more restrictive legislation has an effect on their attitude towards driving after the consumption of one beer. Controls for whom the zero-tolerance for alcohol applies find it more condemnable than those for whom the 0.05% BAC limit applies. Users who themselves drive often under influence less often mind going along with an impaired driver, whereas users who rather seldom drive under influence are more indisposed. The decision to drive under influence is stated to mainly depend on characteristics of drug intake (amount, type and effect of consumed drug, time of drug consumption). Users who rather seldom drive under influence stated a higher priority of the time of drug use compared to users who often drive under influence. This corresponds to the result shown in Walter et al. (2011) that moderate alcohol or cannabis users who commit fewer drives under influence compared to heavy and excessive users also have lower BACs and THC blood plasma levels while driving under influence. Also quite relevant in the process of deciding whether or not to drive under influence are in the users' view the density of police controls, whether or not passengers could be endangered, and the possible option to ride along with another person. Many users, and to some part controls as well, stated that they would appreciate a threshold for driving under the influence of cannabis. The most frequently specified reasons were the long traceability of the substance in body fluids and a feeling of injustice compared to persons who drink and drive (because of the different legal approaches). Most subjects accept the implementation of the zero-tolerance for young and novice drivers for driving under alcohol influence for safety reasons or would not mind if it applied to every driver. Users accept the zero-tolerance to a lower degree compared to controls. This confirms their rather liberal attitude towards driving under substance influence. Heavy and excessive alcohol users especially take the view that the legal BAC limit should be higher than 0.05% and that they can drink higher amounts of alcohol and still drive safely as compared to moderate alcohol users. For users obeying the law is a less important ethical principal than for controls. On this score no differences based on consumption intensity or the degree of driving under influence could be found.

There are numerous findings that support the effectiveness of sanctioning and police enforcement by deterring from high risk road user behaviour. The success of these strategies depends on the deterrence threat they create. Important characteristics here are a high surveillance level, a quick and efficient sanctioning, severe, strict and consis-

tent sanctions, and pertinent knowledge on behalf of the road user (Krisman & Schöch, 2011; Zaal, 1994). Experienced drivers had a better knowledge of the alcohol-related traffic legislation than young and novice drivers. The sanction for violations against the 0.00% BAC limit was rated almost as high as the sanction for violations against the 0.05% BAC limit, although it is actually lower. Users had a better knowledge of the legal consequences that are imposed when getting caught while driving under the influence of illegal drugs than controls. The consequences for drug offences were in general assessed to be lower than the real consequences that have to be expected. A positive effect of the subjective risk of being stopped by the police on drug driving was proved within the framework of the present study and is reported in Walter et al. (2011). This report refers to an effect of the subjective sanction severity on the occurrence of drives under influence, albeit the effect is rather small and is only marginally significant for the sanction that is imposed for violations against the 0.05% BAC limit. The more severe a person perceives the sanction, the less often the person commits the offence.

The results of the present piece of work (Deliverable 2.2.2 – Part I and Part II) were integrated in a model that shows dependencies of different societal, behavioural, and legal variables that are relevant in the context of developing measures to combat driving under influence.

The following insights can be drawn that might be relevant for the discussion about drug driving and associated prevention and rehabilitation measures:

- **Target group**: Prevention and rehabilitation measures should be addressed to the main target group of heavy and excessive users. A therapeutic approach to reach the target group of risky drug users might be an appropriate approach to reduce drug driving.
- **Social influence**: Friends and family members of exposed persons should be addressed and should be made aware of their influence and responsibility in the developing process of problematic behaviour.
- **Information about risks**: Information about the real risks and the real extent of drug driving should be disseminated to prompt attitudinal changes towards more responsible and safety-oriented attitudes.
- **Information about enforcement**: The more likely a person perceives a police stop to occur, the more often the person decides against driving under influence. By an increase in media coverage about changes in enforcement practices and the effectiveness of enforcement strategies, the deterring effect of police enforcement can be further enhanced (Krisman & Schöch, 2011).
- **Information about sanctions**: Dissemination activities should explicitly address the consequences that are to be expected in the case of drug offences because subjects are often not aware of the different sanctioning stages according to the StVG[2], the StGB[3], and the FeV[4], respectively.
- **Scientific-based information**: It is important to design media activities that provide information about sanctions and enforcement with a scientifically based foundation. By doing so the social acceptance and public awareness of the measures might increase much more than in the cases where the reasons for the measures remain concealed (Krisman & Schöch, 2011).

[2] Straßenverkehrsgesetz: German Road Traffic Act
[3] Strafgesetzbuch: German Penal Code
[4] Fahrerlaubnisverordnung: German Driver Licensing Act

- **Information harmonised with characteristics of target-group**: Campaigns should address the personal needs of the recipient and should provoke emotions to increase the willingness of the recipient to seriously consider the safety topic in question (Gelau & Pfafferott, 2009). The present piece of work provides characteristics of persons at risk of driving under influence. From this knowledge suggestions for designing prevention measures can be deduced.

Through the present study it was possible to create a database for not only quantifying the drug driving prevalence, but also for analysing mediating and modifying factors that serve as major input on rehabilitation and prevention. Collecting data about drug use and driving over a multi-week time period, enabled the identification of behavioural patterns that help to better understand the phenomenon of drug driving. Furthermore, an attempt was made to find person-related characteristics, like personality variables and the social context of a person, that explain why a person uses drugs or drives under influence and another person does not. All in all, the present study provides a very large amount of information on understanding drug use and driving under influence of psychoactive substances. The new methodological approach of collecting data through a repeated-entry diary technique by using smartphones as study devices has proved to be a promising method and should serve as a standard to which future studies should aspire.

2. Introduction

One objective of the DRUID project is to identify characteristics of drug impaired drivers. This investigation is aimed at giving recommendations for designing campaigns to prevent driving under influence, for designing documents and brochures for the dissemination of relevant information, and for identifying new, effective ways to communicate with target groups. The present study – placed within Work Package 2 – provides prevalence rates for driving under the influence of alcohol and cannabis in the German driving population and information about situational and person-related characteristics of drug driving and drug drivers, respectively.

Prevalence rates estimated by the survey results and related situational factors of drug driving were reported in Walter et al. (2011). The prevalence for THC-positive drives in Germany was estimated to be 0.14% (95% CI: 0.09% - 0.2%)[5]. For the 18-24-year-old German driver population a prevalence for alcohol-positive drives of 1.57% (95% CI: 0.52% - 2.7%) and 3.3% (95% CI: 1.63% - 5%) for 25-39-year-olds was found[6]. Influencing factors are the perceived risk of being stopped by the police, the distance, the availability of alternative modes of transportation, and the presence of companions. The higher a person rates the likelihood of being stopped by the police, the more often the person decides against drug driving. Moreover, driving under influence occurs less frequently the longer the distance is that needs to be travelled. In rural areas and bigger cities the probability of driving under influence increases compared to smaller cities. In smaller cities the persons can walk or use the bike to cover the rather short distances. Even if in bigger cities the availability of public transport is generally high, this mode of transportation is limited especially at times when drug driving is most prevalent, i.e. at night and on weekends. The results also suggest that female companions lower the probability of drives under influence, especially when the driver is male.

Furthermore, it was shown that a striking predictor for frequent drug driving and highly impaired driving in general is a high consumption frequency. Thus, prevention strategies that focus on consumption indirectly have a positive effect on drug driving. If persons most at risk alter their consumption behaviour to moderate substance use, the probability that this person drives under influence naturally decreases. So, in the present report not only characteristics of drug drivers are presented but also characteristics of persons who consume drugs compared to persons who do not consume drugs. By identifying attributes associated with drug use and drug driving, persons who should be addressed by campaigns can be described according to their personal and social context, and useful information for prevention can be derived.

[5] THC blood plasma level≥1ng/ml, drug combinations included.
[6] BAC≥0.01%, drug combinations included.

3. Results

3.1 Mental diseases

To get information about the subjects' psychological problems the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) was conducted (Wittchen et al., 1997). The DSM-IV is the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders of the American Psychiatric Association (APA, 1994; German: Saß, Wittchen & Zaudig, 1996). Axis I disorders include the following major mental disorders: Substance Use Disorders, Anxiety Disorders, Eating Disorders, Mood Disorders, Somatoform Disorders, Psychotic Disorders, and Adjustment Disorder. Furthermore, information about any past or current diagnosis of Attention Deficit and Hyperactivity Disorder (AD(H)D) or Borderline Personality Disorder was received by the subjects.

3.1.1 Overview

Figure 1 shows the lifetime prevalence of the main mental disorders estimated from the study sample (Dydd) compared with prevalence rates derived from other studies (MFS, NEMESIS, cited in Meyer, Rumpf, Hapke, Dilling, & John, 2000; Tacos, Meyer et al., 2000). To account for differences according to gender and study group, the prevalence rates for males and females within the sample of the present study were averaged per study group and then multiplied by the proportion of users and controls, respectively, within the 18-39-year-old German population[7]. The two calculated values (proportion of users' and controls' prevalence rate) were then added for each disorder. Almost all prevalence rates estimated by this calculation were higher than within the three other studies (MFS, NEMESIS, Tacos). Three possible explanations can be suggested for this discrepancy:

1. Age and Time-effect: All other studies queried persons up to an age of 64/65 and were conducted 10 to 20 years ago, whereas the sample of the present study only comprises of subjects who are aged 18 to 39 at present. According to Kessler et al. (2005), the lifetime prevalence estimates of mental disorders are higher in recent cohorts than in earlier cohorts.
2. Setting-effect: Within the present study a lot of attention was paid to maintain an open and friendly relationship with the subjects by in-depth face-to-face survey sessions. Moreover, the setting was not a conventional clinical setting. Thus, the subjects might have talked more freely about their problems compared to more anonymous settings. Therefore, the well-known bias against reporting embarrassing behaviours reported by Cannell (cited in Kessler et al., 2005) might be lower within the present study.
3. Population-effect. While all other studies drew their samples by random sampling (N_{MFS}=483; $M_{NEMESIS}$=7,076; N_{Tacos}=4,075), the present study recruited the subjects by media campaigns and word-of-mouth-recommendations (N_{Dydd}=295). Thus, the sam-

[7] Prevalence for users (inclusion criteria: regular drug use, i.e. more than three times in four weeks) within the 18-39-year-old German population: 2.8%
Prevalence for controls: 97.8%

ple could selectively consist of people who are more interested in psychological research and this in turn could be due to a higher proportion of psychological problems within the sample than on average.

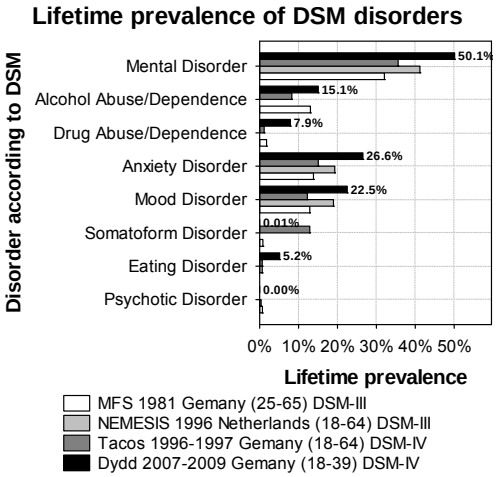


Figure 1: Lifetime prevalence estimates for major mental disorders by the present study (Dydd 2007-2009) compared to other studies (MFS 1981, NEMESIS 1996, Tacos 1996-1997).

Independent from the question of representativeness of the estimated prevalence rates, it is possible to compare the user and the control population for differences concerning the number of diagnoses measured within the study (Substance Use Disorders excluded). The users (MD=1) were diagnosed with marginally more mental disorders than the controls (MD=0) (Figure 2).

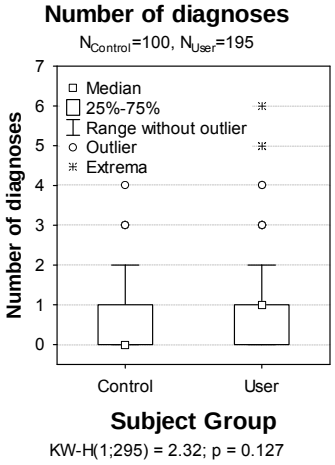


Figure 2: Median of number of diagnoses for users (N_{User}=195) and controls ($N_{Control}$=100) (25%-75%, range without outlier, outlier, extrema).

All mental disorders that were queried and the corresponding lifetime prevalence rates for users and controls of the present study are listed in Table 1. Clear differences between users and controls were found – by chi-square testing – for Alcohol, Cannabis, Multiple Drug and general Drug Abuse and Dependence. The users have higher prevalence rates in these categories. Moreover, significantly more users were diagnosed with having abused "other drugs" (i.e. sniffing agents, methylphenidate) as well as amphetamine. Additionally, for the following Substance Use Disorders marginally higher lifetime preva-

lence rates for the user population were found: Amphetamine Dependence, Sedatives Abuse, Opiates Dependence, Cocaine Dependence, and Hallucinogens Abuse.

Table 1: Mental disorders (Main categories and sub-category) queried in present survey, information source and prevalence within user (N_{User}=195) and control sub-group ($N_{Control}$=100) (in percent, ±0.95 CI).

Category	User	Control	chi-square (df=1)	p-value
Alcohol-use Disorders	**Percent (±0.95 CI)**	**Percent (±0.95 CI)**		
Alcohol Abuse	29.2% (22.8-35.6)	9% (3.4-14.6)	**17.49**	**0.000**
Alcohol Dependence	20.5 (14.8-26.2)	6% (1.3-10.7)	**12.1**	**0.001**
Drug use Disorders				
Drug Abuse	33.8% (27.2-40.5%)	3% (-)	**44.37**	**0.000**
Drug Dependence	61% (54.2-67.9%)	4% (0.2-7.8%)	**106.42**	**0.000**
Sedatives Abuse	2.1% (0.1-4%)	0% (-)	**3.34**	**0.068**
Sedatives Dependence	0.5% (-)	0% (-)	0.83	0.362
Cannabis Abuse	18.5% (13-23.9)	1% (-)	**25.04**	**0.000**
Cannabis Dependence	55.9% (48.9-62.9%)	4% (0.2-7.8%)	**91.47**	**0.000**
Amphetamine Abuse	6.7% (3.2-10.2%)	1% (-)	**5.94**	**0.015**
Amphetamine Dependence	1.5% (-)	0% (-)	**2.5**	**0.114**
Opiates Abuse	0% (-)	0% (-)		
Opiates Dependence	1.5% (-)	0% (-)	**2.5**	**0.114**
Cocaine Abuse	0.5% (-)	1% (-)	0.22	0.639
Cocaine Dependence	2.1% (0.1-4%)	0% (-)	**3.34**	**0.068**
Hallucinogens Abuse	2.1% (0.1-4%)	0% (-)	**3.34**	**0.068**
Hallucinogens Dependence	0.5% (-)	0% (-)	0.83	0.362
Multiple drug use Abuse	8.2% (4.4-12.1%)	0% (-)	**13.71**	**0.000**
Multiple drug use Dependence	14.9% (9.9-19.9%)	0% (-)	**25.61**	**0.000**
Others Abuse	3.1% (0.7-5.5%)	0% (-)	**5.03**	**0.025**
Others Dependence	0.5% (-)	0% (-)	0.83	0.360
Anxiety Disorders	22.6% (16.7-28.4%)	24% (15.6-32.4%)	0.08	0.782
Panic disorder and/or Agoraphobia	3.1% (0.7-5.5%)	9% (3.4-14.6%)	**4.5**	**0.034**
Panic disorder with Agoraphobia	1.5% (-)	3% (-)	0.67	0.413
Panic disorder without Agoraphobia	0% (-)	2% (-)	**4.35**	**0.037**
Agoraphobia without Panic Disorder	1.5% (-)	4% (0.2-7.8%)	1.62	0.203
Social Phobia	4.1% (1.3-6.9%)	6% (1.3-10.7%)	0.51	0.476
Specific Phobia	11.3% 6.8-15.7%)	9% (3.4-14.6%)	0.37	0.541
Obsessive-Compulsive Disorder	1% (-)	3% (-)	1.44	0.230
Posttraumatic Stress Disorder	7.2% (3.6-10.8%)	6% (1.3-10.7%)	0.15	0.700
Generalized Anxiety Disorder	2.1% (0.1-4%)	1% (-)	0.48	0.489
Eating Disorders	4.6% (1.7-7.6%)	4% (0.2-7.8%)	0.06	0.806
Anorexia Nervosa	3.1% (0.7-5.5%)	2% (-)	0.31	0.580
Bulimia Nervosa	1.5% (-)	2% (-)	0.08	0.774
Mood Disorders	28.2% (21.9-34.5%)	21% (13-29%)	**1.84**	**0.175**
Major Depression	23.1% (17.2-29%)	19% (11.3-26.7%)	0.66	0.418
- Single Episode	13.3% (8.6-18.1%)	16% (8.8-23.2%)	0.38	0.538
- Recurrent Episodes	9.7% (5.6-13.9%)	3% (-)	**5.02**	**0.025**
Dysthymic Disorder	3.1% (0.7-5.5)	2% (-)	0.31	0.580
Bipolar Disorders	1.5% (-)	0% (-)	**2.5**	**0.114**
Hypomania	0.5% (-)	0% (-)	0.83	0.362
Somatoform Disorders	0.5% (-)	0% (-)	0.83	0.362
Somatisation Disorder	0% (-)	0% (-)		
Pain Disorder	0% (-)	0% (-)		
Hypochondria	0.5% (-)	0% (-)	0.83	0.362
Unspecific somatoform disorder	0% (-)	0% (-)		
Psychotic Disorders	0% (-)	0% (-)		
Adjustment Disorder	7.7% (4-11.4%)	5% (0.7-9.3%)	0.8	0.373
AD(H)S	8.7% (4.8-12.7%)	0% (-)	**14.6**	**0.000**
Borderline	1.5% (-)	0% (-)	**2.5**	**0.114**

With respect to Anxiety Disorders controls have or had slightly more Panic Disorders without Agoraphobia. For Mood Disorders a marginally significant difference was found. While the prevalence of a Major Depression in general does not differ between users and controls, users have more Recurrent Episodes and marginally more Bipolar Disorders (i.e. Bipolar II Disorder, Cyclothymia). Furthermore, the users stated having more AD(H)D diagnoses and having been slightly more often diagnosed with Borderline Personality Disorder.

3.1.2 Substance use Disorder

According to DSM-IV, Substance Dependence is defined as a maladaptive pattern of substance use leading to clinically significant impairment or distress, as manifested by three (or more) of the following criteria, occurring any time in the same 12-month period (APA, 1994):

- The substance is often taken in larger amounts or over a longer period than intended (*Loss of control*).
- There is a persistent desire or unsuccessful effort to cut down or control substance use (*Desire to change*)
- A great deal of time is spent in activities necessary to obtain the substance, use the substance, or recover from its effects (*Time costs*).
- Important social, occupational, or recreational activities are given up or reduced because of substance use (*Neglect of other activities*).
- The substance use is continued despite knowledge of having a persistent physical or psychological problem that is likely to have been caused or exacerbated by the substance (e.g. current cocaine use despite recognition of cocaine-induced depression or continued drinking despite recognition that an ulcer was made worse by alcohol consumption) (*Consumption despite health problems*).
- Tolerance, as defined by either of the following: (a) A need for markedly increased amounts of the substance to achieve intoxication or the desired effect or (b) Markedly diminished effect with continued use of the same amount of the substance (*Tolerance*).
- Withdrawal, as manifested by either of the following: (a) The characteristic withdrawal syndrome for the substance or (b) The same (or closely related) substance is taken to relieve or avoid withdrawal symptoms (*Withdrawal*).

According to DSM-IV, Substance Abuse is defined as a maladaptive pattern of substance use leading to clinically significant impairment or distress as manifested by one (or more) of the following criteria, occurring within a 12-month period (APA, 1994):

- Recurrent substance use resulting in a failure to fulfil major role obligations at work, school, or home (such as repeated absences or poor work performance related to substance use; substance-related absences, suspensions, or expulsions from school; or neglect of children or household) (*Neglect of duties*).
- Recurrent substance use in situations in which it is physically hazardous (such as driving an automobile or operating a machine when impaired by substance use) (*Endangerment*).
- Recurrent substance-related legal problems (such as arrests for substance related disorderly conduct) (*Legal problems*).

- Continued substance use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of the substance (e.g. arguments with spouse about consequences of intoxication and physical fights) (*Consumption despite social problems)*.

The actual consumed amount of the substance is not relevant for diagnosing Substance Abuse or Dependence according to DSM-IV. The focus lies on the clinically significant impairment or distress caused by the substance use. Moreover, when plotting the outcome of the SCID-I for current substance use by the consumption groups of the main substances used[8], a clear relation between consumption intensity and the current diagnosis becomes obvious (Figure 3). The more one consumes, the more likely Dependence and Abuse are diagnosed. The differences between the substances cannot be interpreted because the classifications of *moderate*, *heavy,* and *excessive consumption* are substance-specific (e.g. moderate cannabis use≤1 unit/day versus moderate use of hard drugs≤2 episodes/month)[9].

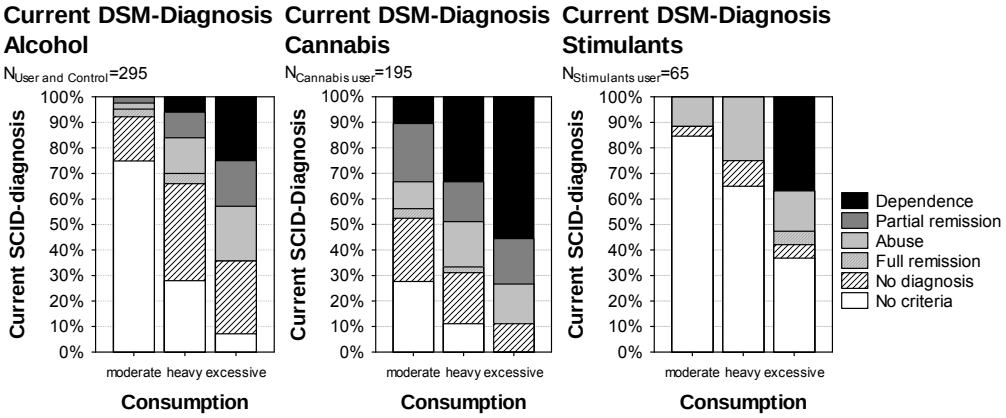


Figure 3: Percent of current diagnoses of Abuse, Dependence (Dependence, Partial remission, Full remission) and not fully diagnosed Abuse/Dependence (No diagnosis) versus no fulfilment of any criteria (No criteria) for alcohol ($N_{User\ and\ Control}$=295), cannabis ($N_{Cannabis\ user}$=195) and stimulants ($N_{Stimulants\ user}$=65).

Withdrawal symptoms most often occurred in the case of cannabis dependence (Figure 4, left). The symptoms that were named most often were sleeplessness, restlessness, and bad temper. Subjects who were diagnosed with alcohol dependence always stated having developed an alcohol *tolerance* and spending large amounts of time on drinking alcohol or recovering from its effects (*Time costs*). A lot of subjects dependent on cannabis or stimulants stated having a persistent desire to cut down or control substance use but fail to do so (*Desire to change*). Only 15% of all alcohol dependent subjects made this confession. Concerning Substance Abuse no differences were found regarding the substance that was abused (Figure 4, right).

[8] For stimulants an interview outcome with any fulfilled criteria for current Multiple Drug Use (Dependence, partial remission, abuse, full remission, no diagnose) was also taken into account if one substance currently used was a stimulant (defined as Amphetamine, Ecstasy, Cocaine) (N=14 out of 23).

[9] Alcohol: Moderate use (N=167): ≤24 g/day (male), ≤12 g/day (female);
Heavy use (N=100): >24-60 g/day (male), >12-40 g/day (female);
Excessive use (N=28): >60 g/day (male), >40 g/day (female)
Cannabis: Moderate use (N=105): >0-<1 unit/day; Heavy use (N=45):1-<2 units/day;
Excessive use (N=45): ≥2 units/day
Stimulants: Moderate use (N=26): >0-≤2 episodes/month; Heavy use (N=20): ≤6 episodes/month;
Excessive use (N=19): >6 episodes/month

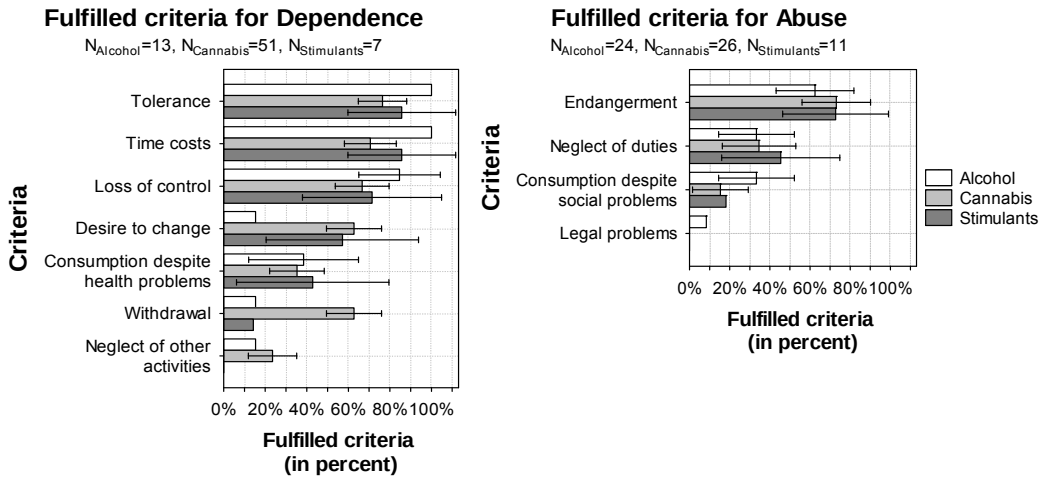


Figure 4: Fulfilment of criteria in the case of a Dependence diagnosis ($N_{Alkohol}$=13, $N_{Cannabis}$=51, $N_{Stimulants}$=7; left) and in the case of an Abuse diagnosis ($N_{Alkohol}$=24, $N_{Cannabis}$=26, $N_{Stimulants}$=11, right) (in percent, ±0.95 CI).

All users were asked if they intend to reduce or stop drug consumption in the near or distant future. If so, they had to indicate to which drug the intention refers (*hard drugs*[10], *alcohol*, *and/or cannabis*). Highly involved drug users are more willing to reduce/quit consumption than users whose consumption intensity is rather low (Figure 5). The effect is significant for *hard drugs*, *alcohol,* and *cannabis* (Table 2). The difference between the drugs cannot be interpreted because the classifications of *moderate*, *heavy,* and *excessive consumption* are substance-specific (e.g. moderate cannabis use≤1 unit/day versus moderate use of hard drugs≤2 episodes/month)[11].

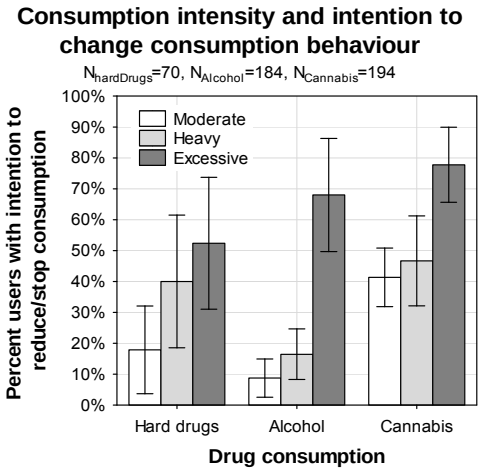


Figure 5: Consumption intensity and percentage of subjects who intended to reduce/stop consumption for moderate, heavy, and excessive users of hard drugs, alcohol, and cannabis ($N_{hardDrugs}$=70, $N_{Alcohol}$=184, $N_{Cannabis}$=194).

[10] Use of illegal drugs except cannabis and/or use of non-prescribed medicines.
[11] Hard drugs: Moderate use (N=28): >0-≤2 episodes/month; Heavy use (N=20): ≤6 episodes/month; Excessive use (N=22): >6 episodes/month;
Alcohol: Moderate use (N=80): >0-≤24 g/day (male), >0-≤12 g/day (female);
Heavy use (N=79): >24-60 g/day (male), >12-40 g/day (female);
Excessive use (N=25): >60 g/day (male), >40 g/day (female);
Cannabis: see footnote 9 (Page 13).

Table 2: Percentage (±0.95 CI) and statistics of users who intended to reduce/stop consumption ($N_{hardDrugs}$=70, $N_{Alcohol}$=184, $N_{Cannabis}$=194).

	Perc.$_{Mode.}$ (±0.95 CI)	Perc.$_{Heavy}$ (±0.95 CI)	Perc.$_{Exce.}$ (±0.95 CI)	chi-square (df)	p-value
Hard drugs	17.9% (3.7-32%)	40% (18.5-61.5%)	52.38% (31-73.7%)	6.9 (2)	0.032
Alcohol	8.8% (2.6-14.9%)	16.5% (8.3-24.6%)	68% (49.7-86.3%)	42.77 (2)	0.000
Cannabis	41.3% (31.9-50.8%)	46.7% (32.1-61.2%)	77.8% (65.6-89.9%)	17.13 (2)	0.000

3.2 Consumption patterns

A direct influence of the consumption intensity on driving under influence could be demonstrated by the present study and was reported in Walter et al., 2011. The more one consumes, the more drives under influence the person commits. In this report a more precise description of the consumption pattern of the users shall be given. The analysis is conducted for the use of illegal substances and for alcohol consumption. The proportion of hours with substance use on weekends[12] compared to weekdays and the proportion of hours with substance use in the evenings/at nights[13] compared to at daytime was calculated per person and dichotomized by median-split. The median proportion of drug use on weekends is 41.4% (34.5-48.3%) and the median proportion of drug use in the evenings/at nights is 84.3% (79.2-89.4%). From this categorisation a contingency table was created (Table 3). It is hypothesised that users who mostly use drugs on weekends and mostly at night have the lowest proportion of drives under influence on all drives. The influence of the time of day is thought to be higher than the influence of the day of week. So, the proportion of drives under influence is supposed to increase according to the numbers of the different categories (1-4).

Table 3: Contingency table according to day (high proportion of substance use on weekends, low proportion of substance use on weekends) and time (high proportion of substance use in the evening/at night, low proportion of substance use in the evening/at night).

Consumption – Time and day		Weekend	
		High proportion	Low proportion
Evening/night	High proportion	1) Mostly on weekends and mostly at night	2) Often on weekdays and mostly at night
	Low proportion	3) Mostly on weekends and often during the day	4) Often on weekdays and often during the day

Figure 6 (left) shows the median proportion of drives under influence of illegal drugs for the above described categories 1-4. When users consume illegal drugs mostly on weekends and mostly at night (Category 1), they hardly ever commit drives under influence. The same holds true for those users who also use drugs often on weekdays but still mostly at night (Category 2). The highest proportion of drives under influence was found for users who have a relative high proportion of drug use on weekdays and during the day (Category 4), followed by those who consume drugs mostly on weekends, but relatively often during the day (Category 3). Correlating the proportion of drug use on weekends and the proportion of drug use in the evening/at night, respectively, with the proportion of drives under influence, results in a low negative correlation for the former (r=-0.2) and a medium negative correlation for the latter (r=-0.6). The group of users who restrict

[12] Weekend: all reported hours after 8:31pm on Fridays until 8:30pm on Sundays; Weekday: all remaining hours.
[13] Evening/night: all reported hours from 5:31pm until 5:30am; daytime: all remaining hours.

their consumption to weekends and evenings/nights (Category 1) makes up the greatest part of moderate drug users[14] (86.8%) (Figure 6, right). Quite a high proportion of excessive drug users (61.8%) can be found within the group of users who also use drugs during the day and during the week (Category 4). In the remaining two categories the proportion of heavy drug users is quite high (Category 2: 30.2%, Category 3: 29.5%)

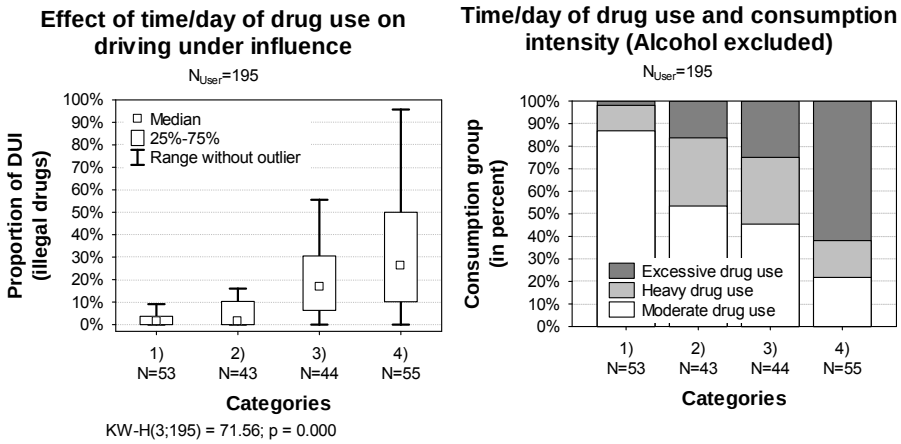


Figure 6: Effect of time/day of consumption on the proportion of drives under influence of illegal drugs of all drives (left; median, 25%-75%) and relation of time/day of consumption and consumption intensity (right; excessive drug use:≥2 units per day, heavy drug use: ≥1-2 units per day, moderate drug use:<1 unit per day) (N_{User}=195).

The median proportion of alcohol use on weekends is 53% (47.1-58.9%) and the median proportion of alcohol use in the evenings/at nights is 92% (88.8-95.2%). Compared to cannabis use, alcohol consumption is more restricted to evenings/nights and weekends. Figure 7 (left) shows the median proportion of drives under influence of alcohol for the above described categories 1-4. The effect of time of alcohol use (evening/night versus daytime) and day of alcohol use (weekday versus weekend) on the proportion of drives under alcohol is not as profound as for cannabis. Nevertheless, the effect is significant. The lowest proportion of drives under the influence of alcohol was found for users who consume alcohol mostly on weekends and mostly at night (Category 1). The highest proportion of drives under influence was found for users who often drink alcohol on weekdays and during the day (Category 4), followed by those who drink alcohol mostly on weekends but often during the day (Category 3) and those who drink alcohol often on weekdays and mostly at night (Category 2). Correlating the proportion of alcohol consumption on weekends and the proportion of alcohol consumption in the evening/at night, respectively, with the proportion of drives under influence results in low negative correlations (r=-0.2). So, compared to cannabis use, the time of alcohol use has a less profound influence on the frequency of drives under influence, while the influence of the day of substance use is comparably. The group of users who restrict their consumption to weekends and evenings/nights (Category 1) consists to 100% of moderate (86.8%) and heavy users (13.2%) (Figure 7, right). In the remaining categories the proportion of moderate alcohol users decreases (Category 2: 52.2%, category 3: 43.5%, category 4: 37.7%), whereas the proportion of heavy and excessive users increases (Category 2: 47.8%, category 3: 56.5%, category 4: 62.3%).

[14] Use of illegal drugs and/or non-prescribed medicines (Alcohol excluded).

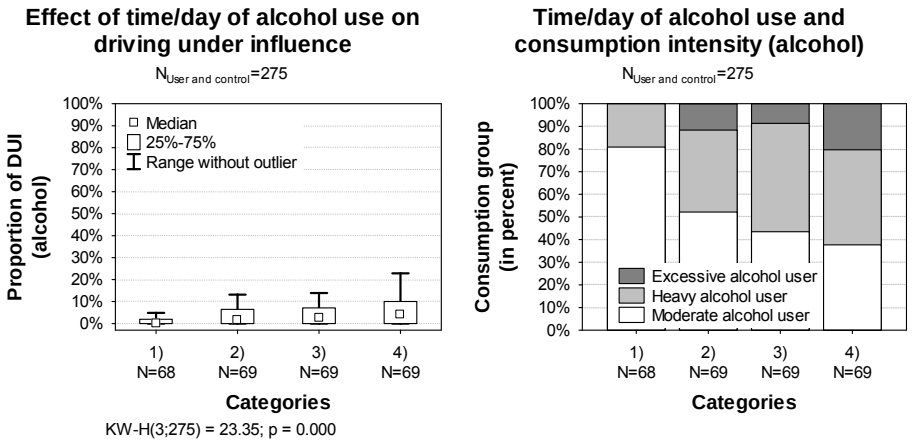


Figure 7: Effect of time/day of consumption on the proportion of drives under influence of alcohol of all drives (left, median, 25%-75%) and relation of time/day of consumption and consumption intensity (right; excessive alcohol use: >60 g/day (male), >40 g/day (female); heavy alcohol use: >24-60 g/day (male), >12-40 g/day (female); moderate alcohol use: >0-≤24 g/day (male), >0-≤12 g/day (female)) ($N_{User\ and\ control}$=275).

3.3 Art2020

The psychometric performance of driver aptitude in accord with the German Driver's Licence Ordinance ("Fahrerlaubnis-Verordnung", FeV), Annex 5 (Janker, 2009), and the "Guidelines for Expertise on Driver Aptitude" Chapter 2.5 ("Begutachtungs-Leitlinien zur Kraftfahrereignung"; Lewrenz, 2000) was assessed by the application of the computer-based Act & React Test System (ART) 2020 Standard test battery. A series of seven ART2020 tests was applied:

- **MAT** (Non-verbal intelligence test; Bukasa & Wenninger, 2001a): The test is a screening of logical reasoning, understanding of rules and causal relations.
- **Q1** (Test of attention under monotonous conditions; Bukasa & Wenninger, 2001b): The test measures continuity of attention regarding quantitative and qualitative aspects.
- **LL5** (Test for visual structuring ability; Bukasa & Wenninger, 2001c): The test examines dynamic perception functions in a complex visual environment under time pressure.
- **GEMAT3** (Visual memory test; Bukasa & Wenninger, 2001d): The test examines non-verbal short term recall functions.
- **PVT** (Test for sensorimotor coordination and peripheral perception ability; Bukasa, Piringer & Wenninger, 2004): The test examines eye-hand-foot coordination and peripheral perception in a dual task condition
- **SENSO** (Test for sensorimotor coordination; Bukasa, Piringer & Wenninger, 2003): The test records traffic-specific eye-hand-foot coordination under free choice and pre-given speed.
- **RST3** (Test for reactive stress tolerance; Bukasa & Wenninger, 2001e): The test measures resistance to work load determined by different speed levels and information processing complexity.

The applied tests can be assigned to the performance dimensions listed in the FeV (Table 4):

Table 4: Applied ART2020 tests and associated performance dimensions.

ART2020 tests and associated performance dimensions
- Coordination capacity: LL5, PVT, SENSO - Concentration and attention capacity: Q1 - Reaction capacity: RST3 - Stress resistance: RST3

The GEMAT3 and the MAT measure memory capacities and intelligence, respectively. These dimensions are not listed in the FeV. However, in Austria these tests are applied as standard test procedures when testing the psychometric performance of driver aptitude. In the framework of the present study they are relevant to detect potential cognitive deficits of long term drug users.

147 subjects in total went through the test battery. It was planned to analyse the effect of lifetime drug use (Control, LightUse, HeavyUse; groups described in Chapter 3.3.2) and acute cannabis intoxication (NoAcuteCann, AcuteCann; groups described in Chapter 3.3.1) on the performance of driver aptitude (in accord with the German Driver's Licence Ordinance). 15 subjects were excluded from analysis because of the following reasons:

1. Six controls did not completely go through all tests (two of them also reported a lifetime drug use of more than 40 times)
2. Seven controls reported a lifetime drug use of more than 40 times
3. One user reported a lifetime cannabis use of less than 40 times
4. One user did not deliver a urine sample

The final sample consisted of 132 subjects (N_{User}=90; $N_{Control}$=42). All users that were included into the analyses reported a lifetime cannabis use of more than 40 times.

The following parameters were analysed:

1) Percentage of subjects who failed the complete ART2020 test-battery and percentage of subjects who failed the single sub-tests (MAT, Q1, LL5, GEMAT3, PVT, SENSO, RST3): Scores were transformed into percentage values according to the reference sample. According to the "Guidelines for Expertise on Driver Aptitude" Chapter 2.5 ("Begutachtungs-Leitlinien zur Kraftfahrereignung"; Lewrenz, 2000), a sub-test is failed if the subject reached a percentage value below 16. The whole battery is failed if at least one sub-test was failed.
2) Number of succeeded tests
3) Mean raw scores for each parameter of the different sub-tests (MAT, Q1, LL5, GEMAT3, PVT, SENSO, and RST3). Multivariate Analyses of Variance were applied for each test. If the global result was significant or marginally significant, t-tests were applied afterwards. Because of this hierarchical testing procedure, alpha-adjustment was not necessary. The SENSO consists of 17 parameters, the RST3 of 12 parameters, and both tests are run in three phases. The Multivariate Analyses of Variance were calculated for each phase separately.
4) Number of succeeded parameters.

3.3.1 Acute effects of cannabis

Either before or after the performance testing with the ART2020 a urine sample was collected. Of the controls who completed the ART2020 and were not excluded because of their lifetime drug use no one had a urine sample positive for the analysed substances ($N_{Control}$=42). Of the users who were included in the analysis (N_{User}=90) no one had a urine sample positive for opiates. Users with a urine sample positive for amphetamines or cocaine were excluded from the analysis of acute effects of cannabis (N=6). Because all users were regular cannabis users and a urine sample mainly measures the metabolites of cannabis, it is not surprising that of the remaining 84 users 77.4% (N=65) had a urine sample positive for cannabinoids. Only users with a positive urine sample on cannabis and a calculated BAC[15] of zero when being tested by the ART2020 were included (N=64). They were categorised according to whether or not the calculated THC blood plasma level at the time of being tested by the ART2020 was zero and above zero, respectively ($N_{NoAcuteCann}$=48, $N_{AcuteCann}$=16[16]).

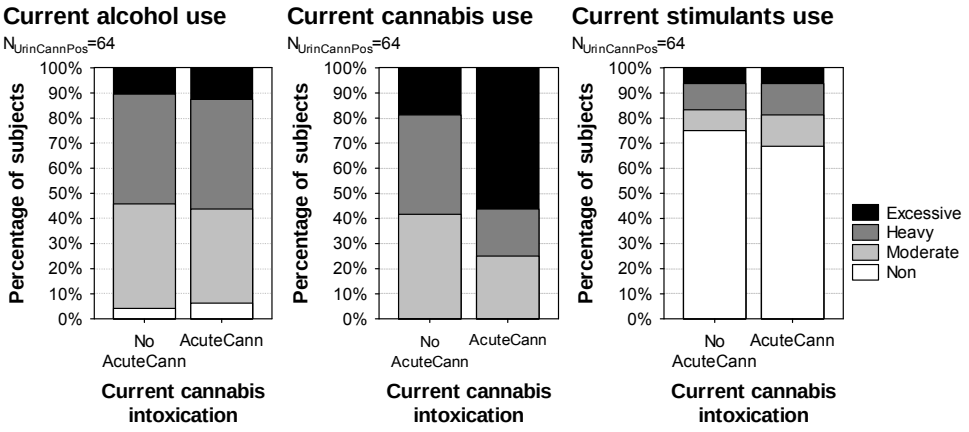


Figure 8: Percentage of non, moderate, heavy or excessive alcohol (left), cannabis (middle) and stimulants use (right) for acutely not intoxicated and acutely cannabis intoxicated users ($N_{NoAcuteCann}$=48, $N_{AcuteCann}$=16).

Table 5: Percentage of heavy and excessive substance use and statistics for acutely not intoxicated and acutely cannabis intoxicated users ($N_{NoAcuteCann}$=48, $N_{AcuteCann}$=16).

	Percentage of heavy and excessive users (analysis over all user categories)			
Current use	**Percent$_{NoAcuteCann}$ (±0.95 CI)**	**Percent$_{AcuteCann}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
Alcohol	54.2% (40.1%-68.3%)	56.3% (31.9%-80.6%)	0.2 (3)	0.977
Cannabis	58.3% (44.4%-72.3%)	75% (53.8%-96.2%)	7.87(2)	0.020
Stimulants	16.7% (6.1%-27.2%)	18.8% (-)	0.32 (3)	0.956

Users who were not acutely intoxicated by cannabis (*NoAcuteCann*) and those who were acutely intoxicated (*AcuteCann*) did not differ in their current consumption intensity concerning alcohol and stimulants (Figure 8, Table 5). Furthermore, their experience with drugs in general (lifetime drug use light or heavy, categories described in chapter 3.3.2) did not differ either. On the other hand, acutely cannabis intoxicated users were more often excessive cannabis users than those who were not acutely intoxicated by cannabis.

[15] The BAC and THC blood plasma calculation is described in chapter 10 in Walter et al. (2011).
[16] THC blood plasma level (in ng/ml): MEAN=5.51, MIN=0.14, $Q_{.25}$=1.06, MD=3.49, $Q_{.75}$=10.05, MAX=21.6.

Those users who were acutely intoxicated by cannabis while performing the ART2020 did not perform significantly worse than those users who were not acutely under influence (based on failure rates; Figure 9, Table 6). Concerning the Q1, the GEMAT3, the PVT, and the RST3 trends were found. Users who are acutely intoxicated tend to perform worse than those who are not under influence concerning the Q1, the GEMAT3, and the RST3, whereas not intoxicated users tend to perform worse in the PVT. With regards to the GEMAT3 it has to be kept in mind that only one person failed in total. The total number of succeeded tests did not differ between the analysed subject groups.

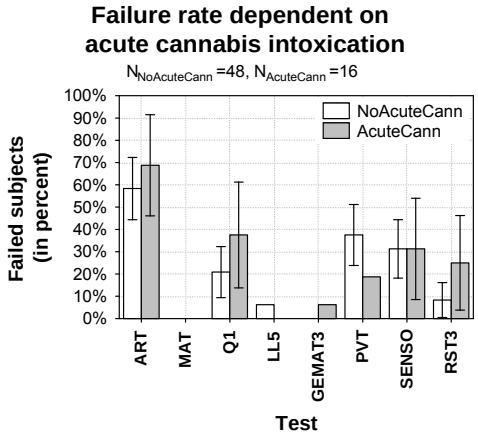


Figure 9: Failure rate in the whole test battery (ART) and the single sub-tests (MAT, Q1, LL5, GEMAT3, PVT, SENSO, RST3) dependent on acute cannabis intoxication ($N_{NoAcuteCann}$=48, $N_{AcuteCann}$=16) (in percent, ±0.95CI).

Table 6: Failure rate and statistics per test for users with and without acute cannabis intoxication ($N_{NoAcuteCann}$=48, $N_{AcuteCann}$=16).

Failure rate				
Test	**Percent$_{NoAcuteCann}$ (±0.95 CI)**	**Percent$_{AcuteCann}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
ART	58.3% (44.4%-72.3%)	68.8% (46%-91.5%)	0.56 (1)	0.455
MAT	0%	0%		
Q1	20.8% (9.3%-32.3%)	37.5% (13.8%-61.2%)	1.68 (1)	0.195
LL5	6.3% (-)	0% (-)	1.77 (1)	0.183
GEMAT3	0%	6.3% (-)	2.82 (1)	0.093
PVT	37.5% (23.8%-51.2%)	18.8% (0%-37.9%)	2.05 (1)	0.152
SENSO	31.3% (18.1%-44.4%)	31.3% (8.5%-54%)	0 (1)	1
RST3	8.3% (0.5%-16.2%)	25% (3.8%-46.2%)	2.7 (1)	0.101

When applying the evaluation procedure recommended by the "Guidelines for Expertise on Driver Aptitude" ("Begutachtungs-Leitlinien zur Kraftfahrereignung"; Lewrenz, 2000), the sensitivity and specificity of the ART2020 test battery was calculated as follows:

		Acute cannabis intoxication		
		AcuteCann	NoAcuteCann	
Test battery	failed	11 (a)	28 (b)	a+b
	passed	5 (c)	20 (d)	c+d
		a+b	b+d	

Sensitivity: $\frac{a}{a+b}$ **= 68.8%**

Specificity: $\frac{d}{b+d}$ **= 41.7%**

The **sensitivity** of a test measures the proportion of actual positives that are correctly identified as such (in the present example the percentage of acutely intoxicated subjects who failed the test battery). The **specificity** of a test measures the proportion of negatives that are correctly identified (in the present example the percentage of sober subjects who passed the test battery). Both characteristic values are rather low (for the whole test battery as well as for the sub-tests, the latter values are not listed here). So, the above reported results have to be interpreted with care.

The number of succeeded parameters (percentage value 16 or higher) did not differ between the analysed study groups. With respect to the raw scores of the single parameters only some differences could be isolated (Table 7, significant results and trends)[17]. In the Q1 those who were acutely intoxicated tended to have a higher number of processed items but also have a higher percentage of errors. The number of correct responses in the GEMAT3 differed significantly between the analysed subject groups. Acutely cannabis intoxicated users had less correct responses than those who were not acutely intoxicated. In phase 3 of the RST3 the intoxicated users made more mistakes accompanied by a tendency to have less correct responses. In phase 1 they tend to have less delayed reactions but also a higher percentage of errors.

Table 7: Mean scores and statistics of significant parameters for users with and without acute cannabis intoxication ($N_{NoAcuteCann}$=48, $N_{AcuteCann}$=16).

Parameter scores				
Test	**$Mean_{AcuteCann}$ (±0.95 CI)**	**$Mean_{NoAcuteCann}$ (±0.95 CI)**	**t**	**p-value**
Q1				
ProcessedItems	741.6 (678.3-804.9)	696.4 (665-727.8)	1.41	0.163
%Errors	2.4 (1.7-3)	1.7 (1.3-2.1)	1.82	0.074
GEMAT3				
CorrectResponses	20.8 (19.3-22.2)	22 (21.4-22.5)	-2.03	0.047
RST3				
%DelayedReactions1	0.8 (0.2-1.4)	1.4 (1-1.9)	-1.44	0.156
%Errors1	2.1 (1.1-3.1)	1.3 (1-1.7)	1.81	0.075
CorrectResponses3	102.7 (100.8-104.5)	104.3 (103.2-105.4)	-1.55	0.126
%Errors3	4.8 (3.2-6.4)	3 (2.4-3.7)	2.64	0.011

3.3.2 Long-term effects of drug use

To analyse the long-term effects of drug use on the performance in the ART2020, only users with a negative urine screening result for amphetamines, cocaine, and opiates, and users who were not acutely intoxicated by alcohol or cannabis (calculated BAC=0, negative urine result for cannabis or positive urine result for cannabis and a calculated THC blood plasma level of 0ng/ml) were included in the analysis. Furthermore, users with a negative drug screening result and a lower creatinine value than 20 dl/ml were excluded from analyses because a lowered creatinine level could implicate that the sample is diluted and a false negative outcome is likely to occur. So, the final sample size consisted of 42 controls and 64 users.

The users were further categorised into users with a light lifetime drug use ($N_{LightUse}$=46) and users with a heavy lifetime drug use ($N_{HeavyUse}$=18) according to the user classes

[17] A list of all parameters of each test together with the corresponding failure rates according to the "Guidelines for Expertise on Driver Aptitude" Chapter 2.5 ("Begutachtungs-Leitlinien zur Kraftfahrereignung"; Lewrenz, 2000) can be found in the appendix (Chapter 7).

defined in Walter et al. (2011; Table 8, LightUse: CanOnly and CanOthLow, HeavyUse: CanOthHigh and CanHer).

Table 8: User classes based on frequency of previous drug consumption and number of users in each class and category, respectively (N_{User}=64).

			Lifetime drug consumption			N_{User}=64
Category	**User class**	**Class description**	**Cann**	**Stim/Hallu/Oth**	**Her**	
LightUse	CanOnly	Cannabis only	**>40x**	0x	0x	17
	CanOthLow	Cannabis and sometimes stimulants and/or sometimes hallucinogens and/or sometimes other drugs and/or sometimes high potential drugs	**>40x**	<10x	<10x	29
HeavyUse	CanOthHigh	Cannabis and oftentimes stimulants and/or oftentimes hallucinogens and/or oftentimes other drugs and/or sometimes high potential drugs	**>40x**	**>10x**	<10x	16
	CanHer	Cannabis and oftentimes high potential drugs	**>40x**	not specified	**>10x**	2

Users examined here (*LightUse, HeavyUse*) show higher current alcohol consumption than controls (Figure 10, left; Table 9). Whether users have a light or heavy lifetime drug use history does not affect their current cannabis consumption (Figure 10, middle). On the other hand, users with heavy lifetime drug consumption were currently more often excessive and heavy stimulants users than those with a light lifetime drug use (Figure 10, right).

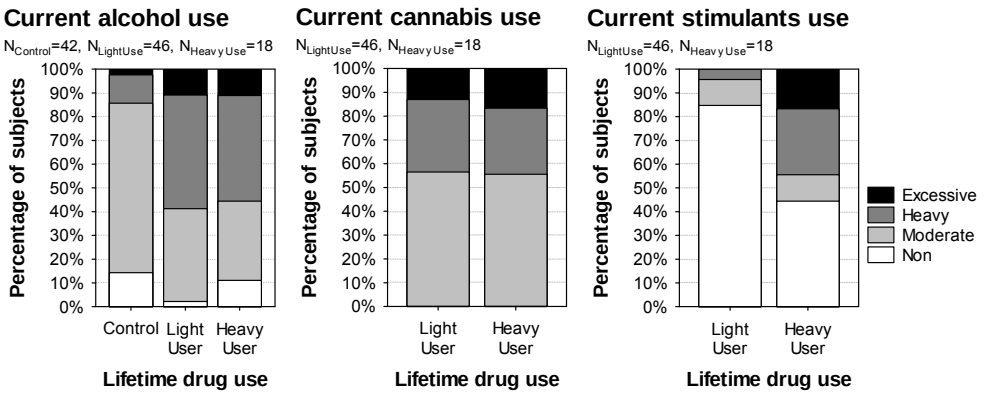


Figure 10: Percentage of non, moderate, heavy or excessive alcohol (left), cannabis (middle) and stimulants use (right) for controls and users with a light and heavy lifetime drug use ($N_{Control}$=42, $N_{LightUse}$=46, $N_{HeavyUse}$=18).

Table 9: Percentage of heavy and excessive substance use and statistics for controls and users with a light and heavy lifetime drug use ($N_{Control}$=42, $N_{LightUse}$=46, $N_{HeavyUse}$=18).

Percentage of heavy and excessive users (analysis over all user categories)					
Current use	**$Perc_{Control}$ (±0.95 CI)**	**$Perc_{LightU.}$ (±0.95 CI)**	**$Perc_{HeavyU.}$ (±0.95 CI)**	**chi-squ. (df)**	**p-value**
Alcohol	14.3% (4.5%-24.1%)	58.7% (44.3%-73.1%)	55.6% (34.9%-80.9%)	24.03 (6)	0.001
Cannabis		43.5% (30.2%-56.8%)	44.4% (21.4%-62.8%)	0.15 (2)	0.928
Stimulants		4.3% (-)	44.4% (21.4%-62.8%)	16.41 (3)	0.001

Those users who have a heavy or light lifetime drug use did not perform significantly worse on the ART2020 than controls (based on failure rates; Figure 11, Table 10). A very slight effect was found for the PVT which suggests that more heavy drug users failed the

test than light users and controls. The total number of succeeded tests did not differ between the analysed subject groups.

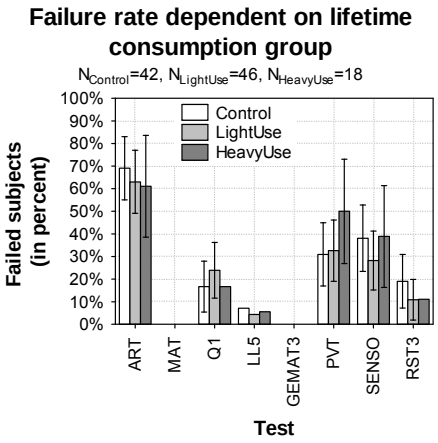


Figure 11: Failure rate in the whole test battery (ART) and the single sub-tests (MAT, Q1, LL5, GEMAT3, PVT, SENSO, RST3) dependent on lifetime consumption group ($N_{Control}$=42, $N_{LightUse}$=46, $N_{HeavyUse}$=18) (in percent, ±0.95CI).

Table 10: Failure rate and statistics per test for users (heavy or light use) and controls ($N_{Control}$=42, $N_{LightUse}$=46, $N_{HeavyUse}$=18).

Failure rate					
Test	**$Perc_{HeavyU.}$ (±0.95 CI)**	**$Perc_{LightU.}$ (±0.95 CI)**	**$Perc_{Control}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
ART	61.1% (38.6%-83.6%)	63% (49.1%-77%)	69% (55.1%-83%)	0.5 (2)	0.778
MAT	0%	0%	0%		
Q1	16.7% (-)	23.9% (11.6%-36.2%)	16.7% (5.4%-27.9%)	0.85 (2)	0.652
LL5	5.6% (-)	4.3% (-)	7.1% (-)	0.32 (2)	0.852
GEMAT3	0%	0%	0%		
PVT	50% (26.9%-73.1%)	32.6% (19.1%-46.2%)	31% (17%-44.9%)	2.12 (2)	0.346
SENSO	38.9% (16.4%-61.4%)	28.3% (15.2%-41.3%)	38.1% (23.4%-52.8%)	1.19 (2)	0.551
RST3	11.1% (-)	10.9% (1.9%-19.9%)	19% (7.2%-30.9%)	1.34 (2)	0.510

The **sensitivity** (in the present example the percentage of heavy lifetime drug users who failed the test battery) and **specificity** (in the present example the percentage of controls who passed the test battery) that were calculated by the results of the present analysis of long-term effects of drug use are comparable to the ones reported in Chapter 3.3.1:

$$\textbf{Sensitivity: } \frac{a}{a+b} \textbf{ = 61.1\%}$$

$$\textbf{Specificity: } \frac{d}{b+d} \textbf{ = 31\%}$$

The ART2020 and the recommended evaluation procedure, respectively, do not seem to be an adequate measure to identify neither acute effects of cannabis intoxication nor long-term effects of drug use – as operationalised in the present study. It has to be kept in mind that the sample of the present study mainly consisted of cannabis users. Only two subjects surveyed in the present context were using heroin on a regular basis in their life.

The number of succeeded parameters (percentage value 16 or higher) did not differ between the analysed study groups. When analysing the raw scores of the parameters, some differences between the subject groups could be isolated (Table 11, significant

results and trends)[18]. In the MAT the controls had the most correct responses, followed by the light users. The lowest number of correct responses was found for the heavy users. In the LL5 heavy users had a lower number of processed items compared to light users and controls. The controls tend to have a higher percentage of errors compared to light users. Their percentage of errors was as high as that of the heavy users. The number of correct responses in the GEMAT3 tends to be different between the analysed subject groups. Users with a heavy lifetime drug use had less correct responses than those who have a light lifetime drug use and controls. In phase 1 of the RST3 the heavy users and the controls tend to make more mistakes compared to light users. In phase 2 the heavy users tend to have the fewest number of correct responses accompanied by the highest percentage of omissions.

Table 11: Mean scores and statistics of significant parameters for users with heavy and light lifetime drug use and controls ($N_{Control}$=42, $N_{LightUse}$=46, $N_{HeavyUse}$=18).

Parameter scores					
Test	**$Mean_{HeavyU.}$ (±0.95 CI)**	**$Mean_{LightU.}$ (±0.95 CI)**	**$Mean_{Control}$ (±0.95 CI)**	**F**	**p-value**
MAT					
CorrectResponses	10.6 (9.7-11.4)	11.8 (11.3-12.4)	12.4 (11.9-13)	6.84	0.002
LL5					
ProcessedItems	30.2 (28.2-32.1)	34.4 (33.1-35.7)	34.1 (32.8-35.4)	7.01	0.001
%Errors	2.6 (1.1-4.1)	2 (1.2-2.9)	3.5 (2.3-4.6)	2.14	0.113
GEMAT3					
CorrectResponses	21.3 (20.3-22.2)	22.3 (21.7-22.8)	22.4 (21.9-22.8)	2.86	0.062
RST3					
%Errors1	1.9 (0.8-3)	1.3 (1-1.7)	1.9 (1.4-2.5)	1.69	0.190
CorrectResponses2	97.4 (91.5-103.2)	102 (100.5-103.5)	101.2 (99.3-103.1)	2.94	0.057
Omissions2	8.2 (3-13.5)	4 (2.9-5)	4.5 (3.1-5.9)	3.81	0.025

3.4 Personality

The literature was reviewed for psycho-social factors to predict drug driving (Walter et al., 2011). Based on this literature review, it was decided to apply the following series of eight personality questionnaires:

- **NEO-FFI** – Personality[19] (Borkenau & Ostendorf, 1993)[20]: 'Neuroticism', 'Extraversion', 'Openness to experience', 'Agreeableness', 'Conscientiousness'
- **SSS** – Sensation-Seeking (Beauducel, Strobel & Brocke, 2003)[21]: 'Thrill and Adventure Seeking', 'Disinhibition', 'Experience Seeking', 'Boredom Susceptibility'
- **ADHDQ** – Attention Deficit and Hyperactivity Disorder in childhood (Zeberlein & Küfner, 2003): 'Distractibility', 'Inattention', 'Hyperactivity/Impulsivity', 'Psycho-social consequences', 'Drug effect on inattention and hyperactivity'
- **SPSRQ** – Sensitivity to Punishment and Sensitivity to Reward Questionnaire (Torrubia, Ávila, Moltó & Caseras, 2001): 'Sensitivity to Punishment', 'Sensitivity to Reward'

[18] A list of all parameters of each test together with the corresponding failure rates according to the "Guidelines for Expertise on Driver Aptitude" Chapter 2.5 ("Begutachtungs-Leitlinien zur Kraftfahrereignung"; Lewrenz, 2000) can be found in the appendix (Chapter 7).

[19] Even if there are no findings that indicate an association between drink and drug driving and the "Big Five" factors of personality, the corresponding questionnaire was applied to get information about broader personality dimensions.

[20] According to Costa and McCrae (1995).

[21] According to Zuckerman (1978).

- **UFB** – Social Competence (Ullrich & Ullrich, 1998): 'Fear of blame and criticism', 'Fear of contact to those of the opposite sex, fear of responsibility', 'Inability to set plans and set plans into motion' (originally positive scale, reversed polarity), 'Inability to say no', 'Feeling of self-blame in relation to their own actions as they relate to and affect others', 'Inappropriately exaggerated feelings of embarrassment'
- **IPC** – Control beliefs (Krampen, 1981): 'Internal control orientation', 'Powerful others control orientation', 'Chance control orientation'
- **SVF** – Stress-coping strategies (Erdmann & Janke, 2008): 'Compare with others', 'Guilt defence', 'Distraction from situation', 'Substitutional satisfaction', 'Situational control', 'Reaction control', 'Positive self-instruction', 'Need for social support', 'Avoidance', 'Flight tendency', 'Rumination', 'Resignation', 'Self-accusation', 'Self-medication/alcohol use'
- **VIP** – Traffic-specific item pool[22] (Schmidt & Piringer, 1986): 'orientation at social expectations', 'uncritical self-perception', 'aggressive interaction', 'emotional relationship to car and driving'.

The following study groups were analysed for differences:

- Users versus controls and
- Users who committed many drives under influence (drives under the influence of illegal drugs and/or drives with a BAC above the legal limit) versus users who committed no/some drives under influence (HighDUI versus LowDUI; categorisation by median-split)

The scores of each scale were transformed into T-values according to the reference sample. If differences depending on age and gender are assumed, T-values for males/females and different age categories were available and used. For the questionnaire Attention Deficit and Hyperactivity Disorder in childhood (ADHDQ) given percentiles were used because T-values were not available (*<Perc25*, *Perc25-Perc50*, *>Perc50*). Multivariate Analyses of Variance were applied for each questionnaire. If the global result was significant or marginally significant, t-tests were applied afterwards (for ADHDQ: M-L Chi-square). To make a statement about the size of significant effects, effect sizes for t-tests ($\hat{\delta}$) and χ^2- tests (w), respectively, were calculated according to the following formula (Bortz & Döring, 2006).

$\hat{\delta} = t \cdot \sqrt{\frac{n_A + n_B}{n_A \cdot n_B}}$	n_A=Sample size of group A, n_B=Sample size of group B **Trivial effect**: <0.2 **Small effect**: 0.2-<0.5 **Medium effect**: 0.5-<0.8 **Strong effect**: ≥0.8
$w = \sqrt{\frac{\chi^2}{n}}$	n=Sample size **Trivial effect**: <0.1 **Small effect**: 0.1-<0.3 **Medium effect**: 0.3-<0.5 **Strong effect**: ≥0.5

Figure 12: Calculation and interpretation of effect sizes for t-test and χ^2-test, respectively (Bortz & Döring, 2006).

[22] As a measurement of traffic-specific personality dimensions.

3.4.1 NEO-FFI

For the scales of the NEO-FFI (Neuroticism, Extraversion, Openness to experience, Agreeableness, and Conscientiousness) no presumptions about the differences between the analysed subject groups were made. Compared to the controls, users scored lower on the scale 'Conscientiousness' and higher on the scale 'Openness to experience' (scales are described below the table) (Table 12; only significant results). Regarding the scale 'Conscientiousness', the effect can be described as medium, whereas the effect regarding the scale 'Openness to experience' is small. No difference was found for those users who drive a lot under influence and those who commit fewer drives under influence.

Table 12: NEO-FFI: Presumptions and significant test results.

Personality Questionnaire:					
NEO-FFI – Presumptions	no presumption				
Significant test result:	**$Mean_{User}$**	**$Mean_{Control}$**	**t**	**p-value**	**ES**
Openness to experience	49.86	45.84	3.48	0.001	0.4
Conscientiousness	47.93	53	-3.94	0.000	0.5

Openness to experience

- Persons with a high score have a lively fantasy, have an accented sense of own feelings – of positive as well as negative feelings, are highly interested in personal as well as public matters; are eager for knowledge, are intellectual, imaginative, happy to try out new things, artistically minded; are willing to question existing norms and to respond to new social, ethical, and political ideals; are independent in their judgments, behave unconventionally, try out new ways of thinking and acting, prefer variation
- Persons with a low score tend to behave conventional, tend to have conservative attitudes; prefer familiar things to new things, emotional reactions are rather subdued

Conscientiousness

- Persons with a high score describe themselves as focused, ambitious, hardworking, persistent, systematic, strong-minded, disciplined, reliable, punctual, tidy, accurate, fussy; have an exaggerated high level of aspiration, a compulsive tidiness, are workaholics
- Persons with a low score describe themselves as careless, phlegmatic, and inconsistent; pursue goals with low commitment

3.4.2 Sensation Seeking (SSS)

For the Sensation Seeking Scales (SSS - Thrill and Adventure Seeking, Disinhibition, Experience Seeking, and Boredom Susceptibility) it was presumed that users have higher scores on all scales compared to controls, especially those who commit many drives under influence. A strong effect was found for the scale 'Experience Seeking', a medium effect for the scale 'Disinhibition', and a small effect for the 'Thrill and Adventure Seeking' scale (Table 13). As presumed, the users scored higher on these scales compared to the controls. No difference was found for those users who drive a lot under influence and those who commit rather few drives under influence.

Table 13: SSS: Presumptions and significant test results.

Personality Questionnaire:					
SSS – Presumptions	User/HighDUI high on all scales				
Significant test results:	**$Mean_{User}$**	**$Mean_{Control}$**	**t**	**p-value**	**ES**
Thrill and adventure seeking	57.43	53.83	3.37	0.001	0.4
Disinhibition	59.66	53.59	5.62	0.000	0.7
Experience Seeking	57.98	49.43	7.9	0.000	1.0

Thrill and Adventure Seeking

- Persons with a high score tend to have diverse, new, complex, and intense experiences, accept psychological, social, and legal risks in return

Disinhibition

- Persons with a high score tend to behave socially and sexually disinhibited

Experience Seeking
- Persons with a high score try to gather new experiences through a non-conform lifestyle and travels

3.4.3 Sensitivity to Punishment and Sensitivity to Reward (SPSRQ)

For the SPSRQ ('Sensitivity to Punishment', 'Sensitivity to Reward') it was presumed that, compared to controls, users would have lower scores on the scale 'Sensitivity to Punishment' and higher ones on the scale 'Sensitivity to Reward', and again especially those who commit many drives under influence. A medium effect was found for the scale 'Sensitivity to Reward'. Users have higher scores than controls (Table 14). For the difference between the 'Sensitivity to Reward' scale and the 'Sensitivity to Punishment' scale a small effect was found. Both effects are consistent with the presumptions. No difference was found for those users who drive a lot under influence and those who commit rather few drives under influence.

Table 14: SPSRQ: Presumptions and significant test results.

Personality Questionnaire:					
SPSRQ – Presumptions	User/HighDUI high on S. t. Reward and low on S. t. Punishment				
Significant test result:	**$Mean_{User}$**	**$Mean_{Control}$**	**t**	**p-value**	**ES**
Sensitivity to Reward	53.11	48.64	3.76	0.000	0.5
S. t. Reward – S. t. Punishment	11.3	6.48	3.12	0.002	0.4

Sensitivity to Punishment
- Persons with a high score are motivated in response to cues for punishment and cues to frustrated non-reward

Sensitivity to Reward
- Persons with a high score are motivated in response to cues for reward and cues for omission of punishment

3.4.4 Social Competence (UFB)

For the scales on social competence (UFB - Fear of blame and criticism, Fear of contact to those of the opposite sex/fear of responsibility, Inability to set plans and set plans into motion, Inability to say no, Feeling of self-blame in relation to one's own actions as they relate to and affect others, Inappropriately exaggerated feelings of embarrassment) it was presumed that users would have higher scores on all scales compared to controls, especially those who commit many drives under influence. According to Kaplan (1975), adolescents with low self-esteem and low social competence are motivated to take action to restore positive self-regard by unlawful behaviour. A small effect was found for the scale 'Inappropriately exaggerated feelings of embarrassment' (Table 15). Contrary to expectations, users scored lower on the scale compared to the controls. The result suggests that drug users are less embarrassed when they infringe social norms. This finding fits the one mentioned in Chapter 3.4.1 that indicates that users compared to controls are in general less conscientious. No difference was found for those users who drive a lot under influence and those who commit rather few drives under influence.

Table 15: UFB: Presumptions and significant test results.

Personality Questionnaire:					
UFB – Presumptions	User/HighDUI higher on all scales				
Significant test result:	**$Mean_{User}$**	**$Mean_{Control}$**	**t**	**p-value**	**ES**
Inappropriately exaggerated feelings of embarrassment	48.26	51.05	-2.51	0.013	0.3

Inappropriately exaggerated feelings of embarrassment

- Persons with a high score are over-polite in reference to following norms and over-embarrassed when infringing on rules; show modest gestures, modest facial expressions and a modest involvement in conversation in social disturbing situations; prefer impersonal and controllable situations

3.4.5 Coping strategies (SVF)

For the SVF (Compare with others, Guilt defence, Distraction from situation, Substitutional satisfaction, Situational control, Reaction control, Positive self-instruction, Need for social support, Avoidance, Flight tendency, Rumination, Resignation, Self-accusation, Self-medication/alcohol use; Positive coping strategies: scale 1-10, Negative coping strategies: scale 13-19) it was presumed that users compared to controls would have higher scores on scales that describe negative coping strategies and lower scores on scales that describe positive coping strategies, especially those who commit many drives under influence. A strong effect was found for the scale 'Self-medication/alcohol use', and a small effect for the sum score 'Positive coping strategies' (Table 16). As presumed, the users compared to the controls scored higher on the negative scale 'Self-medication/alcohol use', and those who committed no or a low number of drives under influence compared to those who had a lot of drives under influence scored higher on positive scales.

Table 16: SVF: Presumptions and significant test results.

Personality Questionnaire:					
SVF – Presumptions	User/HighDUI low on positive scales and high on negative scales				
Significant test result:	**$Mean_{User}$**	**$Mean_{Control}$**	**t**	**p-value**	**ES**
Self-medication/alcohol use	56.59	48.36	7.50	0.000	0.9
Significant test result:	**$Mean_{HighDUI}$**	**$Mean_{LowDUI}$**	**t**	**p-value**	**ES**
Positive coping strategies	50.96	52.57	-2.13	0.035	0.3

Drug intake as coping strategy

- Persons with a high score tend to take drugs when they are under stress

Positive coping strategies

- Persons with a high score have positive coping strategies ('Compare with others', 'Guilt defence', 'Distraction from situation', 'Substitutional satisfaction', 'Situational control', 'Reaction control', 'Positive self-instruction')

3.4.6 Traffic-specific item pool (VIP)

For the scales of the VIP (Orientation at social expectations, Uncritical self-perception, Aggressive interaction, Emotional relationship to car and driving) no presumptions about the differences between the analysed subject groups were made. Compared to the controls, users scored lower on the scale 'Uncritical self-perception' (small effect) (Table 17). No difference was found for those users who drive a lot under influence and those who commit rather few drives under influence.

Table 17: VIP: Presumptions and significant test results.

Personality Questionnaire:					
VIP – Presumptions	no presumption				
Significant test result:	**$Mean_{User}$**	**$Mean_{Control}$**	**t**	**p-value**	**ES**
Uncritical self-perception	38.83	45.86	-2.22	0.027	0.3

Uncritical self-perception of own driving behaviour

- Persons with a high score describe driving as uncritical even if critical driving situations or road conditions occur (e.g. driving in a rush, fog, unknown road, long drive)
- Persons with a low score admit that own driving behaviour is critical sometimes and in some situations

3.4.7 Control beliefs (IPC)

For the scales of the IPC (Internal control orientation, Powerful others control orientation, Chance control orientation) it was presumed that users would have less internal control (scale 1) and higher external control (scale 2-3) than controls. Compared to the controls, users scored lower on the scale 'Internal control orientation' (small effect) and higher on the scale 'Chance control orientation' (medium effect) (Table 18). Those users who drive a lot under influence also scored higher on the scale 'Chance control orientation' than those who commit rather few drives under influence (small effect).

Table 18: IPC: Presumptions and significant test results.

Personality Questionnaire:					
IPC – Presumptions	User/HighDUI low on internal control and high on external control				
Significant test result:	**$Mean_{User}$**	**$Mean_{Control}$**	**t**	**p-value**	**ES**
Internal control orientation	51.98	55.31	-2.82	0.005	0.4
Chance control orientation	53.74	48.72	4.14	0.000	0.5
Significant test result:	**$Mean_{HighDUI}$**	**$Mean_{LowDUI}$**	**t**	**p-value**	**ES**
Chance control orientation	55.49	52.05	2.39	0.018	0.4

Internal control orientation
- Persons with a high score are self-controlled/self-paced in reference to personal events and their own life
- Persons with a low score have a low level of autonomy

Chance control orientation
- Persons with a high score have an external control belief in terms of being resigned to one's fate; belief that life is unstructured and that it depends to a high degree on fate, coincidences, and (mis)fortune

3.4.8 AD(H)D in childhood (ADHDQ)

For the scales of the ADHDQ (Distractibility, Inattention, Hyperactivity/Impulsivity, Psycho-social consequences, Drug effect on inattention and hyperactivity) it was presumed that users compared to controls would have higher scores on all scales, especially those who commit many drives under influence. Compared to controls, users scored higher on the scales 3-5 (Table 19). The effect concerning the scale 'Psycho-social consequences' was small, whereas the other two effects were medium. Those users who commit a lot of impaired drives scored higher on the same scores compared to users who had no/a few drives under influence. The effect concerning the scale 'Drug effect on inattention and hyperactivity' was medium, whereas the other two effects were small.

Table 19: ADHDQ: Presumptions and significant test results.

Personality Questionnaire:					
ADHDQ – Presumptions	User/HighDUI higher on all scales				
	analysis over all three percentiles:				
Significant test result:	**$>Perc50_{User}$**	**$>Perc50_{Control}$**	**chi-square (df)**	**p-value**	**ES**
Hyperactivity/Impulsivity	42%	22.7%	22.52 (2)	0.000	0.3
Psycho-social consequences	44.1%	24.7%	11 (2)	0.004	0.2
Drug effect on inattention and hyperactivity	62.9%	27.4%	51.18 (2)	0.000	0.4
Significant test result:	**$>Perc50_{HighDUI}$**	**$>Perc50_{LowDUI}$**	**chi-square (df)**	**p-value**	**ES**
Hyperactivity/Impulsivity	42.5%	32.5%	15.94 (2)	0.000	0.2
Psycho-social consequences	54.3%	29.3%	16.53 (2)	0.000	0.2
Drug effect on inattention and hyperactivity	70.7%	41.3%	29.02 (2)	0.000	0.3

Hyperactivity/Impulsivity
- Persons with a high score were hyperactive and impulsive in their childhood

Psycho-social consequences
- Persons with a high score had psychological problems and problems in social situations in their childhood because of being inattentive, hyperactive, and impulsive

Drug effect on inattention and hyperactivity

- Persons with a high score describe a positive effect of psychoactive substance consumption on concentration, emotions, self-control, memory, and perception

3.5 Social context

It has been hypothesised that family and friends can have an influence on the drug use or impaired driving behaviour of a person. Within families where alcohol is used, adolescents may observe alcohol use, acquire favourable attitudes toward alcohol use, and begin using alcohol themselves (Wills, Mariani, & Filer, 1996, cited in Bahr et al., 2005). Similarly, if their friends drink alcohol or commit impaired driving, adolescents are likely to receive positive social reinforcement from their friends for the same behaviour (Petraitis, Flay, & Miller, 1995, cited in Bahr et al., 2005). Besides social learning, social control theory also tries to explain a person's deviant behaviour. According to this theory, every person has the impulse to act deviant and would do so if no social controls by families and other social institutions would hinder him from doing so (Hirschi, 1969, cited in Bahr et al., 2005). This means that if a person has a close relation to the parents, they feel obliged to act in a way that pleases their parents. In a similar way, monitoring by parents may influence deviant behaviour. When monitoring is high, teens may act in pro-social ways because they are thought to be watched and judged by their parents.

3.5.1 Peer influence and nights out

To be able to analyse the influence of peers, the subjects were asked how often they go out on average, if their partner or their friends use drugs, if their friends drive while impaired and how their friends think about the subject's impaired driving. The questions are listed in Table 20.

Table 20: Q-Start questions concerning peer influence.

Question
How often do you go out on average (meet friends, party, disco, bar)? 5-7 times per week, 3-4 times per week, 1-2 times per week, 1-3 times per month, less frequently **→ Nights out**
If you have a permanent partner, does he or she take drugs? yes, so-called „soft" drugs (cannabis); yes, so-called „hard" drugs (amphetamines, opiates, cocaine); yes, so-called „soft" and „hard" drugs; no, my partner doesn't take drugs; I have no permanent partner **→ Partner's drug use**
Assume that you are driving after the intake of the following substances, how would your friends react if they found out? (1 beer, more than 4 beers, cannabis, stimulants (e.g. amph.,speed), ecstasy, hallucinogens (e.g. LSD, mushrooms), cocaine, opiates (heroin and others), sedatives) 0=it wouldn't bother them …10=they would disapprove of it **→ Peers' opinion about subject's impaired driving**
How many of your friends with whom you have regular contact take so-called „soft" drugs (cannabis)? no one, few, about the half, many **→ Peers' drug use (soft drugs)**
How many of your friends with whom you have regular contact take so-called „hard" drugs (amphetamines, opiates, cocaine)? no one, few, about the half, many **→ Peers' drug use (hard drugs)**
How many of your friends with whom you have regular contact take illegal drugs and drive afterwards? no one, few, about the half, many **→ Peers' drug driving**

Users have more nights out than controls (t=3.63, p=0.000), as do younger subjects compared to older subjects (18-24 vs. 25-29: t=2.12; p=0.035, 18-24 vs. 30-39: t=5.18; p=0.000, 25-29 vs. 30-39: t=2.86; p=0.005) (Figure 13).

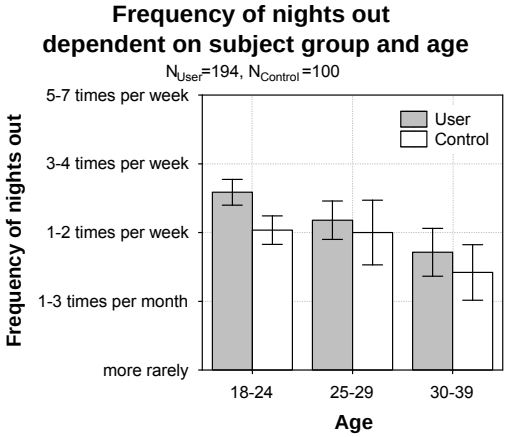


Figure 13: Frequency of nights out (5-7 times per week, 3-4 times per week, 1-2 times per week, 1-3 times per month, more rarely) dependent on subject group (user, control) and age (18-24, 25-29, 30-39) (N_{User}=194; $N_{Control}$=100) (Mean, ±0.95 CI).

The more often someone goes out, the higher the consumed alcohol dose per day is (Figure 14); the use of cannabis and stimulants does not vary depending on the frequency of nights out.

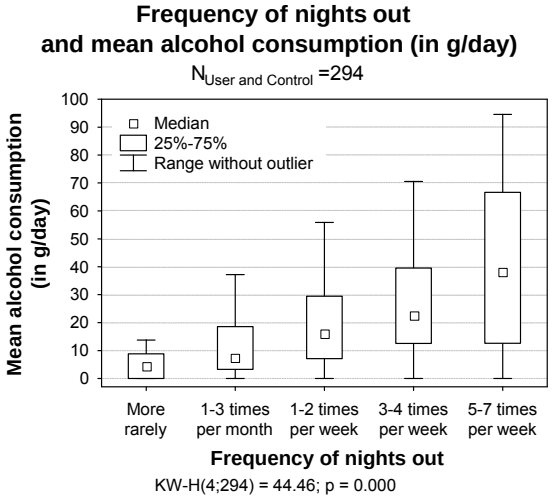


Figure 14: Frequency of nights out (5-7 times per week, 3-4 times per week, 1-2 times per week, 1-3 times per month, more rarely) and mean alcohol consumption (in g/day) for users and controls ($N_{User\ and\ Control}$=294) (Median, 25%-75%, Range without outlier).

The more often someone goes out, the more drives under the influence of alcohol one has (BAC≥0.01%) (Figure 15); driving under the influence of stimulants does not vary depending on the frequency of nights out; for cannabis it can be shown that especially those who go out quite often (5-7 times per week) and those who go out rather seldom (1-3 times per months) have the highest number of THC-positive drives (THC≥1ng/ml).

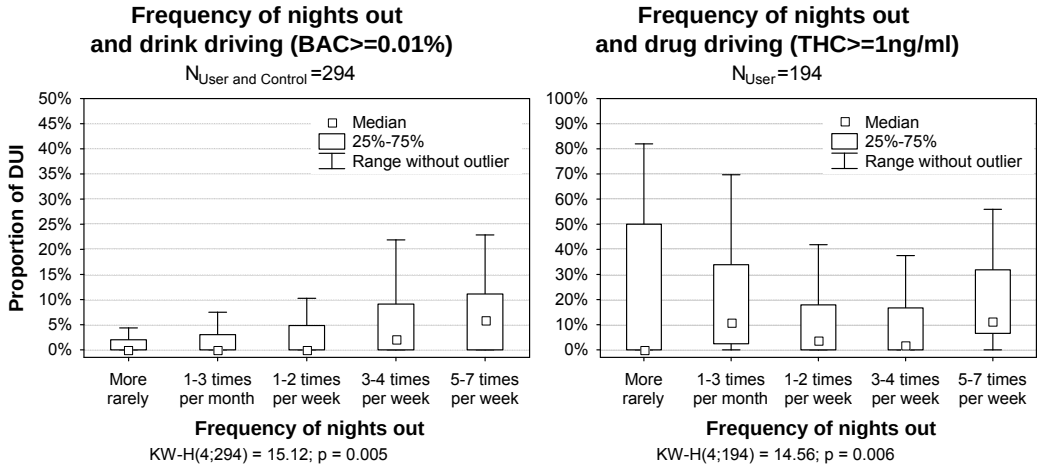


Figure 15: Frequency of nights out (5-7 times per week, 3-4 times per week, 1-2 times per week, 1-3 times per month, more rarely) and mean proportion of driving under the influence of alcohol (BAC≥0.01%; left) for users and controls ($N_{User\ and\ Control}$=294) and of driving under the influence of cannabis (THC≥1ng/ml; right) for users (N_{User}=194) (Median, 25%-75%, Range without outlier).

51.6% of the users declared having a permanent relationship (±0.95 CI: 44.5%-58.3%) compared to 54% of the controls (±0.95 CI: 44.2%-63.8%). Those users who are not in a relationship and those who have a relationship with a partner who uses hard drugs consume more drugs a day and more often "hard" drugs[23] (*yes, so-called „hard" drugs*, *yes, so-called „soft" and „hard" drugs*) than those who have a partner who does not consume drugs or who consumes only soft drugs (Figure 16). It was also found that if a female user stated to have a partnership, it was much more likely that the partner also used drugs (89.6%, ±0.95 CI: 80.9%-89.2%) compared to partners of male drug users (54.4%, ±0.95 CI: 42.6%-66.2%).

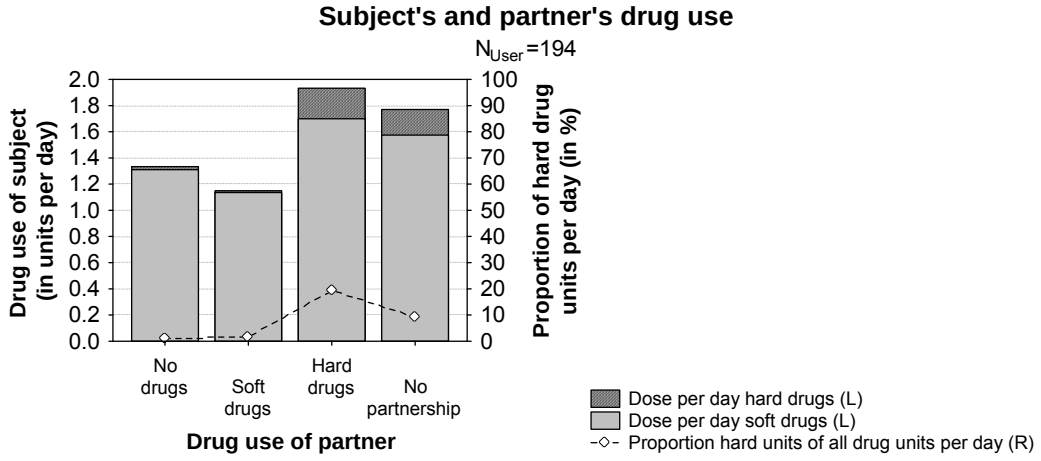


Figure 16: Mean "soft" and "hard" drug use of subjects in units per day (e.g. joints in the case of cannabis) and mean proportion of "hard" drug units per day depending on drug use of partner (no drugs, "soft" drugs, "hard" drugs, no partnership) for users (N_{User}=194).

76.4% of the users declared being part of a clique (±0.95 CI: 70.4%-82.5%) compared to 65% of the controls (±0.95 CI: 55.7%-74.3%). Users who had no drives with a BAC of 0.05% or higher or a median proportion of cannabis-positive drives or less (THC blood

[23] "hard" drugs: illegal drugs except cannabis and/or non-prescribed medicines.

level≥1ng/ml) declared that their friends would more often disapprove of them driving after they drank more than four beers and driving after consuming cannabis, respectively, compared to users who had drives with a BAC of 0.05% or higher and a higher proportion of cannabis-positive drives than the median (Mean on 0-10 scale for Alcohol≥0.05%: HighDUI=5.3, LowDUI=6.4; for Cannabis: HighDUI=3.1; LowDUI=4.8) (Figure 17). Concerning drives after the consumption of stimulants or one beer no difference was observable between those who had a higher proportion than the median proportion of corresponding drives and those who had a lower proportion. Peers highly disapprove of drives under the influence of stimulants and hardly ever disapprove of drives after the consumption of one beer.

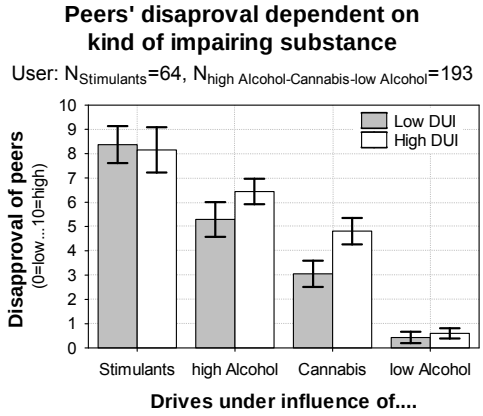


Figure 17: Peers' disapproval (scale: 0=low…10=high) dependent on kind of impaired drive (stimulants, high alcohol, cannabis, low alcohol) for subjects who either had no/a median proportion of DUI or less (Low DUI) or those who had drives under influence/a higher proportion than the median (High DUI) ($N_{Stimulants}$=64; $N_{high\ Alcohol\text{-}Cannabis\text{-}low\ Alcohol}$=193) (Mean, ±0.95 CI).

Table 21: Mean rating (±0.95 CI) and statistics of peers' disapproval.

Peers' disapproval				
DUI-Substance	**$Mean_{highDUI}$ (±0.95 CI)**	**$Mean_{lowDUI}$ (±0.95 CI)**	**t**	**p-value**
Stimulants	8.4 (7.6-9.1)	8.2 (7.2-9.1)	-0.37	0.712
high Alcohol	5.3 (4.6-6)	6.4 (5.9-7)	2.61	0.010
Cannabis	3.1 (2.5-3.6)	4.8 (4.3-5.4)	4.55	0.000
low Alcohol	0.4 (0.2-0.7)	0.6 (0.4-0.8)	1.08	0.281

The more the peers use drugs in the subject's point of view, the higher the subject's daily drug dose is (significant for "hard" drugs and marginally significant for "soft" drugs) (Figure 18); the more the peers drive while impaired in the subject's point of view, the higher the subject's proportion of drives under influence is (Figure 18).

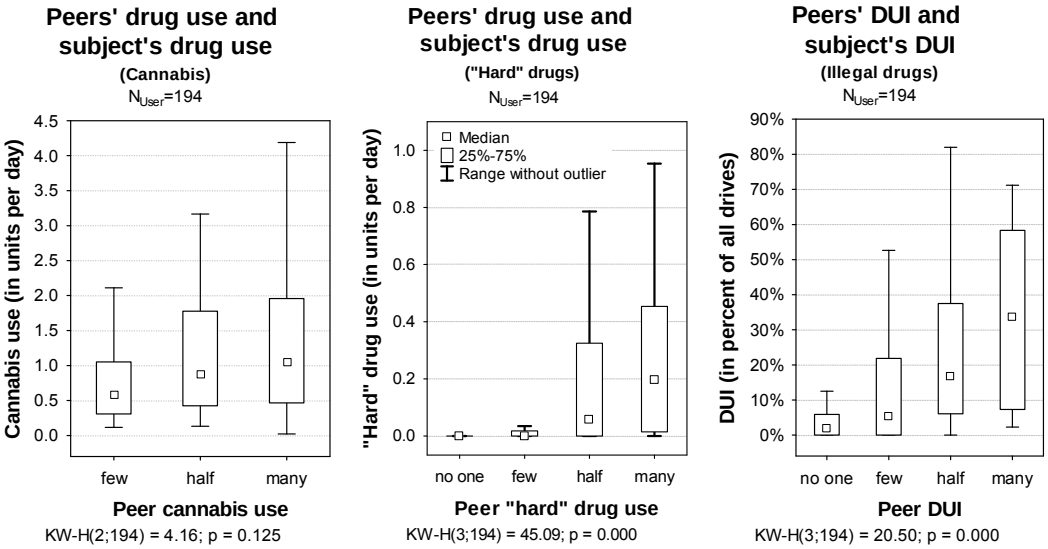


Figure 18: Cannabis use (left, in units per day), use of "hard" drugs (middle, in units per day) and drives under the influence of illegal drugs (right, in percent) of subjects (N_{User}=194) and of peers (no one, few, half, many) (Median, 25%-75%, Range without outlier).

3.5.2 Parents' influence

To analyse the parental influence on the subject's drug use and impaired driving behaviour, the subjects were asked about their relationship with their parents, if they favour the way they were raised, and if they would raise their children in the same manner. They were asked about their father's educational status and his job position, and if the parents lived together or apart. The questions are listed in Table 22 and Table 23.

Table 22: Q-Start questions concerning parents' influence and parental home.

Question
Would you bring up your child like your parents brought you up or would you do it different? in the same manner, similarly, differently, completely differently **→ Own way of raising child**
How did your parents bring you up? very strict, strict, lenient, too lenient **→ Parents' way of raising child**
What is your father's highest graduation? No/basic education, middle education, advanced education **→ Father's educational status**
What is your father's job position? Working family member/househusband, worker, simple work, clerical work, upper work, higher work, freelance academic, self-employed **→ Job position of father**
Did your parents live together, did they live apart, or were they divorced? Live(d) together, live(d) apart, are (were) divorced **→ Parents' marital status**
How much beer, wine or liquor does your father/mother drink on a usual Saturday evening? **→ Parents' alcohol consumption**

Table 23: Questions about the relationship with parents according to the German study "Jugend 2000" (Deutsche Shell, 2000).

Relationship with parents (Response option: 1=not at all true, 2=little true, 3=true, 4=very true)	
Abbr.	**Scale and Items**
Resp	**Respectful connection with parents**
R_1	I always had a lot of respect for my parents.
R_2	The family bond within our family is much stronger than within other families.
R_3	In my life my parents always came first.
R_4	My parents are my role models.
Trus	**Mistrust in child**
T_1	My parents always reproached me for only making mistakes.
T_2	My parents always mistrusted me.
T_3	My parents are extremely old-fashioned.
T_4	My parents always criticized me.
Mate	**Generous fulfilment of child's material wishes**
M_1	I always got everything from my parents that I wanted.
M_2	When I asked for a toy, I always got it.
M_3	In my family we always had enough money to fulfil our material wishes.
M_4	In my family we always had to save money and carefully had to think about what we spent it on. (R)
Worr	**Parents' worries**
W_1	My parents were always worried about me.
W_2	My parents were always concerned about me using cannabis.
W_3	My parents were always concerned about me keeping bad company.
W_4	My parents were always concerned about my future.
Perf	**Parents' performance claims**
P_1	My parents always asked about my school matters.
P_2	In my family school grades were very important.
P_3	My parents always encouraged me to be punctual and tidy.
P_4	My parents always had high hopes for me.
Self	**Child's self-reliance**
S_1	My parents never influenced me in important decisions.
S_2	My parents were always very proud of me.
S_3	In my opinion, my parents were always satisfied with me.
S_4	My parents always let me do what I thought was right.
Symp	**Parents' sympathy**
Sy_1	I always felt that my parents understood me best.
Sy_2	My parents always helped me with my homework.
Sy_3	My parents always tried to understand me.
Sy_4	My parents tried to understand me to the extent that they even shared my interests and hobbies.

Users scored higher than controls on the scales "Parents' worries" and "Mistrust in child" (Figure 19, left). Controls scored higher than users on the scales "Child's self-reliance" and "Respectful connection with parents". So, the controls' relationship to their parents can be described as better as that of the users'. Comparing those users who often drive under influence (highDUI) with those who commit rather less drives under influence (low-DUI) results in differences concerning "Parents' worries", "Mistrust in child" and a marginal difference concerning "Parents' performance claims" (Figure 19, right). The ones who drive under influence more often reach higher scores compared to those who drive less often under influence. Nevertheless, one should consider that the differences between the study groups are in the majority of the cases smaller than one point out of 16 points on the scale.

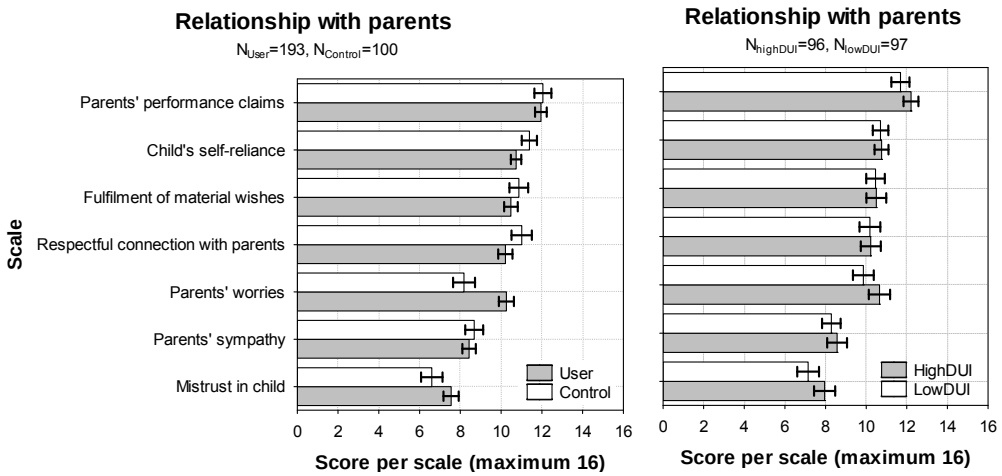


Figure 19: Scores that describe relationship with parents (respectful connection with parents, mistrust in child, generous fulfilment of child's material wishes, parents' worries, parents' performance claims, child's self-reliance, parents' sympathy) of users versus controls (left, N_{User}=193, $N_{Control}$=100) and frequent versus infrequent drug drivers (right, $N_{highDUI}$=96, N_{lowDUI}=97)(Mean, ±0.95 CI).

Table 24: Mean rating (±0.95 CI) and statistics of relationship with parents (significant and marginal significant results) for users and controls (N_{User}=193, $N_{Control}$=100) and frequent and infrequent drug drivers ($N_{highDUI}$=96, N_{lowDUI}=97).

Relationship with parents				
Scale	**Mean$_{User}$ (±0.95 CI)**	**Mean$_{Control}$ (±0.95 CI)**	**F**	**p-value**
Child's self-reliance	10.7 (10.5-11)	11.4 (11-11.8)	-8.35	0.004
Respectful connection with parents	10.2 (9.9-10.6)	11 (10.5-11.5)	-6.79	0.010
Parents' worries	10.3 (9.9-10.6)	8.2 (7.6-8.7)	40.90	0.000
Mistrust in child	7.5 (7.2-7.9)	6.6 (6.1-7.1)	8.47	0.004
Scale	**Mean$_{highDUI}$ (±0.95 CI)**	**Mean$_{lowDUI}$ (±0.95 CI)**	**F**	**p-value**
Parents' performance claims	12.2 (11.8-12.6)	11.7 (11.2-12.1)	3.22	0.074
Parents' worries	10.7 (10.1-11.2)	9.9 (9.4-10.4)	4.56	0.034
Mistrust in child	8 (7.4-8.5)	7.1 (6.6-7.7)	4.65	0.032

70.3% of the users stated that the parents' way of raising them was too lenient/lenient compared to 59% of the controls (Figure 20, left). This difference reached significance (Table 25). 41.5% of the users stated that they would raise their own children completely differently/differently than their parents raised them compared to 33% of the controls (not significant; Figure 20, right). Between frequent drug drivers (*highDUI)* and rather infrequent drug drivers (*lowDUI)* no clear differences were found concerning the parents' way and their own way of raising children (Table 25, not diagrammed below).

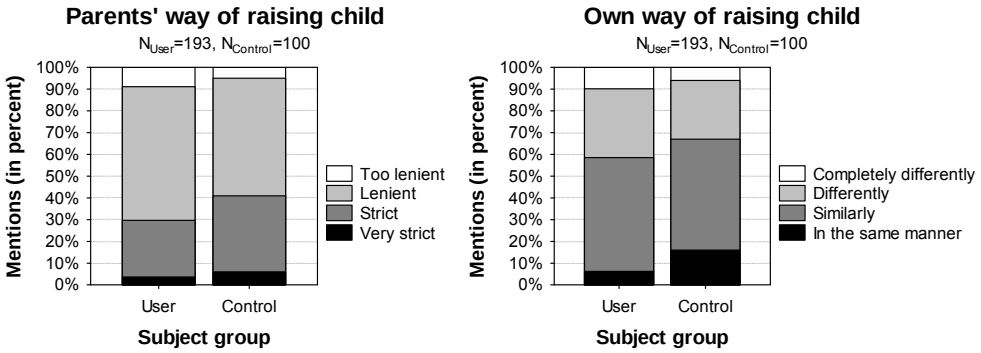


Figure 20: Parents' way of raising child (too lenient, lenient, strict, very strict) and own way of raising child (completely differently, differently, similarly, in the same manner) for users (N_{User}=193) and controls ($N_{Control}$=100) (in percent of mentions).

Table 25: Percentage (±0.95 CI) and statistics of describing the parents' way of raising child as too lenient/lenient and the intended own way of raising child as completely differently/differently for users and controls (N_{User}=193, $N_{Control}$=100) and frequent and infrequent drug drivers ($N_{highDUI}$=96, N_{lowDUI}=97).

Parents' way of raising child too lenient/lenient versus strict/very strict			
$Percent_{User}$ (±0.95 CI)	**$Percent_{Control}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
70.3 (63.9%-76.8%)	59% (49.4%-68.6%)	3.77 (1)	0.052
$Percent_{HighDUI}$ (±0.95 CI)	**$Percent_{LowDUI}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
68.4% (59.1%-77.8%)	39.2% (29.5%-48.9%	1.99 (1)	0.159
Own way of raising child completely differently/differently versus similarly/in the same manner			
$Percent_{User}$ (±0.95 CI)	**$Percent_{Control}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
41.5% (34.5%-48.4%)	33% (23.8%-42.2%)	0.32 (1)	0.570
$Percent_{HighDUI}$ (±0.95 CI)	**$Percent_{LowDUI}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
43.8% (33.8%-53.7%)	39.2% (29.5%-48.9%)	0.42 (1)	0.519

52.4% of the users stated that their father has an advanced educational status compared to 42.9% of the controls (Figure 21). This difference almost reached significance (Table 26). Between frequent drug drivers (*highDUI)* and rather infrequent drug drivers (*lowDUI)* the father's educational status did not differ significantly (Table 26, not diagrammed below).

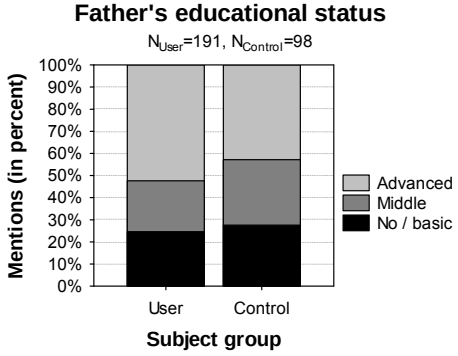


Figure 21: Father's educational status (advanced, middle, no/basic) for users (N_{User}=191) and controls ($N_{Control}$=98) (in percent of mentions).

Table 26: Percentage (±0.95 CI) and statistics of mentioning the father's educational status to be advanced for users and controls (N_{User}=191, $N_{Control}$=98) and frequent and infrequent drug drivers ($N_{highDUI}$=96, N_{lowDUI}=97).

Advanced educational status of father versus middle/no/basic			
$Percent_{User}$ (±0.95 CI)	**$Percent_{Control}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
52.4% (45.3%-59.4%)	42.9% (33.1%-52.7%)	2.34 (1)	0.126
$Percent_{HighDUI}$ (±0.95 CI)	**$Percent_{LowDUI}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
48.9% (38.8%-59%)	55.7% (45.8%-65.6%)	0.87 (1)	0.352

63.8% of the users stated that their father has a management or advanced job position, is a freelance academic or self-employed, compared to 53.1% of the controls (Figure 42, right). This difference almost reached significance (Table 27). The frequent drug drivers (*highDUI)* indicated in 56.5% of the cases that the father has a higher job position compared to 70.8% of the rather infrequent drug drivers (*lowDUI)* (Figure 42, left). This difference reached significance (Table 27).

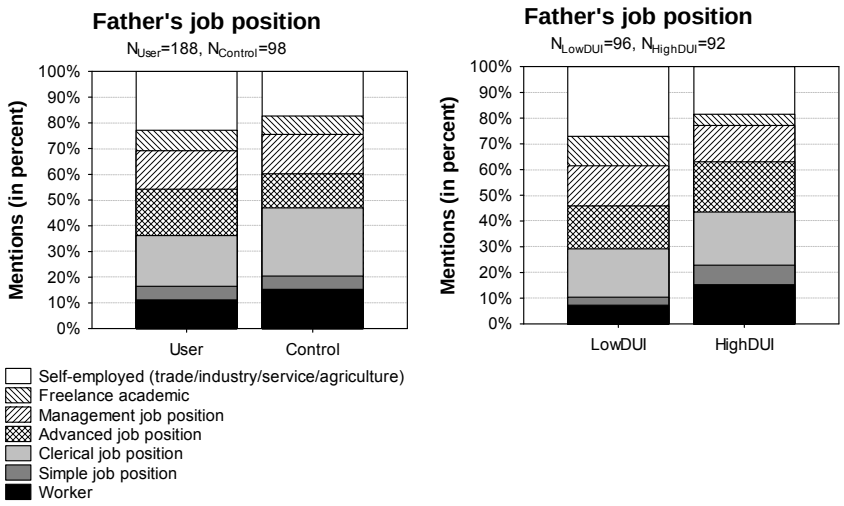


Figure 22: Father's job position (self-employed, freelance academic, management/advanced/clerical/simple job position, worker) for users versus controls (left, N_{User}=188, $N_{Control}$=98) and frequent versus infrequent drug drivers (right, $N_{HighDUI}$=92, N_{LowDUI}=96) (in percent of mentions).

Table 27: Percentage (±0.95 CI) and statistics of mentioning the father's job position to be high (self-employed, freelance academic, management/advanced job position) for users versus controls (N_{User}=188, $N_{Control}$=98) and frequent versus infrequent drug drivers ($N_{HighDUI}$=92, N_{LowDUI}=96).

High job position of father versus low			
$Percent_{User}$ (±0.95 CI)	**$Percent_{Control}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
63.8% (57%-70.7%)	53.1% (43.2%-62.9%)	3.12 (1)	0.078
$Percent_{HighDUI}$ (±0.95 CI)	**$Percent_{LowDUI}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
56.5% (46.4%-66.7%)	70.8% (61.7%-79.9%)	4.17 (1)	0.041

36.5% of the users stated that their parents live/lived apart or are/were divorced compared to 26.3% of the controls (Figure 23). This difference almost reached significance (Table 28). Between frequent drug drivers (*highDUI)* and rather infrequent drug drivers (*lowDUI)* the marital status of the parents did not differ significantly (Table 28, not diagrammed below).

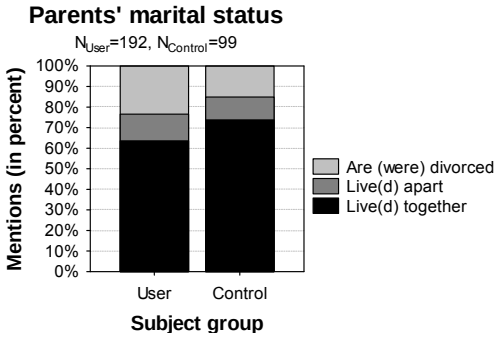


Figure 23: Parents' marital status (are (were) divorced, live(d) apart, live(d) together) for users (N_{User}=192) and controls ($N_{Control}$=99) (in percent of mentions).

Table 28: Percentage (±0.95 CI) and statistics of mentioning the parents' marital status for users versus controls (N_{User}=192, $N_{Control}$=99) and frequent versus infrequent drug drivers ($N_{HighDUI}$=95, N_{LowDUI}=97).

Parents live/lived apart, are/were divorced versus live(d) together			
$Percent_{User}$ (±0.95 CI)	**$Percent_{Control}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
36.5% (29.7%-43.3%)	26.3% (17.6%-34.9%)	3.07 (1)	0.080
$Percent_{HighDUI}$ (±0.95 CI)	**$Percent_{LowDUI}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
33.7% (24.2%-43.2%)	39.2% (29.5%-48.9%)	0.62 (1)	0.429

Those subjects whose alcohol consumption was high or excessive stated a higher alcohol consumption of their parents (Father: MD 40 grams, ±0.95 CI 0-60 grams; Mother: MD 20 grams, ±0.95 CI 0-40 grams) than moderate alcohol users (Father: MD 6.4 grams, ±0.95 CI 0-40 grams; Mother: MD 0 grams, ±0.95 CI 0-24 grams) (Figure 24).

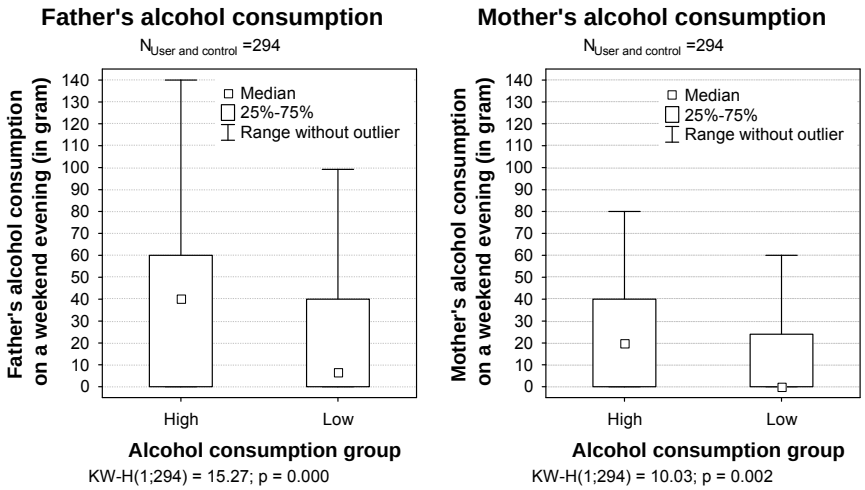


Figure 24: Father's (left) and mother's (right) alcohol consumption on a regular weekend evening (in grams) for heavy/excessive (High alcohol consumption group) versus moderate/no alcohol users (Low alcohol consumption group) ($N_{User\ and\ control}$=294) (Median, 25%-75%, Range without outlier).

3.6 Attitudes

Several questions the subjects were asked refer to attitudes (Table 29; *attitude towards drug use, attitudes towards drug driving*, *motives against drug driving*, *attitudes towards thresholds*, *general attitudes*).

Table 29: Q-Start questions concerning subjects' attitudes.

Question
Attitude towards drug use
Which of the following drugs would you never take or would you never take again? (alcohol, cannabis, psilocybin, sniffing agents, cocaine, amphetamine, ecstasy, LSD, crack, heroin) yes/no **→ Willingness to use a substance (answers of controls → social acceptance)**
Attitudes towards drug driving
How condemnable do you take driving under drugs? (one beer, cannabis, more than 4 beers, sedatives, amphetamine, cocaine, ecstasy, opiates, hallucinogens) 0=not at all …10=very much **→ Attitude towards drug driving**
"If I know the driver had taken the following substances, I don't go with him." To what extent do you agree to this statement? 0=completely disagree...10=completely agree **→ Own opinion about riding along with an impaired driver**
Motives against drug driving
How much does your decision to drive or not to drive after the consumption of drugs (incl. alcohol) depend on the following points? 0=not at all, 1=very little, 2=little, 3=medium, 4=much, 5=very much **→ Reasons for not driving after the consumption of drugs (detailed description of response options in Table 32)**

Attitudes towards thresholds
Do you favour a threshold for driving under the influence of cannabis? no/don't know/yes → **Attitude towards threshold for cannabis**
How many euros penalty would definitely prevent you from DUI? I would always drive/3,000 euros/1,000 euros/500 euros/100 euros/I never drive under influence → **Deterring effect of penalty**
Do you favour the new 0.00% BAC limit for young and novice drivers? Yes, better would be 0.00% for everyone Yes, I am in favour of it, it is safer I don't care No, I don't favour it, one beer should be permitted → **Attitude towards zero-tolerance for alcohol for young and novice drivers**
Which alcohol limit do you suggest for driving a motor vehicle? → **Desired alcohol limit**
How much do you think you have to drink to reach 0.1%? → **Perceived relation between amount of alcohol and BAC**
How much alcohol would you drink at maximum and still drive safely? → **Opinion about amount of alcohol to still drive safely**
General attitudes
How satisfied are you with your personal life situation on the whole? 0=totally dissatisfied...10=totally satisfied → **Life satisfaction (Satisfaction)**
To what extent do you agree with the following statement: "Someone who is always concerned with his health has no fun."? 0=completely agree…10=completely disagree (reversed polarity) → **Health awareness (HealthAware)**
To what extent do you agree with the following statement: "I try to eat only healthy food."? 0=completely disagree...10=completely agree → **Healthy nutrition (HealthFood)**
To what extent do you agree with the following statement: "If a constitutional state is to function, all laws have to be observed strictly!"? 0=completely disagree...10=completely agree → **Awareness of law (LawAware)**

3.6.1 Attitudes towards drug use and drug driving

If the controls' willingness to use a substance is interpreted as general social acceptance, then the use of alcohol is highly socially accepted (98%), the use of cannabis is partly socially accepted (47%), and the use of other drugs is least socially accepted[24].

Figure 25 (left) shows the subjects attitude towards driving under the influence of different substances (N_{User}=194, $N_{Control}$=100). Users, much like controls, find it very much condemnable to drive under the influence of opiates and hallucinogens. While the controls' disapproval of driving after the consumption of amphetamine, cocaine or ecstasy is as high as their disapproval of driving after opiates and hallucinogens consumption, the users take driving under amphetamine and cocaine influence as condemnable as they take driving under the influence of more than four beers and sedatives. Users find driving under ecstasy influence as condemnable as controls find driving after cannabis consumption and the consumption of more than four beers or sedatives. Users do not find it very condemnable to drive under the influence of cannabis. The lowest rates were found for drives after the consumption of one beer. For all substances except opiates and hallucinogens the users' scores are lower than the controls' scores (Table 30).

[24] Psilocybin: 15%, sniffing agents: 12%, cocaine: 13%, amphetamine: 11%, ecstasy: 10%, LSD: 10%, crack: 9%, heroin: 8%.

It further turned out that for controls the legal BAC limit has an effect on their attitude towards driving after one beer (Figure 25, left). The 18-24-year-old controls for whom the zero-tolerance applies find it still not very much but to some degree more condemnable to drive after one beer than those 18-24-year-old controls for whom the 0.05% BAC limit applies (t=1.70; p=0.096). For users no effect was found.

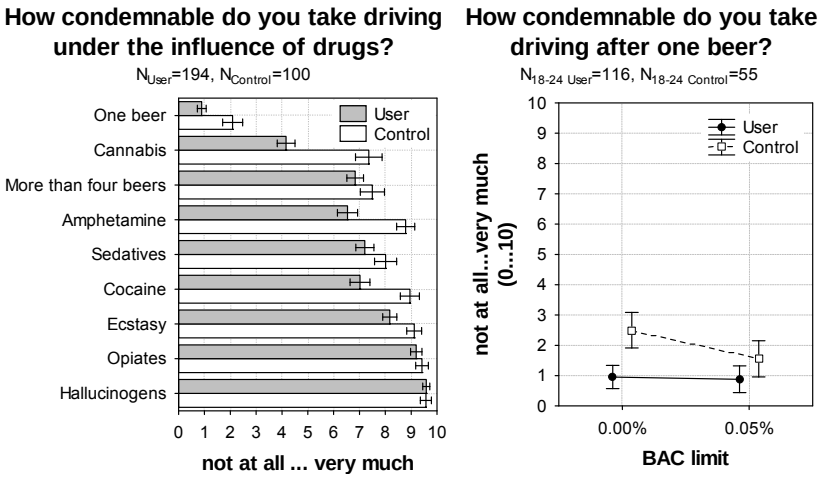


Figure 25: Attitude of users and controls towards driving under the influence of one beer, cannabis, more than 4 beers, sedatives, amphetamine, cocaine, ecstasy, opiates, and hallucinogens (left, N_{User}=194, $N_{Control}$=100) (Mean, ±0.95 CI) and attitude of 18-24-year-old users and controls towards driving after one beer dependent on which BAC limit applies (right, $N_{18\text{-}24\ User}$=116, $N_{18\text{-}24\ Control}$=55) (Mean, ±0.95 CI).

Table 30: Mean (±0.95 CI) and statistics of attitude of users and controls towards driving under the influence of different substances (N_{User}=194, $N_{Control}$=100).

How condemnable do you take driving under drugs? (0=not at all …10=very much)				
Substance	**Mean$_{User}$ (±0.95 CI)**	**Mean$_{Control}$ (±0.95 CI)**	**t**	**p-value**
One beer	0.9 (0.7-1.1)	2.1 (1.7-2.5)	-6.51	0.000
Cannabis	4.2 (3.8-4.5)	7.4 (6.8-7.9)	-10.5	0.000
More than four beers	6.8 (6.5-7.2)	7.5 (7-8)	-2.35	0.019
Tranquilizer	7.2 (6.9-7.6)	8 (7.6-8.4)	-2.77	0.006
Amphetamine	6.5 (6.1-6.9)	8.8 (8.4-9.1)	-7.4	0.000
Cocaine	7 (6.6-7.4)	9 (8.6-9.3)	-6.41	0.000
Ecstasy	8.2 (7.9-8.4)	9.1 (8.8-9.4)	-4.35	0.000
Opiates	9.2 (9-9.4)	9.4 (9.2-9.7)	-1.23	0.218
Hallucinogens	9.6 (9.5-9.7)	9.6 (9.4-9.8)	0.13	0.900

The subjects were further asked if they would go along with a driver of whom they knew he had taken drugs (one beer, cannabis, more than 4 beers, sedatives, amphetamine, cocaine, ecstasy, opiates, or hallucinogens; 0=low disapproval...10=high disapproval). Those users whose proportion of impaired drives on all drives concerning the substance in question is higher than the median proportion (*HighDUI*) are less adverse to going along with an intoxicated driver compared to those users whose proportion of drives under influence is as high as the median or lower (*LowDUI*) (Figure 26). Whereas the difference is statistically significant when the question is asked referring to a driver intoxicated by alcohol or cannabis, the result is only marginally significant when referring to a driver intoxicated by stimulants (Table 31). The analysis is restricted to the main drugs under which the subjects drove while participating (alcohol, cannabis, and stimulants).

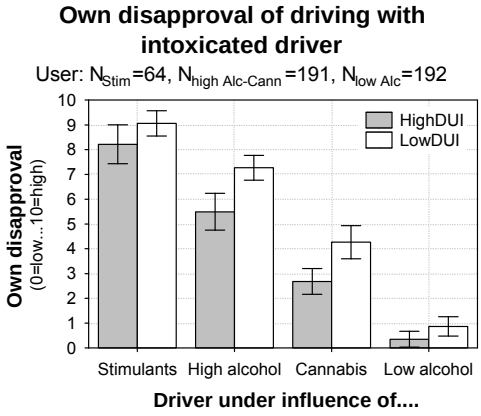


Figure 26: Own disapproval of driving with an intoxicated driver (Mean, ±0.95 CI; 0=low disapproval...10=high disapproval; under influence of stimulants, i.e. amphetamine/cocaine/ecstasy, high alcohol, i.e. more than four beers, cannabis, or low alcohol, i.e. one beer) dependent on the subjects' proportion of drives under influence of all drives (HighDUI=higher than median proportion, LowDUI= as high as median proportion or lower; under influence of stimulants, i.e. amphetamine/cocaine/ecstasy, high alcohol, i.e. BAC≥0.05%, cannabis, i.e. THC blood plasma level≥1ng/ml, or low alcohol, i.e. BAC<0.05%).

Table 31: Mean (±0.95 CI) and statistics of own disapproval of driving with an intoxicated driver (under influence of stimulants, i.e. amphetamine/cocaine/ecstasy, high alcohol, i.e. more than four beers, cannabis, or low alcohol, i.e. one beer).

Own disapproval of driving with an intoxicated driver (0=low disapproval...10=high disapproval)				
Substance	**Mean$_{HighDUI}$ (±0.95 CI)**	**Mean$_{LowDUI}$ (±0.95 CI)**	**t**	**p-value**
Stimulants	8.2 (7.4-9)	9.1 (8.6-9.6)	1.84	0.071
High alcohol	5.5 (4.8-6.2)	7.3 (6.8-7.8)	4.07	0.000
Cannabis	2.7 (2.2-3.2)	4.3 (3.6-4.9)	3.74	0.000
Low alcohol	0.4 (0.0-0.7)	0.9 (0.5-1.3)	2.03	0.044

3.6.2 Motives against drug driving

Another question referred to possible reasons for not driving after the consumption of drugs. There were four thematically different categories of items for which the subjects had to indicate to what extent it influences their decision to drive when intoxicated by psychoactive substances (Table 32; *Characteristics of drug intake*, *route characteristics*, *possible alternatives*, *and social reasons*).

Table 32: Question concerning reasons for not driving after the consumption of drugs.

How much does your decision to drive or not to drive after the consumption of drugs (incl. alcohol) depend on the following points? (Response option: 0=not at all, 1=very little, 2=little, 3=medium, 4=much, 5=very much)	
Abbr.	**Scale and Items**
Drug	**Characteristics of drug intake**
D_1	…how much I have taken
D_2	…when I have taken the drug
D_3	…which drug/combination of drugs I have taken
D_4	…how roadworthy/tired I feel
Rout	**Route characteristics**
R_1	… the type of route (motorway, rural, city)
R_2	… the length of the route
R_3	… the level of familiarity with the route
R_4	… the density of controls on the route

Alte	Possible alternatives
A_1	…whether I have money for a taxi or not
A_2	…whether I can walk/take public transport or not
A_3	…whether I can go with someone or not
A_4	…whether I have to be at home the next morning or whether I can sleep over or not
A_5	…whether I need the car at home the next morning or not
Soci	**Social reasons**
S_1	…whether I have passengers who I could endanger or not
S_2	…whether I should take somebody home or not
S_3	…whether it bothers my passengers or not
S_4	…how sober I am compared to other potential drivers

The decision to drive under influence is stated to mainly depend on characteristics of drug intake (amount of consumed drug, type of drug/drug combination, effect of consumed drug, time of drug consumption) (Figure 27). The density of police controls, whether or not passengers could be endangered, and the possibility of riding along with another person are also quite relevant for the decision for or against driving under influence. Possible alternatives to impaired driving, like walking, public transportation, a low need to go home or a low need to have the car at home and some route characteristics (length of the route, familiarity with the route) are of middle importance for the decision to drive after drug consumption. The least important is whether or not the subject has money for a taxi or not, followed by most items that refer to social reasons (whether it bothers others, whether the subject has to take home another person, how sober other potential drivers are) and the remaining item that refers to the route characteristic "type of route".

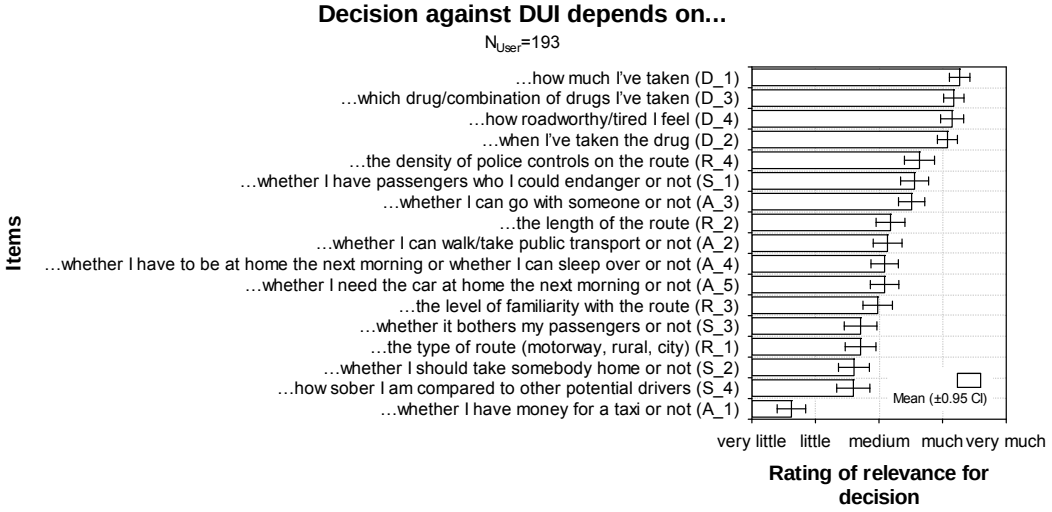


Figure 27: Reasons for deciding against driving under influence sorted by their influence (very little, little, medium, much, very much) (N_{User}=194) (Mean, ±0.95 CI).

The first seven items shown in Figure 27 were the most relevant issues in the decision making process independent of how often users drive under influence. Those users whose proportion of impaired drives on all drives is rather low (*LowDUI*) state that the consumption time is more relevant to their decision to drive after consumption compared to users whose proportion of impaired drives is rather high (*HighDUI*) (Table 33). Concerning the remaining items, the order slightly but not systematically varies between the two study groups. Those who often drive under influence state that whether or not they

can go with someone, whether or not it bothers the other passengers, and whether or not they should take others home carries more weight than it does for users who rather seldom drive under influence (Figure 28, Table 33).

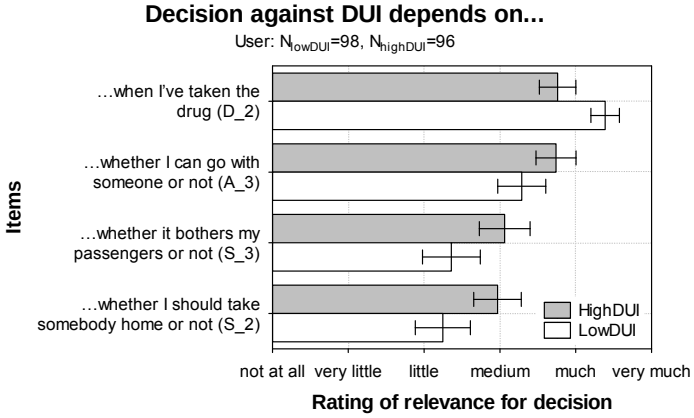


Figure 28: Significant differences of relevance of reasons for decisions against DUI on item-level for those who committed DUI rather seldom (N_{LowDUI}=98) and those who committed DUI rather often ($N_{HighDUI}$=96) (Mean, ±0.95 CI).

Table 33: Mean rating (±0.95 CI) and statistics of the relevance of different reasons (different items, significant results) for decisions against DUI for those who committed DUI rather seldom (N_{LowDUI}=98) and those who committed DUI rather often ($N_{HighDUI}$=96).

How much does your decision to drive or not to drive after the consumption of drugs (incl. alcohol) depend on the following points? (0=not at all...5=very much)				
Significant items	**Mean$_{highDUI}$ (±0.95 CI)**	**Mean$_{lowDUI}$ (±0.95 CI)**	**t**	**p-value**
D_2	3.8 (3.5-4)	4.4 (4.2-4.6)	-4.09	0.000
A_3	3.7 (3.5-4)	3.3 (3-3.6)	2.17	0.031
S_3	3.1 (2.7-3.4)	2.4 (2-2.7)	2.74	0.007
S_2	3 (2.7-3.3)	2.2 (1.9-2.6)	2.98	0.003

3.6.3 Attitudes towards thresholds

The subjects were asked if they would favour a threshold for driving under the influence of cannabis (Figure 29).

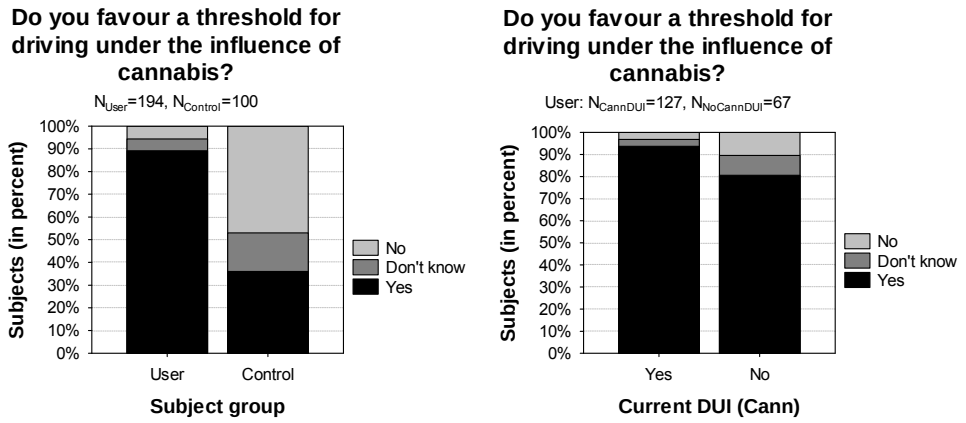


Figure 29: Being in favour of a threshold for driving under the influence of cannabis for users versus controls (left, N_{User}=194, $N_{Control}$=100) and current DUI-offenders (Cann) versus those who did not commit any THC-positive drive while participating (right, $N_{CannDUI}$=127, $N_{NoCannDUI}$=67) (in percent of mentions).

Only 36% of the controls answered “yes”, whereas most of the users (89.2%) stated that they were in favour (Figure 29, left; Table 34). The most frequently specified reasons were the long traceability of the substance in body fluids and a feeling of injustice compared to persons who drink and drive. Users who drove under the influence of cannabis while participating in the study more often are in favour of a threshold compared to users who would not be affected by a threshold since they currently do not drive after cannabis anyway (Figure 29, right; Table 34).

Table 34: Percentage (±0.95 CI) and statistics of being in favour of a threshold for driving under the influence of cannabis for users versus controls (N_{User}=194, $N_{Control}$=100) and current DUI-offenders (Cann) versus those who did not commit any THC-positive drive while participating ($N_{CannDUI}$=127, $N_{NoCannDUI}$=67).

In favour of a threshold for driving under the influence of cannabis (versus don't know/no)			
$Percent_{User}$ (±0.95 CI)	**$Percent_{Control}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
89.2% (84.8%-93.5%)	36% (26.6%-45.4%)	90.78 (1)	0.000
$Percent_{CannDUI}$ (±0.95 CI)	**$Percent_{NoCannDUI}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
93.7% (89.5%-98%)	80.6% (71.1%-90.1%)	7.8 (1)	0.005

The users were also asked how high the penalty would have to be to restrain them from driving under the influence of illegal drugs. Users who had no/very few drives under influence (*LowDUI*) answered in 26.8% of the cases that they never drive under influence and in 17.5% of the cases that they would always drive no matter how high the penalty was. Of the users who had a high proportion of drives under influence of all drives (*HighDUI*) 4.1% stated that they would never drive and 30.9% stated that they would always drive (Figure 30). Of the remaining subjects (N_{LowDUI}=54, $N_{HighDUI}$=63) 72.2% of the LowDUI-group stated that a penalty of up to 500 euros would deter them from intoxicated driving compared to around 50% in the HighDUI-group (Table 35). The other 50% of the latter group said that they would only be deterred from DUI when the penalty was 1,000 euros and higher.

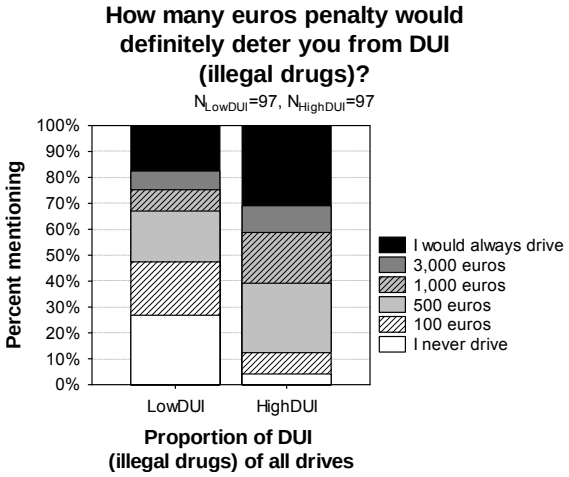


Figure 30: Level of penalty that deters from DUI for those who had a higher proportion of DUI (illegal drugs) of all drives than the median ($N_{HighDUI}$=97) and those who had a lower proportion (N_{LowDUI}=97) (in percent of mentions).

Table 35: Percentage (±0.95 CI) and statistics of being deterred from DUI by a penalty of less than 1,000 euros for those who had a higher proportion of DUI (illegal drugs) of all drives than the median ($N_{HighDUI}$=97) and those who had a lower proportion (N_{LowDUI}=97).

Being deterred from DUI by a penalty of less than 1,000 euros (versus 1,000 euros and more)			
$Percent_{HighDUI}$ (±0.95 CI)	**$Percent_{LowDUI}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
54% (37.2%-70.7%)	72.2% (58.2%-86.3%)	4.18 (1)	0.041

Another question referred to the subjects' acceptance of the implementation of the zero-tolerance for young and novice drivers for driving under alcohol influence. 80% of the controls answered "*yes, better would be 0.00% for everyone*" (*Yes, for all*) or "*yes, I am in favour of it, it is safer*" (*Yes, safe*). Of the users only 61.3% approved the zero-tolerance (Figure 31, left; Table 36). With reference to different age groups (Figure 31, right; Table 36), again, those subjects whom it concerns the most are less enthusiastic about the zero-tolerance. 58.5% of the 18-24-years-olds approve of the zero-tolerance compared to 80.5% of the 25-39-years-olds.

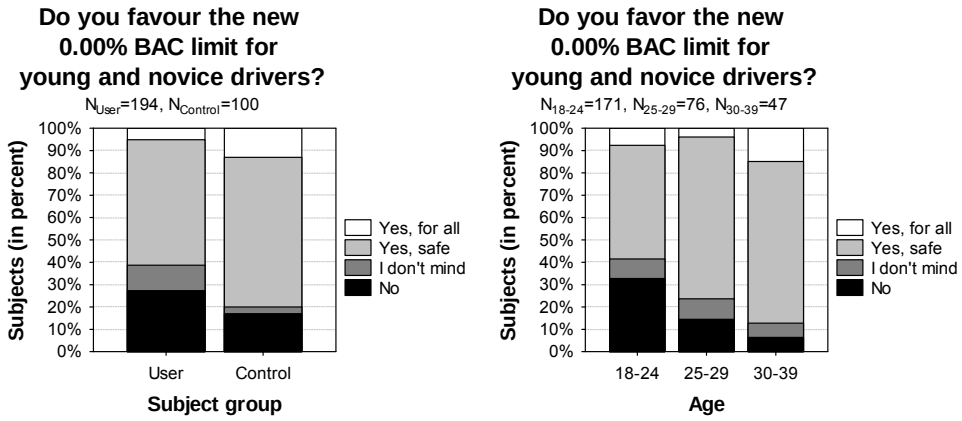


Figure 31: Being in favour of the new 0.00% BAC limit for young and novice drivers for users versus controls (left, N_{User}=194, $N_{Control}$=100) and 18-24-year-olds versus 25-29- and 30-39-year-olds (right, N_{18-24}=171, N_{25-29}=76, N_{30-39}=47) (in percent of mentions).

Table 36: Percentage (±0.95 CI) and statistics of being in favour of the new 0.00% BAC limit for young and novice drivers for users versus controls (N_{User}=194, $N_{Control}$=100) and 18-24-year-olds versus 25-39-year-olds (N_{18-24}=171, N_{25-39}=123).

In favour of the new 0.00% BAC limit for young/novice drivers ("*yes, for all*", "*yes, safe*" versus "*I don't mind*", "*no*")			
$Percent_{User}$ (±0.95 CI)	**$Percent_{Control}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
61.3% (54.5%-68.2%)	80% (72.2%-87.8%)	10.5 (1)	0.001
$Percent_{18-24}$ (±0.95 CI)	**$Percent_{25-39}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
58.5% (51.1%-65.9%)	80.5% (73.5%-87.5%)	15.84 (1)	0.000

Furthermore, the subjects were asked which alcohol limit they would suggest for driving a motor vehicle. The answers were divided into the classes "*<BAC 0.05%*", "*BAC 0.05%*", and "*>BAC 0.05%*". Controls more often took the view that the legal BAC limit should be lower than 0.05% compared to users (Figure 32, left). The same is true for subjects who moderately drink alcohol compared to heavy and excessive alcohol users (Figure 32, right)[25]. Comparing the subjects according to their age shows no significant differences (Figure 32, middle; Table 37).

[25] Moderate use (N=167): ≤24 g/day (male), ≤12 g/day (female);
Heavy use (N=99): >24-60 g/day (male), >12-40 g/day (female);
Excessive use (N=28): >60 g/day (male), >40 g/day (female).

Figure 32: Level of desired alcohol limit (>BAC 0.05%, BAC 0.05%, <BAC0.05%) for users/controls (left), for 18-24-year-olds/25-29-year-olds/30-39-year-olds (middle), and moderate/heavy/excessive alcohol users (right) (in percent of mentions, number of subjects see in figure).

Table 37: Percentage (±0.95 CI) and statistics for desired alcohol limit (<BAC 0.05%) for users/controls, 18-24-year-olds/25-29-year-olds/30-39-year-olds, moderate/heavy/excessive users (number of subjects see in Figure 32).

Percentage of desired alcohol limit lower than 0.05% (analysis over all categories)				
Subject group				
	Perc. $_{User}$ (±0.95 CI)	**Perc.$_{Control}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
	16.5% (3.6%-29.4%)	36% (20.3%-51.7%)	15.35 (2)	0.000
Age group				
Perc.$_{18-24}$ (±0.95 CI)	**Perc.$_{25-29}$ (±0.95 CI)**	**Perc.$_{30-39}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
26.9% (14.7%-39.7%)	17.1% (-)	19.1% (-)	3.72 (4)	0.445
Alcohol consumption				
Perc. $_{Moderate}$ (±0.95 CI)	**Perc. $_{Heavy}$ (±0.95 CI)**	**Perc.$_{Excessive}$ (±0.95 CI)**	**chi-square (df)**	**p-value**
31.1% (18.6%-43.7%)	11.1% (-)	17.9% (-)	30.27 (4)	0.000

The subjects were further asked to indicate how much beer, wine and/or liquor they would have to drink to reach a BAC of 0.1% and how much they can drink at maximum and still be able to drive safely. The stated amount of alcoholic beverages was converted into grams of alcohol. For the graphic presentation (Figure 33) of the statements dependent on the consumption group (*moderate*, *heavy*, *excessive alcohol users*) the converted grams of alcohol were further categorised into 20 grams categories (*<20 grams*, *20-40 grams*… *≥140 grams*). For the analysis the original converted values in grams of alcohol were used (Table 38).

According to the Widmark Formula (Widmark, 1932) a person has to drink around 60-80 grams of alcohol in three hours to reach a BAC of 0.1%, and around 30-40 grams of alcohol in one and a half hours to reach a BAC of 0.05%. Around 60% of moderate and heavy alcohol users think that a person has to drink 80 grams of alcohol at maximum to reach a BAC of 0.1%. Excessive users more often assume a higher amount necessary to reach this BAC level (Figure 33, left). 80% of the moderate users stated being able to drink 40 grams of alcohol at a maximum and still drive safely, whereas 50% and more of heavy and excessive users stated higher alcohol amounts (Figure 33, right). The corresponding analysis reached significance (Table 38).

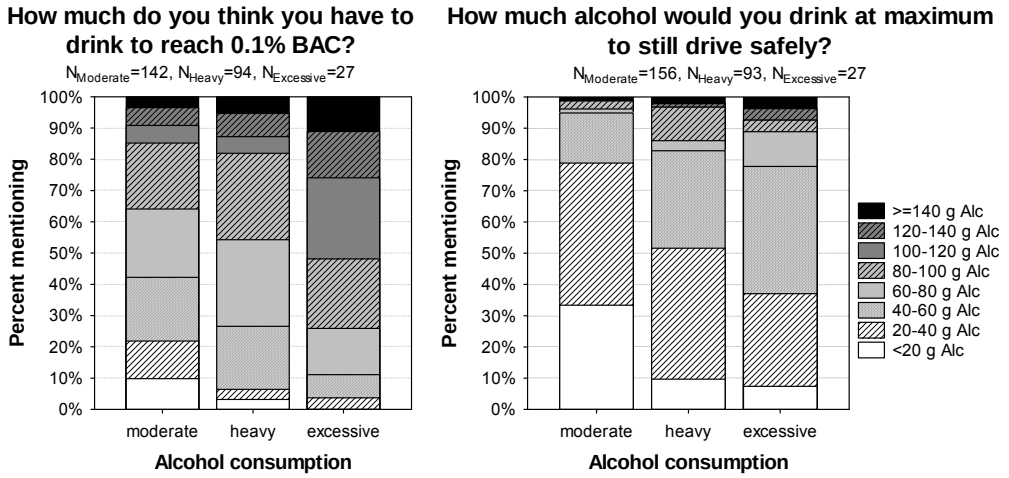


Figure 33: Estimated amount of alcohol (in grams of alcohol) to reach 0.1% BAC (left) and to still drive safely (right) for moderate, heavy, and excessive alcohol users (in percent of mentions, number of subjects see in figure).

Table 38: Estimated mean amount of alcohol (in grams of alcohol; ±0.95 CI) and statistics to reach 0.1% BAC and to still drive safely for moderate, heavy, and excessive alcohol users (number of subjects see in Figure 33).

Estimated mean amount of alcohol to reach 0.1% BAC and to still drive safely					
	$Mean_{Moderate}$ (±0.95 CI)	**$Mean_{Heavy}$ (±0.95 CI)**	**$Mean_{Excessive}$ (±0.95 CI)**	**F**	**p-value**
0.1% BAC	63.2 (57-69.4)	72.2 (65.8-78.6)	94.7 (81.1-108.4)	9.61	0.000
Drive safely	25 (20.5-29.4)	38.8 (33-44.7)	43.9 (31-56.7)	9.62	0.000

3.6.4 General attitudes

The following questions refer to general attitudes:

1. How satisfied are you with your personal life situation on the whole? (*Satisfaction*)
   High scale value → high satisfaction
2. To what extent do you agree with the following statement: "Someone who is always concerned with his health has no fun."? (*HealthAware*)
   High scale value → high health awareness (originally low health awareness, item was recoded)
3. To what extent do you agree with the following statement: "I try to eat only healthy food."? (*HealthFood*)
   High scale value → high healthy nutrition
4. To what extent do you agree with the following statement: "If a constitutional state is to function, all laws have to be observed strictly!"? (*LawAware*)
   High scale value → high awareness of law

Users (N_{User}=194) compared to controls ($N_{Control}$=100) are less satisfied with their personal life situation, are less convinced that obeying the law is beneficial in a constitutional state, and are less aware of a healthy way of life (Figure 34, left; Table 39). The subjects' general intention to eat only healthy food does not differ between users and controls. One presumption when analysing influencing factors of illegal behaviour (use of illegal drugs, drug driving) is a perceived effect of the attitude towards compliance with the law on the degree of illegal behaviour. Comparing moderate, heavy and excessive users (N_{Moder-}

$_{ate}$=100, N_{Heavy}=41, $N_{Excessive}$=53) of illegal drugs[26] with each other and those users who frequently drive under influence[27] with those who rather infrequently drive under influence (N_{LowDUI}=98, $N_{HighDUI}$=96) shows no difference dependent on the degree of law awareness (Figure 34, right; Table 39).

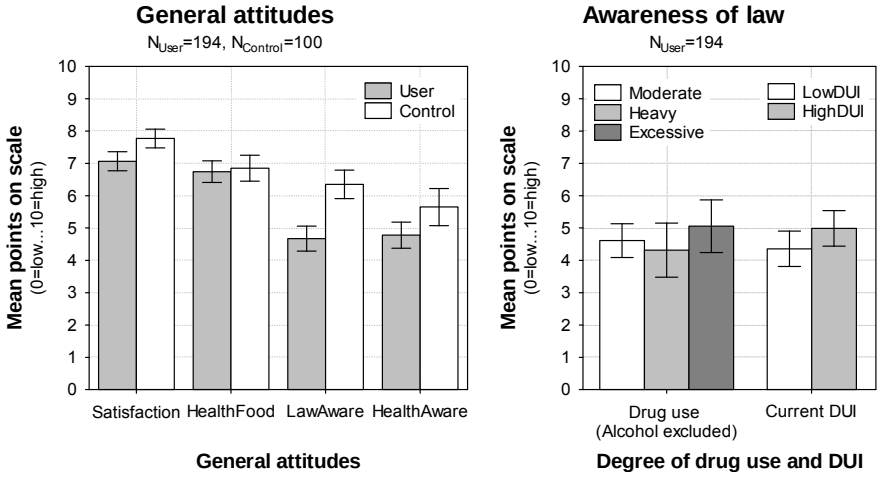


Figure 34: General attitudes (satisfaction, healthy nutrition, law awareness, health awareness) of users (N_{User}=194) and controls ($N_{Control}$=100) and law awareness of moderate/heavy/excessive users and frequent/infrequent drug drivers (LowDUI/HighDUI) (Mean, ±0.95 CI).

Table 39: Mean (±0.95 CI) and statistics of subjects' general attitudes (satisfaction, healthy nutrition, law awareness, health awareness) of users and controls (N_{User}=194, $N_{Control}$=100), mean (±0.95 CI) and statistics of subjects' law awareness of moderate/heavy/excessive users and frequent/infrequent drug drivers (LowDUI/HighDUI) (number of subjects see in text above).

General attitudes				
	Mean$_{User}$ (±0.95 CI)	**Mean$_{Control}$ (±0.95 CI)**	**F**	**p-value**
Satisfaction	7.1 (6.8-7.4)	7.8 (7.5-8.1)	9.05	0.003
Healthy nutrition	6.7 (6.4-7.1)	6.8 (6.4-7.3)	0.15	0.698
Law awareness	4.8 (4.4-5.2)	5.6 (5.1-6.2)	28.15	0.000
Health awareness	4.7 (4.3-5.1)	6.4 (5.9-6.8)	6.05	0.014
Law awareness				
Mean$_{Moderate}$ (±0.95 CI)	**Mean$_{Heavy}$ (±0.95 CI)**	**Mean$_{Excessive}$ (±0.95 CI)**	**F**	**p-value**
4.6 (4.1-5.1)	4.3 (3.5-5.2)	5.1 (4.2-5.9)	0.90	0.410
	Mean$_{LowDUI}$ (±0.95 CI)	**Mean$_{HighDUI}$ (±0.95 CI)**	**F**	**p-value**
	4.4 (3.8-4.9)	5 (4.4-5.5)	2.62	0.107

3.7 Knowledge of legislation and sanction severity

3.7.1 Legal binding consequences for getting caught in Germany

The legal consequences in Germany for getting caught while driving under influence are shown in Table 40. In February 2009 the fines for traffic offences were doubled. Former fines are also listed in Table 40 (in brackets). The offences are differentiated between administrative and criminal offences. In the case of illegal drugs and a BAC between 0.03% and less than 0.11% the prerequisite for a criminal sentence is the occurrence of

[26] Illegal drug use: use of illegal drugs and/or non-prescribed medicines (alcohol excluded).

[27] Drives under influence: drives under influence of illegal drugs and/or non-prescribed medicines and/or alcohol above the legal limit (BAC 0.00% for young and novice drivers and BAC 0.05% for all other drivers, respectively).

signs of impairment. A BAC of 0.11% and more is always treated as a criminal offence. If someone gets caught with a BAC of 0.16% and higher and in most of the cases when someone gets caught while driving under the influence of illegal drugs, a medical and psychological assessment (MPA) is ordered because the fitness to drive is regarded as questionable.

Table 40: Legal consequences for driving under the influence of drugs or alcohol in Germany.

Administrative offence § 24 StVG[28] (§ 24c for BAC 0.00% | § 24a for BAC 0.05% and drugs)	**Criminal offence § 316 StGB[29]**	**MPA § 14 FeV[30]**
drugs (zero tolerance) Signs of impairment		
4 demerit points 500 (1st offence) -1,500€ (3rd offence) (before 01.02.2009: 250-750€) 1 (1st offence) - 3 (2nd, 3rd offence) months driving ban	7 demerit points Penalty or prison up to 1 year Withdrawal (6 months to 5 years)	very likely
BAC 0.00% for all drivers younger than 21 and newly licensed drivers for the first two years of having a licence		
2 demerit points 250€ (before 01.02.2009: 125€) no driving ban, but rehabilitation programme and extension of probationary licence (2 years)		
BAC 0.03% From BAC 0.03% on and signs of impairment		
(neither administrative nor criminal offence, but partial liability in the case of a not self-inflicted accident)	7 demerit points Penalty or prison up to 1 year Withdrawal (6 months to 5 years)	
BAC 0.05%		
4 demerit points 500 (1st offence) -1,500€ (3rd offence) (before 01.02.2009: 250-750€) 1 (1st offence) - 3 (2nd, 3rd offence) months driving ban		
BAC 0.11%		
	7 demerit points Penalty or prison up to 1 year Withdrawal (6 months to 5 years)	
BAC 0.16% (also for cycling)		
	7 demerit points Penalty or prison up to 1 year Withdrawal (6 months to 5 years)	very likely
In the case of **endangerment** or an **accident** drives at all BACs above the respective limit and all drives under the influence of drugs **§ 315c StGB**		
	7 demerit points Penalty or prison up to 5 years Withdrawal (>1 year)	

3.7.2 Knowledge of legislation

The subjects' knowledge about the legal consequences that are faced when driving under the influence of drugs or alcohol and the subjective sanction severity were queried by open questions at the last contact (N=293[31]) (Table 41).

[28] Straßenverkehrsgesetz: German Road Traffic Act
[29] Strafgesetzbuch: German Penal Code
[30] Fahrerlaubnisverordnung: German Driver Licensing Act
[31] Two subjects did not deliver information because they left the study ahead of time and in these cases no detailed final inquiry was carried out.

Table 41: Q-End questions concerning the knowledge of legislation and the subjective sanction severity.

Question
A driver took drugs and drives under influence. He gets caught by the police. He has no drugs on his person, showed no driving mistakes or substantial deficits, and was not involved in an accident. What do you think are the legal consequences? Please name everything that comes into your mind. What is the legal BAC limit in Germany? A driver drives with a higher BAC than that and gets caught by the police. The person showed no driving mistakes or substantial deficits and was not involved in an accident. What do you think are the legal consequences? Please name everything that comes into your mind. Are there any other BAC limits in Germany? If yes, which one? And what are the consequences when driving with a higher BAC? → **Knowledge of legislation**
How severe do you rate the just mentioned sanctions (for drugs and each mentioned BAC limit separately)? 0=not severe ... 10=very severe → **Subjective sanction severity**

3.7.2.1 Data overview and data preparation

In 4.1% (N=44) of all mentioned offences[32] the subjects did not know what consequences are to be expected when driving under the influence of illegal drugs or with a BAC above the mentioned limit. In all other cases they most often stated a driving ban (76%) and a fine (70.6%), and least often demerit points (44.3%) (light and dark grey bars Figure 36). The light grey bars refer to cases when subjects mentioned the consequence but did not specify the extent in months (driving ban), euros (fine), and number of points (demerit points), respectively. The plain bars refer to cases when subjects additionally (or solely in the case of *no* driving ban/fine/demerit points) mentioned a MPA or withdrawal as consequence. The proportions of mentioning a MPA/withdrawal are quite comparable for the different conditions concerning a fine and demerit points, and also for the detailed mentioning of a driving ban in months (dark grey bar, #1). But when the subjects did not mention a driving ban, the mentioning of a MPA/withdrawal was quite unlikely (white bar, #1), whereas in almost all the cases when the subjects mentioned a driving ban but did not specify the extent, they additionally mentioned a MPA/withdrawal (light grey bar, #1). In these cases and in the case that no driving ban but withdrawal was mentioned the missing information about the duration of the driving ban/withdrawal was set to 6 months for further analysis.

In the case young or novice drivers get caught while driving under the influence of alcohol (BAC<0.05%), no driving ban is imposed but the driver has to participate in a rehabilitation programme and the probationary period becomes extended for an additional two years. Figure 35 shows that in 73% of the cases the subjects mentioned either a rehabilitation programme or the extension of the probationary period as a consequence for getting caught with a BAC above zero as young or novice driver. For all other BAC limits and for driving under the influence of drugs these consequences were stated rather infrequently. When analysing the correctness of the mentioned consequences (Chapter 3.7.2.3), the specification of no driving ban for young and novice drivers when driving under the influence of alcohol is only regarded as correct in combination with the mentioning of either a rehabilitation programme or the extenstion of the probationary period (*reha/prob*).

[32] $N_{Offences}$=1070; 293 refer to illegal drugs; 777 refer to alcohol, i.e. on average 2.7 mentioned BAC limits per person (those mentioned BAC limits that could not be assigned to any of the existing BAC limits in Germany are not included therein; N=8).

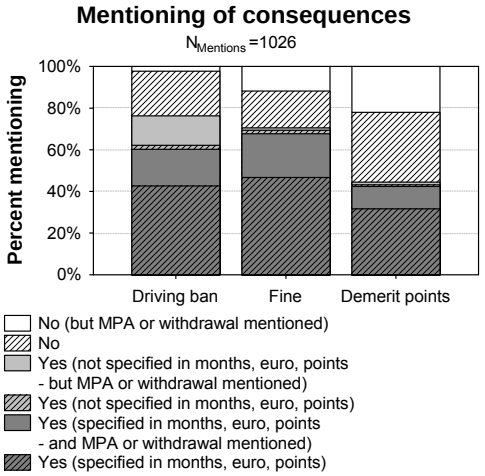


Figure 36: Percent of mentioning driving ban, fine, and demerit points as consequence (yes, no) dependent on if additionally a MPA and/or withdrawal was mentioned and if the extent was specified in months, euros, and number of points, respectively ($N_{Mentions}$=1026).

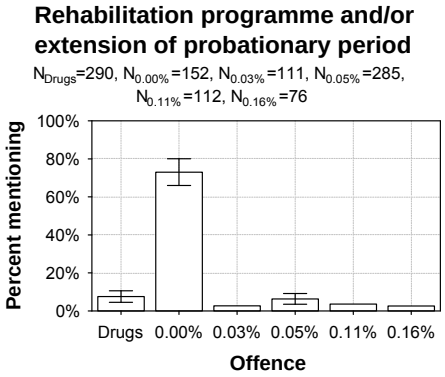


Figure 35: Frequency of mentioning the participation in a rehabilitation programme and/or the extension of the probationary period as consequence of driving under the influence of drugs or with a BAC above the different BAC limits (0.00% for young and novice drivers; 0.05% for all other drivers; 0.03%, 0.11%, 0.16% for all drivers; in percent, ±0.95 CI) (number of cases see in figure).

Table 42 shows in addition to the above described consequences all other consequences that were mentioned. Further criminal proceedings (17.7%), and a blood (7.7%) or urine test (3.8%) were mentioned quite often, whereas the remaining consequences were rather infrequently mentioned.

Table 42: Type of mentioned consequences for driving under the influence of illegal drugs or alcohol and percent of mentioning (±0.95 CI).

Kind of consequence	Percent of mentioning	±0.95 CI
Driving ban	76%	73.4%-78.6%
Fine	70.6%	67.8%-73.4%
Demerit points	44.3%	41.3%-47.3%
Further criminal proceedings	17.7%	15.4%-20%
Rehabilitation programme/extension of probationary period	15.6%	13.4%-17.8%
Blood test	7.7%	6.1%-9.3%
Urine test	3.8%	2.6%-5%
Search warrant (house or car)	1.9%	1.1%-2.7%
Order to leave the car	1.4%	0.7%-2.1%
Community service	1.3%	0.6%-2%
Prison	0.2%	-
Sobering-up cell	0.1%	-

3.7.2.2 Number of mentioned BAC limits

In Germany there are five BAC limits that regulate driving under the influence of alcohol. Most subjects mentioned two (36.5%) or three (36.5%) different BAC limits (Figure 37). Only eight subjects mentioned all BAC limits that exist in Germany (2.7%)[33].

[33] 3 users (1.5% of all users) versus 5 controls (5%); all aged 18-29 years; 7 males (3.8%) versus 1 female (0.9%); 5 moderate to heavy alcohol users (2.1%) versus 3 excessive alcohol users (10.7%).

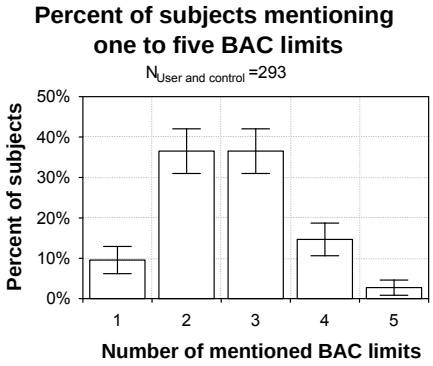


Figure 37: Percent of subjects that mentioned one to five different BAC limits within the German legislation (±0.95 CI) ($N_{User\ and\ control}$=293).

The most often stated BAC limit was 0.05% (N=288; 98.3%; Figure 38, left). The second most frequently mentioned BAC limit was the zero tolerance for young and novice drivers (N=157; 53.6%) – although it was mentioned quite rarely compared to the 0.05% BAC.

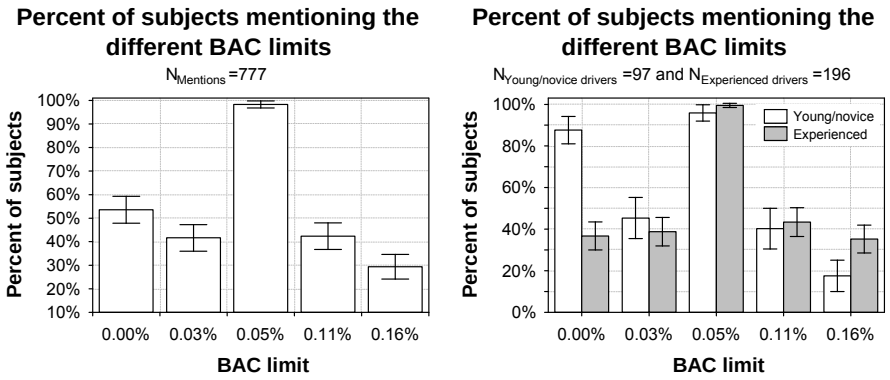


Figure 38: Percent of subjects that mentioned the different BAC limits of all subjects (left figure, $N_{Mentions}$=777) and separated for young/novice (BAC limit 0.00%, N=97) and experienced drivers (BAC limit 0.05%, N=196) (±0.95 CI).

Nevertheless, when comparing the young and novice drivers (BAC limit 0.00%) with the experienced drivers (BAC limit 0.05%) (Figure 38, right), a clear difference was found. Those drivers for whom the zero tolerance applies mentioned it much more often (87.6%) than those drivers for whom it does not apply (36.7%). Moreover, 12.4% of the young and novice drivers did not know that for them the zero tolerance applies. Among others, they mentioned the 0.05% BAC limit. The 0.03% and 0.11% BAC limit were mentioned by around 40% of the subjects. Here, young and novice drivers did not differ from experienced drivers. Around 60% of those who named the 0.03% BAC limit referred to circumstances in which the driver does not make mistakes but is involved in an accident and is therefore punished by the insurance. The remaining 40% refer to situations in which the driver shows signs of impairment and gets punished by the criminal law even if the BAC is rather low. The 0.16% BAC limit was mentioned least frequently (29.4%) and by experienced drivers more often (28.5%) than by young and novice drivers (17.5%). In 5.3% of the cases the subjects mentioned a BAC limit but did not know which consequences would follow when driving with a higher BAC. This was most often the case for the BAC

limits 0.03% (9%), 0.11% (9.7%) and 0.16% (11.6%) (BAC limit 0.00%: 3.2%; BAC limit 0.05%: 1%; illegal drugs: 1%).

Almost all the subjects that mentioned the BAC limit for young and novice drivers correctly assessed it to be 0.00% (96.8%; Figure 39). The 0.03% and 0.05% BAC limit was assessed correctly in around 80% of the cases. Around 15% thought these two BAC levels were lower and around 5% thought they were higher. The worst assessment refers to the 0.11% BAC limit. Here 46.8% of the subjects thought it would be lower and 30.6% thought it would be higher. The percentage of those who thought the limit was higher was only 14.1% when mentioning the BAC limit of 0.16%. The correct assessment was higher for this BAC limit (41.2%) compared to the 0.11% BAC limit (22.6%)

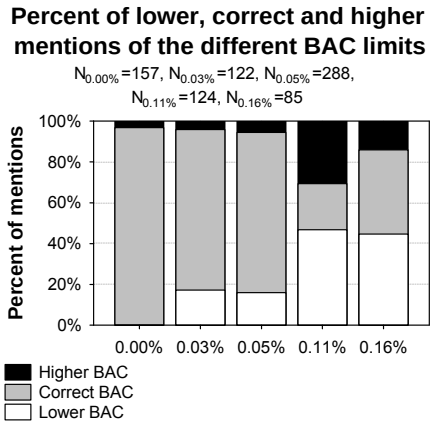


Figure 39: Percent of lower, correct, and higher mentions of the different BAC limits (0.00%, 0.03%, 0.05%, 0.11%, and 0.16%) (number of cases see in figure).

3.7.2.3 Correctness of mentioned consequences

It was analysed whether the subjects know the legal consequences of getting caught correctly or if they assess it to be higher or lower. This analysis is reduced to the main BAC limits (0.00%, 0.05%, and 0.11%) and illegal drugs. The correctness of the expected consequences was depicted by the mentioning or not mentioning of a driving ban, the order of an MPA, fines, demerit points, and subsequent criminal proceedings. All other mentioned consequences were too infrequently mentioned and were therefore ignored. It was then defined how much the statements could range from the true value (i.e. number of months of driving ban, amount of money as fine, etc.). In Table 43 these ranges can be seen in each second column of the listed consequences.

If someone gets caught while driving under the influence of illegal drugs, in most of the cases a MPA is ordered. An MPA is accompanied by a withdrawal of the driving licence until the MPA is positively passed. So even if the driving ban is actually only one month in accordance with § 24a StVG, the driving licence is in most cases withdrawn for around one year (until an ordered MPA is positively passed). Therefore, these two penalties – withdrawal and MPA – were examined together (Table 43, column *Driving ban (in months) and MPA*). Besides, in the case of illegal drugs the probability that criminal proceedings follow – either according to the StGB[34] or the BtMG[35] – is rather high. So, for

[34] Strafgesetzbuch: German Penal Code
[35] Betäubungsmittelgesetz: Controlled Substances Act

illegal drugs the specification of further criminal proceedings was considered to be right. With respect to the 0.00% BAC limit, the participation in a rehabilitation programme and the extension of the probationary period (*Reh/Prob*) were also regarded when classifying the mentioning of the driving ban correct or lower (as already mentioned in Chapter 3.7.2.1). The fines were classified according to the fines prior to the 1st February 2009 or the fines after that date depending on when the interview was conducted. The correct ranges that refer to the former fines are shown in brackets.

Table 43: Expected consequences for driving under the influence of drugs or alcohol in Germany.

	Driving ban (in months)		MPA		Driving ban (in months) and MPA		Fine (in €)		Demerit points		Criminal proceedings	
drugs (zero tolerance)												
M*/DK**	1.7%		1%		1.7%		3.4%		3.8%		1%	
lower	12.3%	<1	42%	no	32.8%	<6 and MPA =0	41.3%	(<125) <250	68.3%	<3	68.6%	no
correct	**25.9%**	1-2	**57%**	yes	**65.5%**	≥6 & MPA=0 | MPA=1	**32.4%**	(125-375) 250-750	**23.5%**	3-4	**30.4%**	yes
higher	60.1%	>2					22.9%	(>375) >750	4.4%	>4		
BAC 0.00% for all drivers younger than 21 and newly licensed drivers for the first two years of having a licence												
M*/DK**	7%		3.2%		7%		5.7%		4.5%		3.2%	
lower	3.2%	0 & Reh/Prob=0			2.5%	0 & MPA=0 & Reh/Prob=0	41.4%	(<60) <125	59.9%	0		
correct	**34.4%**	0 & Reh/Prob=1	**76.4%**	no	**29.9%**	0 & MPA=0 & Reh/Prob=1	**24.2%**	(60-190) 125-375	**15.3%**	1-2	**89.8%**	no
higher	55.4%	>0	20.4%	yes	60.5%	>0 | 0 & MPA=1	28.7%	(>190) >375	20.4%	>2	7%	yes
BAC 0.05%												
M*/DK**	3.1%		1%		3.1%		5.6%		2.8%		1%	
lower	19.8%	<1			19.4%	<1 & MPA=0	37.8%	(<125) <250	62.2%	<3		
correct	**51%**	1-2	**86.5%**	no	**47.2%**	1-2 & MPA=0	**37.8%**	(125-375) 250-750	**31.3%**	3-4	**90.6%**	no
higher	26%	>2	12.5%	yes	30.2%	>2 & MPA=0 | MPA=1	18.8%	(>375) >750	3.8%	>4	8.3%	yes
BAC 0.11%												
M*/DK**	9.7%		9.7%		9.7%		12.1%		12.1%		9.7%	
lower	31.5%	<6			23.4%	<6 & MPA=0	63.7%	≤750	71%	<5	59.7%	no
correct	**58.9%**	≥6	**50.8%**	no	**27.4%**	≥6 & MPA=0	**24.2%**	>750	**16.9%**	5-9	**30.6%**	yes
higher			39.5%	yes	39.5%	MPA=1			0%	>9		

*M= Missing (Mentioned, but without specification and MPA/Withdrawal not mentioned).
**DK="Don't know".

60.1% of the subjects expect a higher driving ban than the one that is actually imposed when caught while driving under the influence of illegal drugs. 57% expect the order of a MPA. As mentioned above, a MPA is quite likely in the case of drug offences and is accompanied by a withdrawal of the driving licence. So, a driving ban of more than six months and/or the order of a MPA were regarded as correct answer. This was mentioned by 65.5% of the subjects. For the violation of the 0.00% BAC limit most subjects expect a higher driving ban than the one that is actually imposed (55.4%). Most subjects (76.4%) correctly do not mention a MPA. In sum, only 29.9% of the subjects correctly mention no driving ban, the order of a rehabilitation programme and/or the extension of the probationary licence as well as no MPA. When considering the 0.05% and the 0.11% BAC limit around 50% of the subjects mentioned the correct extent of the driving ban. Because for the 0.11% BAC limit many subjects also expect a MPA (39.5%) the correct combination of both (driving ban and no MPA) drops to 27.4%. In the case of the 0.05% BAC limit still almost 50% correct indications are found when additionally considering the MPA mentions. Almost no one expects it to be ordered when getting caught while driving with a

BAC of above 0.05%. The fines are most often assessed lower than the correct ones. For all conditions (drugs; 0.00%, 0.05%, and 0.11% BAC limit) the correct indications amount to around 25% to 40%. The highest understatement can be found for the demerit points. Here, 60% to 70% of the subjects do not mention demerit points or assess the number to be lower than the one that is actually imposed. Criminal proceedings are rather infrequently mentioned. But for drugs and the 0.11% BAC limit, it is expected more often (~30%) than for the conditions that definitely do not involve it (0.00% BAC limit, 0.05% BAC limit: ~10%).

It was tried to quantify the subjects' knowledge. A score was calculated for each subject, separated for drugs and alcohol that expresses how good the subjects know the legal consequences. The score consists of the following points:

- one point for each correct mention of driving ban, fines, demerit points, and criminal proceedings for the main BAC limits that apply for each person (young/novice drivers: 0.00%, 0.11%; experienced drivers: 0.05% and 0.11%) and for drug offences
- one point for each additionally mentioned BAC limit (0.00% for experienced drivers | 0.05% for young/novice drivers, 0.03%, 0.16%)

Table 44 shows how the alcohol- and drug-scores are put together. The drug-related knowledge-score can reach a maximum of four points. The alcohol-related knowledge-score can reach a maximum of eleven points.

Table 44: Score definition to describe the subjects' knowledge of the legal consequences for drug and alcohol offences.

		Driving ban	Fine	Demerit points	Criminal proceeding	Mentioning	Maximum score
Drug offence		1 point	1 point	1 point	1 point		**4 points**
Alcohol offence	0.00% | 0.05%	1 point	1 point	1 point	1 point		
	0.11%	1 point	1 point	1 point	1 point		
	0.05% | 0.00%					1 point	
	0.03%					1 point	
	0.16%					1 point	
							11 points

Figure 40 shows the percentage of subjects who reached the different score levels (left: drug score, right: alcohol score) separated for users and controls (in the case of drug offences) and young/novice and experienced drivers (in the case of alcohol offences). The overall distributions of the number of correct mentions of consequences for drug and alcohol offences are quite comparable. The greater part of the subjects reached less than half of the possible number of knowledge-points and few subjects knew nearly all consequences that have to be expected.

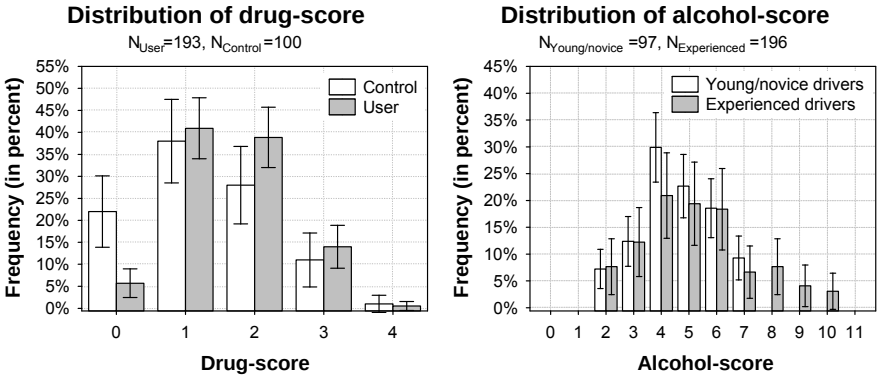


Figure 40: Distribution of drug- and alcohol-score for users and controls ($N_{Control}$=100, N_{User}=193) and young/novice and experienced drivers ($N_{Young/novice}$=97, $N_{Experienced}$=196) (in percent, ±0.95 CI).

While the users had on average 1.6 points concerning their knowledge about the legal consequences of driving under the influence of illegal drugs, the controls had with 1.3 points significantly less (t=2.95; p=0.003). Experienced drivers had on average 5.2 points concerning their alcohol-related knowledge of the legal consequences for impaired driving. Young/novice drivers had 4.6 points of eleven and therefore significantly less than experienced drivers (t=2.55; p=0.011). Users and controls did not differ in their knowledge about the consequences imposed when driving under the influence of alcohol.

3.7.3 Expected degree of sanction and subjective sanction severity

To analyze if sanctions have an effect on the frequency of impaired driving, not the correctness of the stated sanctions were consulted but the expected degree and the subjective sanction severity. Firstly, every mentioned sanction was quantified by summing up sanction-points. The higher the stated sanction (driving ban, fine, demerit points), the more points were allocated. If the participation in a rehabilitation programme and/or the extension of the probationary licence, subsequent criminal proceedings or a MPA were mentioned, additional points were allocated. The allocation of the sanction-points based on the kind and the quantity of sanctions is shown in Table 45.

Table 45: Sanctions-points.

Sanction-points due to kind and quantity of sanction			
Driving ban	**Fine**	**Demerit points**	**Others**
0 months = 0 1-2 months = 1 3-5 months = 2 ≥6 months = 3	0 € = 0 ≤250 € = 1 ≤750 € = 2 >750 = 3	0 points = 0 1-2 points = 1 3-4 points = 2 ≥5 points = 3	Reh/Prob=1 Criminal proceeding=2 MPA=2

Table 46 shows the true degree of sanction (*True sanction*) for drug offences and the main alcohol offences (0.00%, 0.05%, 0.11%) that would be reached if the correct sanction was mentioned. For drug driving and driving with a BAC of 0.11% and higher, the highest true degree of sanction was found (sanction-score=11). For violating the 0.00% BAC limit, the lowest true degree of sanction was found (sanction-score=3). For violating the 0.05% BAC limit, the true degree of sanction that was found is a little higher than the one for violating the 0.00% BAC limit and quite lower than the one for drug offences and BAC 0.11% violations (sanction-score=5).

Table 46: True degree of sanction (sanction-score) for the different offences.

	Driving ban	Fine	Demerit points	Reh/Prob	Criminal proceed.	MPA	SUM
drugs	3	2	2	0	2	2	11
BAC 0.00%	0	1	1	1	0	0	3
BAC 0.05%	1	2	2	0	0	0	5
BAC 0.11%	3	3	3	0	2	0	11

Figure 41 shows the expected degree of sanction (*Expected sanction*) contrasted with the true degree of sanction (*True sanction*) for the different offences. For drug offences and violations of the 0.11% BAC limit, the expected degree of sanction assessed by the subjects was lower than the true degree of sanction. The expected degree of sanction for violations against the 0.00% and 0.05% BAC limit were quite in line with the true degree of sanction. The highest expected degree of sanction was found for driving with a BAC of 0.11% or higher[36]. The lowest was found for driving with a BAC above the 0.00% and 0.05% BAC limit.

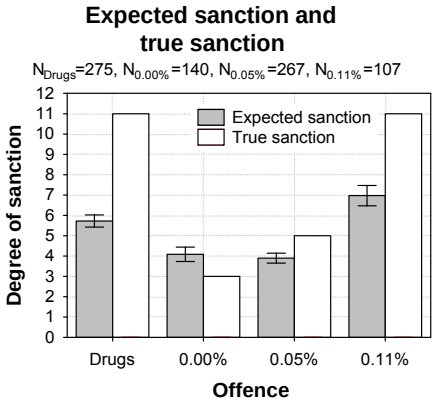


Figure 41: Expected degree of sanction and true degree of sanction calculated according to the mentioned and true sanctions imposed for the different offences (drugs, BAC>0.00%; BAC≥0.05%, BAC≥0.11%; mean, ±0.95 CI) (Number of cases see in figure).

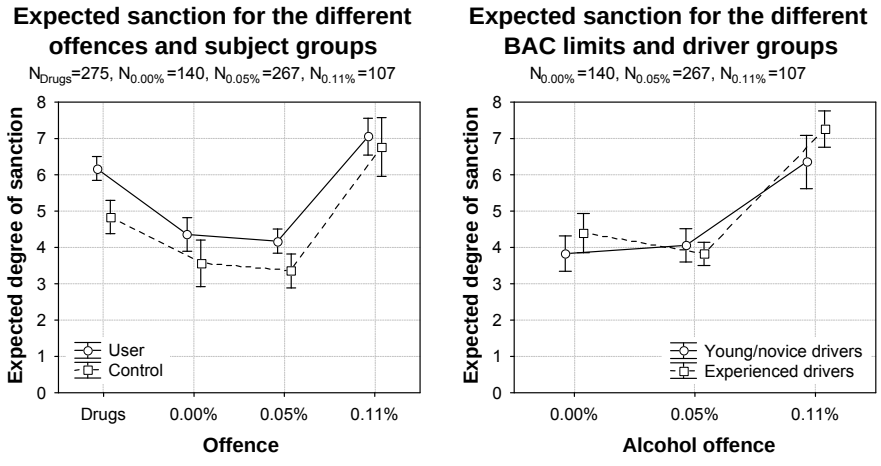


Figure 42: Expected degree of sanction for the different offences (drugs, BAC>0.00%; BAC≥0.05%, BAC≥0.11%; mean, ±0.95 CI) dependent on subject group (user, control; left) and driver group (young/novice driver, experienced driver; right) (number of cases see figure).

[36] $t_{0.11\%\text{-drugs}}$=4.32; p=0.000 | $t_{0.11\%\text{-}0.00\%}$=9.61; p=0.000 | $t_{0.11\%\text{-}0.05\%}$=12.13; p=0.000 | $t_{\text{drugs-}0.00\%}$=6.63; p=0.000 | $t_{\text{drugs-}0.05\%}$=9.29; p=0.000.

Except for the sanctions for violations of the 0.11% BAC limit, the users in general assessed the sanction to be higher than the controls (Figure 42, left)[37]. Between young/novice and experienced drivers no different assessment of the degree of sanction concerning alcohol offences was found (Figure 42, right).

The expected degree of sanction was contrasted with the subjective sanction severity (Table 41) because the latter one has most likely an effect on driving under influence. Figure 43 shows that the relative course of the expected degree of sanction and the subjective sanction severity for the different offences is quite comparable. So, the higher the expected degree of a sanction, the higher the subjective sanction severity is.

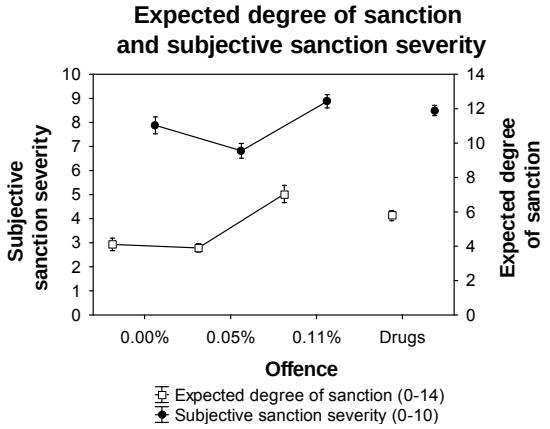


Figure 43: Expected degree of sanction and subjective sanction severity for the different offences (0.00%, 0.05%, 0.11%, drugs; mean ±0.95 CI) (N for expected degree of sanction see Figure 41; for subjective sanction severity: $N_{0.00\%}$=143, $N_{0.05\%}$=279, $N_{0.11\%}$=108, N_{Drugs}=287).

Figure 44 shows the effect of the subjective sanction severity on the frequency of impaired drives. For this illustration, the subjective sanction severity was classified into a high sanction severity and a low sanction severity (by median-split).

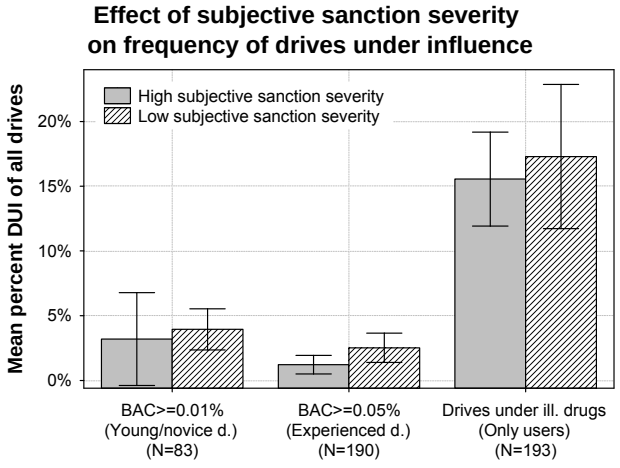


Figure 44: Effect of subjective sanction severity on the frequency of drives under influence (mean, ±0.95 CI) ($N_{Young/novice\ drivers}$=83, $N_{Experienced\ drivers}$=190, N_{Users}=193).

[37] t_{Drugs}=4.32; p=0.000 | $t_{0.00\%}$=2.15; p=0.034 | $t_{0.05\%}$=3.16; p=0.002.

The experienced drivers tend to drive more often above the legal BAC limit when the subjective sanction severity was low compared to when it was high. But this effect did not reach significance (t=1.44, p=0.153). The results for young/novice drivers when considering their mean percentage of drives above the legal BAC limit and for users when considering their mean percentage of drives under the influence of illegal drugs go in the same direction but are far from reaching significance.

4. Integration of the results

The present report focuses on person-related influences on drug consumption and drug driving. In Walter et al. (2011) persons high at risk were identified by classifying them according to their level of consumption and drug driving. Moreover, situational factors of drug driving incidences were reported. In the following, all information relevant for prevention and rehabilitation purposes drawn from the study results is integrated by referring to a qualitative model that was developed by Hargutt (cited in Krisman & Schöch, 2011: Draft of a model-tool, Section 9.2) within the framework of the DRUID project (Figure 45). The model depicts dependencies of different societal, behavioural, and legal variables that are relevant to combat driving under influence.

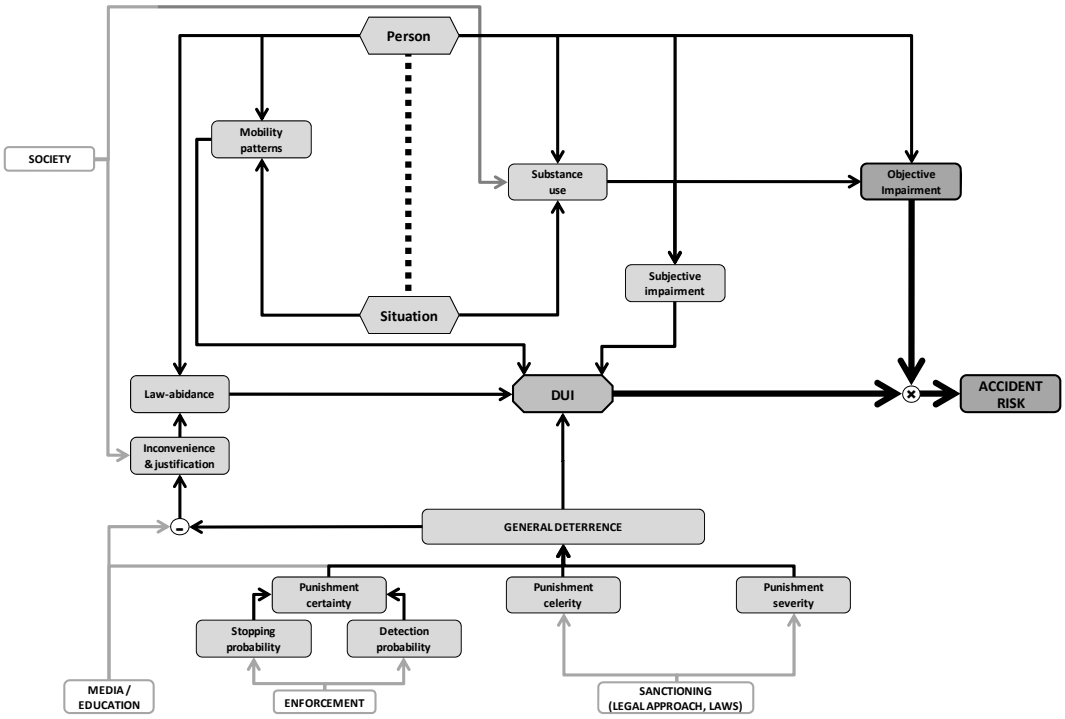


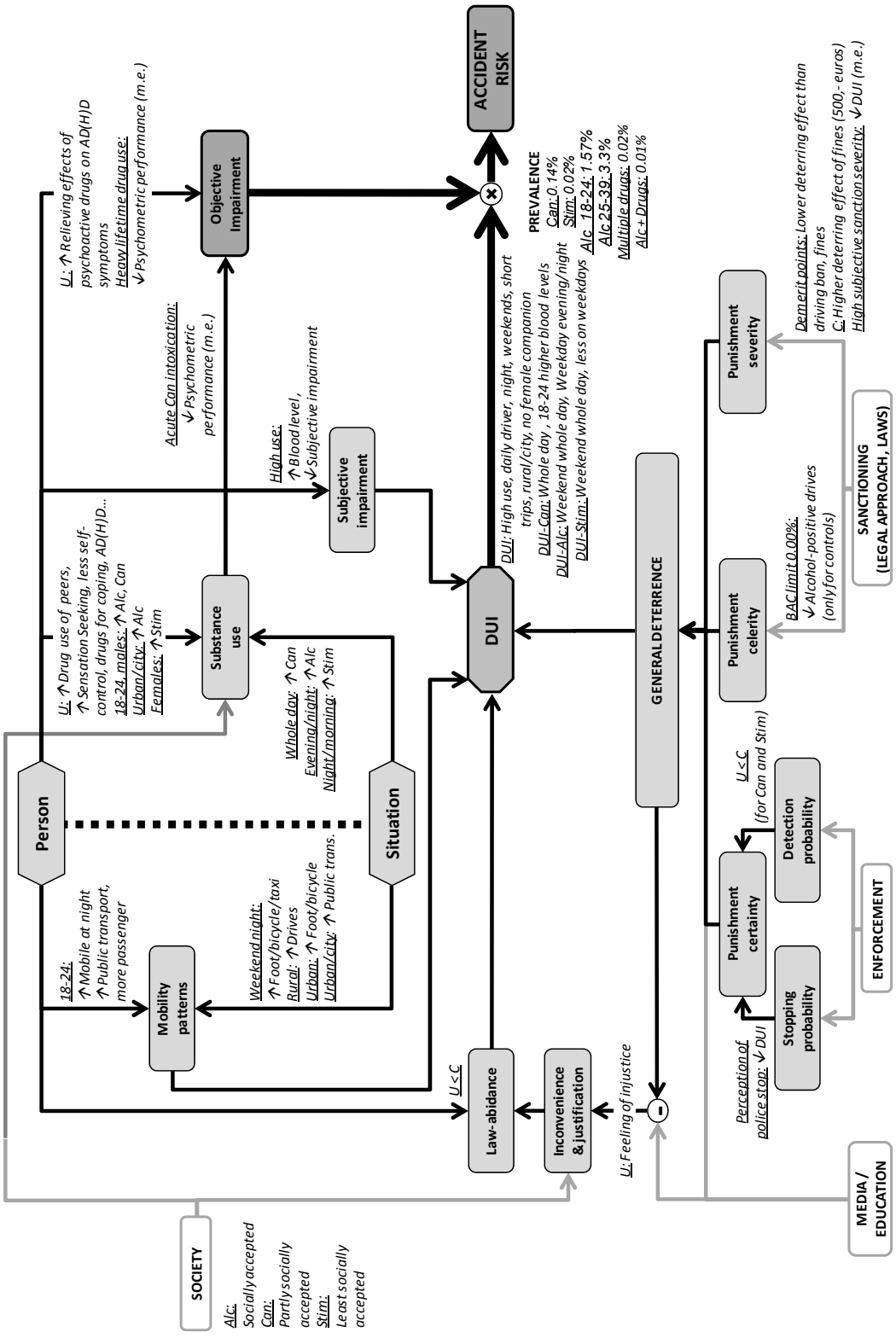
Figure 45: Model containing different societal, behavioural, and legal variables that are relevant in the context of developing measures to combat driving under influence.

In the following a short description of the variables is given:

- **SOCIETY**:
  - Demographic structure, mindset, tolerance, availability of drugs…
- **MEDIA / EDUCATION** (media efforts about sanctioning and enforcement strategies):
  - Creates awareness/acceptance and enhances general deterrence effect
- **GENERAL DETERRENCE**: Punishment certainty, punishment celerity, punishment severity, media/education
  - **PUNISHMENT CERTAINTY** (Enforcement):
    - **STOPPING PROBABILITY**: dependent on officer training, time and location of control sites

  - **DETECTION PROBABILITY**: dependent on screening devices
  - o **PUNISHMENT CELERITY** (Legal approach regarding sanctioning): Immediacy and efficiency of sanctioning (Impairment approach leads to slow juridical procedures due to obligatory court trials, whereas per se laws and zero-tolerance leads to rather quick juridical procedures because court trials are not mandatory in this case)
  - o **PUNISHMENT SEVERITY** (Laws regarding sanctioning): Severity, consistency, transparency of sanctions
- **INCONVENIENCE & JUSTIFICATION**: dependent on *society*, *general deterrence*, *media/education*
  - o Describes the limit of what a society (dependent on the mindset) will endure (e.g. control measures, surveillance)
  - o The negative nexus between *general deterrence* and *media/education* means that the effect of high deterrence on inconvenience can be lowered by media campaigns that explain and justify enforcement/sanctioning
- **PERSON**: Personality, socio-demographic characteristics, diseases, social background of a person…
- **SITUATION**: Time, weekday, companions, residence…
- **SUBSTANCE USE**: dependent on *person* (e.g. personality), *situation* (e.g. weekend night), and *society* (e.g. alcohol use socially accepted)
- **MOBILITY PATTERNS**: dependent on *person* (e.g. young persons are more mobile at night), *situation* (e.g. no availability of public transportation at night)
- **SUBJECTIVE IMPAIRMENT**: dependent on *substance use* (e.g. dose) and *person* (e.g. addicts)
- **OBJECTIVE IMPAIRMENT**: dependent on *substance use* (e.g. dose) and *person* (e.g. relieving effects of psychoactive drugs in the case of AD(H)D, other diseases)
- **LAW-ABIDANCE**: dependent on *inconvenience & justification* (e.g. high risk awareness through media efforts) and *person* (e.g. personality, addicts/patients)
- **DECISION DUI**: dependent on *subjective impairment* (e.g. low in the case of heavy users, high in the case of moderate users), *mobility patterns* (e.g. public transportation available/not available), *law-abidance* (e.g. low/high risk awareness regarding the punished behaviour), and the *general deterrent effect* (e.g. low/high perceived stopping probability)
- **ACCIDENT RISK**: dependent on the occurrence of drug driving and the *objective impairment* (multiplicative nexus: a high objective impairment is rather unproblematic when the occurrence of DUI in traffic is low, and a high occurrence of DUI is rather unproblematic when the objective impairment is low)

Figure 46 shows the main results of the study (Deliverable 2.2.2, Part I and II) assigned to single variables of the model.



U=User; C=Control; Alc=Alcohol; Can=Cannabis; Stim=Stimulants (Amphetamine, Ecstasy, Cocaine); Alc+Drugs=Alcohol+Cannabis/Stimulants/Cannabis+Stimulants, Multiple drugs=Alc+Drugs, Cannabis+Stimulants, Cannabis+Heroin; m.e.=marginal effect.

Figure 46: Model containing different societal, behavioural and legal variables that are relevant in the context of developing measures to combat driving under influence and corresponding results of the present study.

In the following a detailed description of the results of the study (Deliverable 2.2.2, Part I and II) per single variable of the model is given:

- **Prevalence** of **DUI** (Walter et al., 2011)
  - Alcohol: 1.57% for 18-24-year-olds, 3.3% for 25-39-year-olds (drug combinations included)
  - Drugs: 0.14% for cannabis (drug combinations included), 0.02% for stimulants (drug combinations included), 0.02% for multiple drugs, 0.01% for drugs in combination with alcohol
- Influence of **society** on **inconvenience and justification/substance use**
  - Alcohol use is socially accepted: 98% of the controls state that they do not abstain from drinking alcohol
  - Of all illegal drugs, cannabis is the most accepted among controls (47%), so-called "hard" drugs are scarcely accepted (8%-15%)
- Deterrence effect of **stopping probability**
  - The more probable a person thinks a police stop could occur, the more often the person decides against drug driving (Walter et al., 2011)
  - Apart from characteristics of drug intake, the decision to drive under influence is stated to depend to a great extent on the density of police controls
- Deterrence effect of **detection probability** (Walter et al., 2011)
  - Users grade the detection probability of drives under the influence of cannabis and stimulants (the main categories of DUI within the present study) lower than controls, with respect to other substances no differences were found
- Deterrence effect of **punishment celerity**
  - In Germany for young and novice drivers[38] the impairment approach for alcohol-positive drives with low BACs was exchanged by a zero-tolerance approach in 2007. So, for young and novice drivers a higher punishment celerity concerning low BACs can be assumed. It was shown that controls for whom the zero-tolerance for alcohol applies drive less often under the influence of alcohol than controls for whom the 0.05% BAC limit applies, for users no effect was found (Walter et al., 2011)
- Deterrence effect of **punishment severity**
  - Demerit points seem to have a lower deterring effect compared to driving bans and fines
  - Most users who committed no or only some drives under influence stated that a penalty of up to 500 euros would deter them from impaired driving whereas users who committed many drives under influence most often said they would only be deterred from DUI when the penalty was 1,000 euros and higher
  - A tendency was found that indicated that the more severe a sanction is evaluated, the less often the person drives under influence
- Influence of **inconvenience and justification** on **law-abidance** (developed from societal influences and legal regulations)
  - Users have a more liberal attitude towards driving under influence compared to controls
  - According to users, driving under the influence of cannabis and stimulants is less condemnable than according to controls

[38] All drivers between the ages of 18 and 21 and newly licensed drivers of any age for the first two years of having a licence.

  - Controls for whom the 0.00% BAC limit applies take driving with low BACs as more condemnable as controls for whom the 0.05% BAC limit applies (all aged 18-24)
  - Cannabis users have a feeling of injustice compared to persons who drink and drive because of the long traceability of the substance in body fluids and because of the different legislation approaches for drink and drug driving
- Influence of **person** on **substance intake**
  - Socio-demographic variables: Male drug users more often use alcohol and cannabis compared to female drug users, female drug users more often use stimulants compared to male drug users, younger drug users use drugs more often compared to older drug users, users from urban and city areas drink more alcohol, whereas users from rural areas use more cannabis (Walter et al., 2011)
  - Personality (Characteristics of users compared to controls): Sensation seeking, symptoms of hyperactivity/impulsivity in childhood, negative psychological and social after-effects due to AD(H)D symptoms, use of psychoactive substances as coping strategy, openness to new experiences and motivation in response to cues for reward, external locus of control, less conscientiousness, awareness of fallibility with regards to own driving behaviour
  - Mental diseases (Characteristics of users compared to controls): Drug Dependence and Abuse Disorders, Mental diseases (especially Mood Disorder, i.e. Major Depression with Recurrent Episodes and Bipolar Disorders, AD(H)D, and Borderline Personality Disorder), clinically impairment or distress due to drug use, intention to change/stop substance consumption
  - Users report that substance use and drug driving is quite common in their social environment (family, peers)
  - Users report lower attachment to parents and lower parental monitoring which is said to spawn a tendency to behave delinquently, in the present case to use drugs
- Influence of **situation** on **substance intake**
  - Higher consumption on weekends than on weekdays and at nights compared to at daytime, cannabis is consumed rather all day long, alcohol mainly in the evening/at night, stimulants especially late at night/in the early morning (Walter et al., 2011)
  - Excessive and to some part heavy users use drugs all day long and independent from the day of the week whereas moderate users restrict consumption to evenings/nights and weekends
- Influence of **person** on **mobility pattern**
  - 18-24-year-olds more often use other modes of transportation instead of driving (Walter et al., 2011) and are more mobile at night
- Influence of **situation** on **mobility pattern**
  - Subjects from urban and city areas especially use public transportation instead of driving, subjects from urban areas also more often walk or use a bicycle, subjects from rural areas drive more often, on weekend nights the proportion of trips by foot, bicycle or taxi is higher (Walter et al., 2011)
- Influence of **person/substance intake** on **subjective impairment**
  - For alcohol a dose-dependent subjective impairment was found (Walter et al., 2011)
  - For cannabis only for moderate and heavy users a dose-dependent subjective impairment was found (Walter et al., 2011)
  - For excessive cannabis users no dose-dependent subjective impairment was found, even if they have higher THC blood levels while driving compared to mod-

erate and heavy users they do not report a higher subjective impairment (Walter et al., 2011)
  - Excessive users more often developed a tolerance to the substance they are using
  - Heavy and excessive alcohol users take the view that they can drink higher amounts of alcohol and still have the ability to drive safely
- Influence of **substance intake** on **objective impairment**
  - Acutely cannabis intoxicated users show a marginally lower psychometric performance of driver aptitude
- Influence of **person** on **objective impairment**
  - Users compared to controls report more relieving effects of psychoactive substances on AD(H)D symptom
  - Heavy lifetime drug users (so-called “soft” and “hard” drug users) compared to controls and light drug users (esp. so-called “soft” drug users) show a marginally lower psychometric performance of driver aptitude
- Influence of **person** on **law-abidance**
  - Users have a lower willingness to law abidingness than controls
- Influence of **substance use/subjective impairment** on **DUI** decision
  - The more one consumes, the more drives under influence one commits and the higher the level of intoxication while driving impaired is (Walter et al., 2011)
  - The decision to drive under influence is stated to mainly depend on characteristics of drug intake (amount, type and effect of consumed drug, time of drug consumption), especially on the time between drug consumption and driving
  - If subjects should decide between consumption and driving, excessive users less often decide against drug driving, whereas heavy and moderate users often refrain from driving, moderate users additionally relatively often refrain from consumption or restrict their consumption because of a drive (Walter et al., 2011)
- Influence of **mobility patterns** on **DUI decision**
  - DUI is more common in the evening/at night and on weekends, although the proportion of refraining from driving or drug use to avoid drug driving is highest at that time, too (Walter et al., 2011)
  - Drives under the influence of cannabis are committed quite often at any time of the day, on weekdays especially in the evening, on weekends also late at night; drives under the influence of alcohol most often occur in the evening/at night, on weekends additionally in the morning/afternoon due to residual effects from drinking the day before; drives under the influence of stimulants most often occur on weekends, mostly in the evening/at night, but also quite often in the morning/afternoon (Walter et al., 2011)
  - Drives under influence are more common on short trips than trips that cover longer distances, even though subjects often refrain from driving on short trips; on longer trips the proportion of refraining from consumption because of the drive is highest (Walter et al., 2011)
  - Drives under influence are least frequent in urban areas compared to rural and city areas where the possibility of using public transport is rather low at times when drug driving is most common and the distances that had to be covered are rather far (Walter et al., 2011)
  - If female companions are present, the proportion of drives under influence is lowest; if a male and a female person accompany each other males more often decide against and females more often decide towards driving under influence (Walter et al., 2011)

- o If subjects decided against drug driving, a difference was found depending on the general frequency of driving: subjects who generally drive less frequently more often consume as usual and refrain from driving because of previous consumption whereas more regular drivers more often restrict their consumption because of the necessity to drive (Walter et al., 2011)
- o Apart from characteristics of drug intake, the decision to drive under influence is stated to depend to a great extent on whether or not passengers could be endangered and if there exists a possible option to ride along with another person

5. Discussion

5.1 Study aim and methodological approach

The present study was conducted within Work Package 2 (Epidemiology) of the EU-funded project DRUID (Driving under the influence of drugs, alcohol, and medicines) in order to estimate the prevalence of psychoactive substances within the German driver population and to identify preventive and promotive circumstances of drug driving. From information about how many drivers are exposed to drive under influence and information about how often an intoxicated driver is involved in an accident, the accident risk caused by a substance can be specified.

There are representative data about driving behaviour and about the prevalence of drug consumption in general, documented by national and international institutions every few years. Nevertheless, what has been lacking up to now is the combination of data about the consumption of psychoactive substances and driving behaviour in order to get information about driving under the influence of psychoactive substances in Germany. The basic intention of the present study is to close this information gap by introducing a new methodological approach.

To capture real-time data about drug consumption and driving, a repeated-entry diary technique was applied by using smartphones as study devices. The final sample consists of 195 drug users[39] and 100 controls out of the normal driving population stratified for sex, age (18-24-year-olds, 25-29-year-olds, and 30-39-year-olds), and residence (rural, urban, and city area). A questionnaire was installed on smartphones and was filled in daily for 28 consecutive days. All activities were listed in chronological order with the focus on drug consumption and driving. For a detailed description of the methodology see Walter et al. (2011). For defining a drive as being under influence, BACs and THC blood plasma levels were calculated using the information given by the subjects in their daily reports about the consumed amount of alcohol and cannabis and the time delay between consumption and driving. For the BAC calculation, the Widmark formula was applied (Widmark, 1932); for the calculation of THC blood plasma levels, the elimination curve determined by Sticht (G. Sticht, personal communication, December 2009). For all other substances, the doubled half life was used to define a drive as drive under influence: Drives within the doubled half life time after consumption were classified as drug-positive. Through this synchronisation of data about drug use and driving, it was possible to assess the frequency of drug driving (i.e. prevalence rates for the general German driving population) and the situational aspects of such incidences (e.g. time, day, distance, companions). Furthermore, an extended diagnostic part was included in the study to gather person-related driver characteristics (e.g. socio-demographic information, relevant previous experiences, major mental diseases, psychometric performance of driver aptitude, personality variables, information about the social context, attitudes, knowledge about legislation, and information about the subjective sanction severity).

[39] Originally 200 users, 5 were excluded from all analysis because they did not use cannabis within the study period.

Through the longitudinal observation of drug use and driving behaviour of single persons, it was possible to identify driving, consumption, and drug driving patterns, and to connect the high risk behavioural patterns with situational and person-related influencing factors. So, a database for quantifying the drug driving prevalence as well as for analysing mediating and modifying factors that serve as major input on rehabilitation and prevention was created. Prevalence rates estimated by the survey results of the present study and identified situational factors of drug driving were reported in Walter et al. (2011). This report focuses on person-related factors of drug use and drug driving, i.e. the characteristics of drug users and drug impaired drivers.

5.2 Study results

Mental diseases

To assess any psychological problems of the subjects, the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) was conducted (Wittchen et al., 1997). Additionally, the subjects were queried about former psychological health problems diagnosed by physicians. The number of diagnoses per person (Substance Use Disorders excluded) tends to be higher for users compared to controls. Users were more often than controls diagnosed with a Mood Disorder (i.e. Major Depression with Recurrent Episodes and marginally more often Bipolar Disorders), AD(H)D, and marginally more often with a Borderline Personality Disorder (Lifetime prevalence). On the other hand, controls more often received the diagnosis of a Panic Disorder without Agoraphobia. With respect to Substance Use Disorders, users were most often diagnosed with Alcohol, Cannabis, and Multiple Drug Abuse or Dependence. Furthermore, the diagnosis Amphetamine Abuse and Abuse of Other Drugs (Sniffing agents, methylphenidate) was quite common. Less common but still more often diagnosed than in the control group were the diagnoses of Amphetamine, Cocaine, and Opiates Dependence as well as Sedatives and Hallucinogens Abuse. Moderate, heavy, and excessive users of alcohol, cannabis, and stimulants not only differ depending on the amount they consume per day/month. They also differ depending on the reported effects of substance consumption on their well-being. The higher the consumption, the higher the clinically significant impairment or distress expressed by the subjects in the SCID-I interview and the higher the intention to change/stop substance consumption is. When Dependence was diagnosed, the most often fulfilled criteria were tolerance, time costs, and loss of control. In the case of Cannabis and Stimulants Dependence, a desire to change, and in the case of Cannabis Dependence alone, withdrawal symptoms (i.e. sleeplessness, restlessness, and bad temper) were also reported quite often. When Abuse was diagnosed, the most often fulfilled criterion was endangerment through substance usage (i.e. driving or operating machines under influence).

Consumption patterns

Because alcohol and cannabis were used quite often by the subjects of the present study, it was tried to specify distinct consumption patterns that might have a predictive value in the context of drug driving. The basic idea was that if someone restricts his consumption to weekends and nights, the probability that this person drives under influence should be rather low. For cannabis as well as for alcohol, it was possible to show this relation. The time of substance use (evening/night versus during the day) has a more profound influence on the frequency of drives under influence compared to the day of week (weekend versus weekday), especially for cannabis because the proportion of consumption during the day in general is higher than for alcohol. When users consume can-

nabis or alcohol mostly on weekends and mostly at night, they hardly ever commit drives under influence. The same holds true for those users who also use cannabis or alcohol often on weekdays but still mostly at night. The highest proportion of drives under influence was found for users who have a relative high proportion of cannabis or alcohol use on weekdays and during the day, followed by those who consume cannabis or alcohol mostly on weekends but relatively often during the day. Whether someone often consumes during the day and on weekdays is to a great extent connected to the consumption intensity. Excessive and to some part heavy users more often consume at any time and on any day, whereas moderate users restrict their consumption more often to weekends and evenings/nights.

ART2020

The psychometric performance of driver aptitude was assessed by the application of the computer-based Act & React Test System (ART) 2020 Standard test battery. Seven subtests of the test battery were applied, which measure the following performance dimensions: coordination capacity (LL5, PVT, SENSO), concentration and attention capacity (Q1), reaction capacity (RST3), stress resistance (RST3), memory capacity (GEMAT3), and intelligence (MAT). Five of the seven tests can be assigned to the performance dimensions listed in the German Driver's Licence Ordinance ("Fahrerlaubnis-Verordnung", FeV). It was analysed that users who are under the influence of cannabis (calculated THC blood level >0ng/ml) perform worse compared to sober users. Acute intoxication resulted in a tendency to make more mistakes. In three of all seven sub-tests the acutely intoxicated subjects had a higher percentage of errors and/or less correct responses (Q1, GEMAT3, and RST3). These tests are measures to assess concentration and attention capacity, reaction capacity, stress resistance, and memory capacity. Besides, it was investigated if any negative long-term performance effects of drug use can be shown. The analyses showed that heavy lifetime drug use (heavy drug use: use of cannabis and so called "hard" drugs, light drug use: esp. use of cannabis) is associated with fewer correct responses, more omissions, and in part fewer processed items. In four of all seven subtests heavy users performed worse than light users and controls on single parameters, namely in the MAT, the GEMAT3, the LL5, and the RST3. These tests are measures to assess intelligence, memory capacity, coordination capacity, reaction capacity, and stress resistance. In the LL5 and the RST3 (measuring coordination capacity, reaction capacity, and stress resistance) light users made fewer errors than controls. Concerning all other parameters no differences were found.

Although evidence was found that acute cannabis intoxication partly affects the psychometric performance of driver aptitude and that negative long-term performance effects of heavy lifetime drug use exist (while light lifetime drug use has no negative impact), the results have to be interpreted with care. The found differences were very small. Of 39 parameters measured by the ART2020, only 5 turned out to be significantly different between the study groups. Another 7 only showed trends. The recommended evaluation of the ART2020 according to the "Guidelines for Expertise on Driver Aptitude" ("Begutachtungs-Leitlinien zur Kraftfahrereignung"; Lewrenz, 2000) resulted in high overall failure rates of 58% to 69%, no matter which study group is considered (control group included). The highest failure rates were found for the PVT, the Q1, the RST3, and the SENSO. Relatively low failure rates were found for the GEMAT3, the LL5, and the MAT. The calculation of the test sensitivity and the test specificity indicates that the recommended evaluation procedure is neither sensitive nor specific enough to make clear assumptions

about a possible relation between the degree of drug use – as operationalised in the present study – and psychometric performance.

Personality

According to evidence from a literature review that was conducted prior to the study (Walter et al., 2011), questionnaires that specify personality dimensions relevant in the context of drug use and drug driving were applied. It was found that users are to a greater extent sensation seekers than controls. They reported more symptoms of hyperactivity/impulsivity in their childhood as well as more negative psychological and social after-effects due to AD(H)D symptoms. On the other hand, they more often stated that psychoactive substances have a relieving effect on AD(H)D symptoms. Furthermore, they indicated to a greater degree to use psychoactive substances as a coping strategy in the case of feelings of distress. They are more open to new experiences and are motivated in response to cues for reward. Accompanied by a reduced motivation in response to cues for punishment, this is thought to increase the probability of unlawful behaviour in traffic (Castellà & Pérez, 2004). Users take the view that life and the occurrences therein rely on fate and fortune, whereas controls believe in their own scope of influence. An external locus of control is suggested to be related to a lack of caution and failure to take precautionary steps to avoid the occurrence of unfavourable outcomes (e.g. Hoyt, 1973). Moreover, it turned out that users are less conscientious than controls and with regards to their own driving behaviour more aware of fallibility. The only outcome that was contrary to the expectations pertains to a questionnaire that measures the degree of low social competence. It was supposed that users would obtain higher scores than controls. Kaplan (1975) stated that adolescents are involved in unlawful behaviour to restore low self-esteem and low social competence. Of the six corresponding scales users had a lower mean score than controls when it came to inappropriately exaggerated feelings of embarrassment. The result suggests that drug users are less embarrassed when they infringe social norms. In sum, drug use seems to be associated with some personality dimensions (e.g. sensation seeking, hyperactivity/impulsivity, less self-control, rather unconventional behaviour) and drugs seem to be misused to solve personal problems (e.g. psychological and social problems due to hyperactivity/impulsivity, feelings of distress). A less precise but similar difference was found for users who commit many drives under influence compared to users who never or only sometimes drive under influence. Users at high risk of driving under influence reported more symptoms of hyperactivity/impulsivity in their childhood as well as more negative psychological and social after-effects, and that psychoactive substances have a relieving effect on symptoms of hyperactivity/impulsivity. Users who often drive under influence express having less positive coping strategies and believe much more pronounced that life and the occurrences therein rely on fate and fortune as compared to users who rather seldom drive under influence.

Social context

Social learning and Social Control Theory stress the influence of parents and peers on the behaviour of a person (Bahr et al., 2005). Social learning theory proclaims that an individual acquires positive attitudes towards behaviour modelled by persons with whom frequent and intense interactions take place and to whom they look up to. By the present study it could be shown that the higher the subjects grade their parents' alcohol consumption, their peers' and partner's drug use, and their peers' impaired driving, the more they themselves are involved in the behaviour. Further on, subjects who rather often drive under influence say that their friends have a less adverse attitude towards impaired driving, compared to subjects who do not drive under influence or do it rather infrequently.

It is further hypothesized that social control may influence behaviour (Bahr et al., 1998; Hirschi, 1969, cited in Bahr et al., 2005). The social bond a person has with society is proclaimed to be crucial for the occurrence of deviant behaviour. One critical bond identified by Hirschi (1969, cited in Bahr et al., 2005) is the one to parents. The attachment to parents helps adolescents accept conventional values and tends to deter them from deviant behaviour. Users surveyed in the present study indicated their relationship to their parents to be worse than controls, especially those who commit impaired driving quite often. But the found differences between the study groups were rather small. Nevertheless, users, and especially those with many drives under influence, declared that their parents were more worried about them and mistrusted them to a higher degree than controls. By contrast, controls stated to a higher extent that they were raised to achieve a greater degree of autonomy and that their connection with their parents was respectful. In this context, the finding that users scored higher on the scale “Openness to experiences” of the NEO-FFI should be mentioned again. Persons with a high score behave, amongst other things, more unconventionally and try out new ways of thinking and acting. Persons with a low score tend to behave conventionally and to have conservative attitudes. Because users described the relationship to their parents worse than controls, this finding goes in line with the above mentioned connection between a good attachment to parents and the resulting acceptance of conventional values that is thought to lead to desisting from deviant behavior.

Furthermore, parental monitoring is thought to influence delinquent behaviour. The more a person feels watched and supervised by his parents, the less likely delinquent behaviour occurs (Bahr et al., 1998; Hirschi, 1969, cited in Bahr et al., 2005). Users stated that their parents’ way of raising them was too lenient or lenient compared to controls. The lack of strength in parenting might bring forward a tendency of the child to behave delinquently, in the present case to use drugs and to drive impaired. Another indicator for a lower supervision by the parents might be the found tendency that the users’ fathers have a higher job position and are therefore thought to have been less involved in bringing up the child, and that the users more often stated that their parents lived apart or were divorced compared to controls. Contrary to this argumentation, it was found that the fathers of the users with many drives under influence have lower job positions than the fathers of the users who drive rather infrequently under influence. The parents of these two study groups do not differ in living apart or being divorced.

Attitudes

If the controls’ willingness to use a substance is interpreted as general social acceptance, then the use of alcohol is highly socially accepted (98%), the use of cannabis is partly socially accepted (47%) and the use of other drugs is least socially accepted (8-15%).

Attitudes towards drug driving

As mentioned earlier, attitudes towards certain behaviour have an influence on the execution of behaviour (Ajzen, 1985). Within the framework of the present study several questions concerning the mindset of the subjects towards drug driving were asked. While controls find driving under the influence of cannabis as condemnable as driving with four beers or more or under the influence of sedatives, users have fewer objections to driving while impaired by cannabis. Driving with four beers, under the influence of ampheta-

mines, sedatives or cocaine are in the users' view to about the same extent condemnable. Most condemnable for both study groups are drives under the influence of ecstasy, opiates, and hallucinogens. For controls drives under the influence of amphetamines and cocaine are also equally condemnable. Those users who themselves drive often under influence are less adverse to going along with an impaired driver compared to those users who rather seldom drive under influence. It further turned out that for controls (not for users) the legal BAC limit has a marginal effect on their attitude towards driving after one beer. The 18-24-year-old controls for whom the zero-tolerance applies find it to a small degree more condemnable to drive after one beer than those 18-24-year-old controls for whom the 0.05% BAC limit applies.

Motives against drug driving

The decision to drive under influence is stated to mainly depend on characteristics of drug intake (amount, type and effect of consumed drug, time of drug consumption). Users who rather seldom drive under influence state a higher priority of the time of drug use compared to users who often drive under influence. The density of police controls, whether or not passengers could be endangered, and the possible option of riding along with another person are also quite relevant in the decision making process. Other possible alternative modes of transportation, route characteristics as well as the presence and reactions of companions are also stated to be of relevance, although less pronounced.

Attitudes towards thresholds

Many users say they would appreciate a threshold for driving under the influence of cannabis. The most frequently specified reasons were the long traceability of the substance in body fluids and a feeling of injustice compared to persons who drink and drive. Even though controls would not benefit from it, they agree to a great extent that the introduction of a threshold for cannabis would be reasonable. Users who drove under the influence of cannabis while participating in the study were more often in favour of a threshold compared to users who would not be affected by a threshold because they do not drive after cannabis consumption anyway.

Most controls accept the implementation of the zero-tolerance for young and novice drivers for driving under alcohol influence. Of the users, fewer but nevertheless a large proportion approved of the zero-tolerance. With reference to different age groups, again, those subjects who it affects the most (in this case the young subjects) are less enthusiastic about the zero-tolerance. The subjects were further asked how high the alcohol limit should be in their opinion. Controls more often take the view that the legal BAC limit should be lower than 0.05% compared to users. The same is true for subjects who moderately drink alcohol compared to heavy and excessive alcohol users. The view that someone can drink higher amounts of alcohol and still has the ability to drive safely is associated with a higher alcohol tolerance because again a clear difference between moderate and heavy/excessive users was found (moderate users state lower amounts).

General attitudes

Users compared to controls are less satisfied with their personal life situation and are less aware of a healthy way of living. This finding shows again that the consumption of drugs

has a negative impact on the well-being of a person. And this in turn shows the potential of therapeutic intervention strategies for combating drug driving.

For users compared to controls, obeying the law is a less important ethical principal. On this score no difference was found for moderate, heavy, and excessive drug users or for users who commit many and users who commit no or only a few drives under influence.

Knowledge of legislation and sanction severity

Experienced drivers had a better knowledge of the alcohol-related traffic legislation than young and novice drivers[40]. The sanction for violations against the 0.00% BAC limit was assessed to be almost as high as the sanction when violating the 0.05% BAC limit, although it is actually lower. Users compared to controls had a better knowledge of the legal consequences that are imposed when caught while driving under the influence of illegal drugs. However, they expect it to be lower than it actually is. In total, the expected sanction for drug driving is about the same as the expected sanction of offences against the 0.05% BAC limit. Users and controls did not differ in their knowledge of the alcohol-related traffic legislation (number of BAC limits and correct specification of consequences when violating the main BAC limits), although controls again generally expect the sanctions to be lower.

To find out if sanctions have an effect on the frequency of impaired driving, the subjective sanction severity was analysed. Experienced drivers tend to drive more often with BACs above the legal BAC limit (0.05% BAC limit) when the subjective sanction severity was low compared to when it was high (classification by median-split). But this effect did not reach significance. The results found for young and novice drivers (when considering their mean percentage of drives with BACs above zero) and for users (when considering their mean percentage of drives under the influence of illegal drugs) go in the same direction but are far from reaching significance.

Integration of the results

In conclusion the results of the present piece of work (Deliverable 2.2.2 – Part I and Part II) were integrated in a model that shows dependencies of different societal, behavioural, and legal variables that are relevant for combating driving under influence (Chapter 4).

5.3 Implications for prevention and rehabilitation

The following insights can be drawn, which might be relevant for the discussion about drug driving and associated prevention and rehabilitation measures.

The most striking predictor for drug driving is the consumption frequency (Walter et al., 2011). Moderate users and to some degree heavy users in contrast to excessive users

[40] Experienced drivers: correct specification of driving ban (in months), penalty (in euros), number of points and correct assignment of criminal proceedings for violations of the 0.05% and 0.11% BAC limits and mentioning of existence of 0.00%, 0.03% and 0.16% BAC limit

Young/novice drivers: correct specification of driving ban (in months), penalty (in euros), number of points and correct assignment of criminal proceedings for violations of the 0.00% and 0.11% BAC limits and mentioning of existence of 0.05%, 0.03% and 0.16% BAC limit

seem to be able to separate drug use from driving because their proportion of drives under influence on all drives and the substance concentration while driving intoxicated[41] were found to be rather low. Their subjective impairment while being under the influence of a substance goes in line with the actual intoxication. Excessive users more often developed a tolerance to the substance they use. So, the subjective impairment does not equal the objective intoxication in this case. Excessive and to some part heavy users use drugs at any time of the day whereas moderate users restrict drug consumption to weekends and to evenings/nights. Prevention and rehabilitation measures should be addressed to the main target group of heavy and excessive users. This user group often reported more clinically significant impairment or distress due to substance use and expressed a higher intention to change/stop substance consumption. So, aligning preventive measures with therapeutic measures to reach the target group of risky drug users might be the most appropriate approach to reduce drug driving.

Evidence was found that attitudes and social norms play an important role in the context of drug driving. If users downplay the danger of driving under the influence of a psychoactive drug or believe that driving while impaired is a rather common behaviour, the occurrence of drug driving increases. Many users say they would appreciate a threshold for driving under the influence of cannabis. Controls as well – although to a lower degree – support a threshold for cannabis. The most frequently specified reasons were the long traceability of the substance in body fluids and a feeling of injustice compared to persons who drink and drive. Pfeifer and Hautzinger (2001; cited in Gelau & Pfafferott, 2009) suggest that the severity of sanctions should reflect the severity of the offence. If users do not think it is more severe to drive under the influence of cannabis than under the influence of alcohol, a higher penalty for drug offences will not be accepted and the willingness to obey the law will be restricted. This implicates the importance of informative measures in the context of efforts to combat drug driving. Information about the real risks and the real extent of drug driving should be disseminated to create a better awareness of risks in traffic. Furthermore, friends and family members of exposed persons should be addressed and should be made aware of their influence and responsibility in the process of developing problematic behaviour.

Deterring from risky road user behaviour through detection and sanctioning is another approach to combat drug driving. It was found that drug driving is most common on weekends and at nights, on weekends even until the morning hours. To maximise the deterrence effect, police controls should be unpredictable and should be expected at any time and at any place (Gelau & Pfafferott, 2009). Mathijssen and Noordzij (1993; cited in ETSC, 1999) recommend involving conspicuous enforcement at times and places with a lot of traffic but a small proportion of offenders (to create awareness) and unobtrusive controls at places and times with low traffic but a lot of offenders (to deter). Through media coverage about changes in enforcement practices and the effectiveness of enforcement strategies, the level of public awareness and the deterring effect can be further enhanced (Krisman & Schöch, 2011).

Future dissemination should also explicitly address the consequences that are to be expected in the case of drug offences because subjects are often not aware of the different sanctioning stages according to the StVG[42], the StGB[43], and the FeV[44], respectively. A

[41] Moderate user: MD_{BAC}=0.03%; $MD_{THC\ blood\ plasma\ level}$=3.2ng/ml;
Heavy user: MD_{BAC}=0.04%; $MD_{THC\ blood\ plasma\ level}$=4.5ng/ml;
Excessive user: MD_{BAC}=0.07%; $MD_{THC\ blood\ plasma\ level}$=7.7ng/ml.
[42] Straßenverkehrsgesetz: German Road Traffic Act
[43] Strafgesetzbuch: German Penal Code
[44] Fahrerlaubnisverordnung: German Driver Licensing Act

better knowledge about the consequences of breaking the law might further enhance the deterrence effect (Gelau & Pfafferott, 2009).

A better knowledge about laws and consequences of breaking the law, combined with scientifically-based information about why the law exists and what is pursued by adopting the law, can be an effective approach to enhance the general acceptance of the law within the population, to change attitudes and to foster compliance to the law in question (Krisman & Schöch, 2011). So, media and educative measures are of value for general deterrence as well as for general prevention measures (Krisman & Schöch, 2011). As reported by Delaney, Lough, Whelan and Cameron (2004), pure information based and educative campaigns are not as effective as campaigns with a persuasive orientation and those that use emotional rather than rational appeals. Campaigns should address the personal needs of the recipient and should provoke emotions to increase the willingness of the recipient to deal with the safety topic in question. The present piece of work provides characteristics of persons at risk of driving under influence. From this knowledge suggestions for designing prevention measures can be deduced.

5.4 Final remarks

Through the present study it was possible to create a database for not only quantifying the drug driving prevalence, but also for analysing mediating and modifying factors that serve as major input on rehabilitation and prevention.

In Walter et al. (2011), the advantages of the new methodological approach and the challenges with regard to the generalisation of the study results were already discussed. One objective of the present piece of work was the extrapolation of the frequency of drives under influence within the sample into representative values for the general German driver population (Walter et al., 2011). Except for these prevalence rates, all other reported findings refer to the population of regular drug users who regularly drive a vehicle (compared to control subjects who do not use drugs but are comparable to the user sample with regards to age, gender, and residence).

To get information about psychological problems of the subjects, the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) was conducted (Wittchen et al., 1997). As already mentioned in Chapter 3.1.1, the prevalence of Mental Disorders found in the present survey was higher than within other studies (MFS, NEMESIS, Tacos). Three possible explanations were laid out: Firstly, the sample of the present study was younger and more recently investigated than the samples of the other studies. According to Kessler et al. (2005), the lifetime prevalence estimates of mental disorders are higher in recent cohorts than in earlier cohorts. Secondly, reluctance by the subjects to report embarrassing behaviours might be lowered because the study setting was very open and unforced. And thirdly, the sample of the present study was not randomly selected. Instead, it was recruited by media campaigns and word-of-mouth-recommendation. Thus, the sample could selectively consist of people who are more interested in psychological research and this in turn could be due to a higher proportion of psychological problems within the sample than average.

The assignment of the subjects to the study groups that were analysed with respect to their performance on the ART2020 is based on the urine screening result and the pres-

ence or absence of an acute intoxication[45]. The acute intoxication in turn is based on the calculated substance blood concentrations described in Walter et al. (2011). For this calculation, approved mathematical models were used (Widmark formula, Widmark, 1932: THC elimination curve by Sticht, personal communication, December 2009). Nevertheless, the calculation is and will remain only an estimation of the real intoxication. The lacking evidence of objective intoxication by a blood screening constitutes the major constraint of the ART2020 analysis. Concerning the analysis of the effect of lifetime drug consumption, it has to be kept in mind that the subjects surveyed in the present study rather seldom used so called "hard" drugs in their life. The most frequently used drug was cannabis accompanied by a more or less frequent consumption of amphetamines and hallucinogens. A more precise effect might have been found if users with a heavier lifetime drug use (including heroin) would have been investigated.

Concerning the findings that refer to the social context of a person and its relevance for the occurrence of deviant behaviour, it has to be kept in mind that the present study design does not allow a causal attribution. On the one hand, a person could e.g. use drugs and drive under influence because persons close to him do so, too. On the other hand, persons who show the behaviour in question might selectively choose friends and a partner who show the behaviour as well.

The greatest part of the data in the present report is based on self-reports. A person might for example say that the parents drink alcohol more than others do, even if this is indeed not true. Subjective data has to be interpreted with caution because several biases can be inherent. On the one hand, the subjects can consciously make false statements to conceal undesirable behaviour or attitudes ("Social desirability"). On the other hand, the subjects' opinion itself can be biased because of a tendency to interpret circumstances in a way that lets them maintain a positive image of themselves ("Cognitive dissonance").

The Traffic-specific item pool (VIP, Schmidt & Piringer, 1986), which was applied in the present survey, includes among other scales the control scale "*Orientation at social expectations*". Only four subjects (1.4%) of all subjects who had a valid score on this scale reached far above-average values (one user, three controls), whereas a great part of subjects had far below-average values (61 subjects / 21.5%, 39 users / 21%, 22 controls / 22.4%). Even if the questionnaire refers to traffic-specific behaviour, high values can be a general indicator for a tendency to make social desired statements in questionnaire measures. Because only a few subjects reached high values and users were not more conspicuous than controls, a possible bias can be neglected.

Furthermore, the subjects' perception might be biased with the function to reduce cognitive dissonance by only assuming that e.g. driving under influence is very common in general and that it poses no real risk (Festinger, 1957), whereas the reality proves to be different. Anyhow, according to Ajzen (1985) normative beliefs form the subjective norm referred to the behaviour in question. This subjective norm along with attitudes towards

[45] Analysis of acute effects of cannabis (Inclusion criteria: Urine negative for amphetamines, cocaine, opiates, positive for cannabis, calculated BAC=0.00%): Acutely cannabis intoxicated users (THC blood plasma level>0ng/ml) versus sober users (THC blood plasma level=0ng/ml),
Analysis of long-term effects of drug use (Inclusion criteria: Urine negative for amphetamines, cocaine, opiates, negative for cannabis or positive for cannabis and calculated THC blood plasma level=0ng/ml, calculated BAC=0.00%): Sober users with high lifetime drug use versus sober users with light lifetime drug use.

the behaviour and the perceived behavioural control has an impact on the occurrence of the behaviour. In the present context, the behaviour itself is especially of interest. The role of attitudes is of secondary importance. Of course, a connection between the social context and attitudes with deviant behaviour was shown, based on self-reports of the subjects. But if subjects indeed learn behaviour from social models or only think they would behave like other, close persons, is of minor interest. Either way, the findings indicate an influence of social perceptions and attitudes and should be considered in the context of prevention and rehabilitation, no matter how they developed.

The analysis of the knowledge about the legal consequences when committing a drug offence has to be regarded as a rough approach to gain an insight into the topic. When treated like an administrative offence according to § 24 StVG (in the case of no signs of impairment), the offender will be punished with four demerit points, a 500 euros penalty, and a one month driving ban. But because drug offences in traffic are punished according to the StVG[46], the StGB[47], and the FeV[48], respectively, the reality in most of the cases looks more ambiguous and the sanctions are likely to be higher. If someone gets caught while driving under the influence of illegal drugs, in most of the cases a medical and psychological assessment (MPA) according to the FeV is ordered. An MPA is accompanied by a withdrawal of the driving licence until the MPA is positively passed. So, even if the driving ban is actually only one month in accordance with § 24a StVG, the driving licence is often withdrawn for around one year (until an ordered MPA is positively passed). Moreover, in the case of illegal drugs, the probability that criminal proceedings will follow – either according to the StGB (because of signs of impairment) or the BtMG[49] – is rather high. So, for illegal drugs the specification of a withdrawal/driving ban of several months, the order of a MPA, and subsequent criminal proceedings was considered as correct specification when analysing the subjects' knowledge of legislation.

The results of the present study widen the view on drug driving and the associated circumstances. It was possible to emphasise different aspects of the problem and to integrate the information at a higher level. The model that was designed is qualitative (Chapter 4). It shows dependencies that unfortunately cannot be exhaustively proved by the results because no causal relationship between the different variables can be drawn from the data inventory at hand. Further research is necessary to outline more precisely the connections derived in this report. But all in all, the intention of the study to put different aspects of drug driving (prevalence, situational and person-related predictors) into a broader context succeeded. The new methodological approach has proved to be a promising method and should serve as a standard to which future studies should aspire.

[46] Straßenverkehrsgesetz: German Road Traffic Act
[47] Strafgesetzbuch: German Penal Code
[48] Fahrerlaubnisverordnung: German Driver Licensing Act
[49] Betäubungsmittelgesetz: Controlled Substances Act

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7. Annex

Table 47: ART2020 failure rates for cannabis intoxicated users ($N_{AcuteCann}$=16) and users who were not under influence ($N_{NoAcuteCann}$=48,) as well as controls ($N_{Controls}$=42) and users with light ($N_{LightUse}$=46) or heavy lifetime drug use ($N_{HeavyUse}$=18).

Failure rate					
Test/Parameter	**$Perc_{AcuteCann}$**	**$Perc_{NoAcuteCann}$**	**$Perc_{HeavyUse}$**	**$Perc_{LightUse}$**	**$Perc_{Control}$**
ART	68.8%	58.3%	61.1%	63%	69%
MAT	0%	0%	0%	0%	0%
Correct responses	0%	0%	0%	0%	0%
Q1	37.5%	20.8%	16.7%	23.9%	16.7%
Processed items	0%	0%	0%	0%	0%
% Errors	37.5%	20.8%	16.7%	23.9%	16.7%
LL5	0%	6.3%	5.6%	4.3%	7.1%
Processed items	0%	0%	0%	0%	0%
% Errors	0%	6.3%	5.6%	4.3%	7.1%
GEMAT3	6.3%	0%	0%	0%	0%
Correct responses	6.3%	0%	0%	0%	0%
PVT	18.8%	37.5%	50%	32.6%	31%
Mean reaction time	12.5%	14.6%	22.2%	10.9%	16.7%
Mean reaction time - left	12.5%	16.7%	22.2%	10.9%	19%
Mean reaction time - right	0%	14.6%	22.2%	15.2%	14.3%
Mean tracking deviation	12.5%	22.9%	33.3%	19.6%	11.9%
SENSO	31.3%	31.3%	38.9%	28.3%	38.1%
Time – phase 1	0%	0%	0%	0%	0%
Time big errors – phase 1	0%	10.4%	11.1%	8.7%	16.7%
Time small errors – phase 1	0%	8.3%	11.1%	4.3%	7.1%
Number big errors – phase 1	0%	8.3%	5.6%	8.7%	9.5%
Number small errors – phase 1	6.3%	4.2%	5.6%	4.3%	0%
Time big errors – phase 2	0%	2.1%	0%	2.2%	4.8%
Time small errors – phase 2	6.3%	2.1%	5.6%	0%	4.8%
Number big errors – phase 2	0%	2.1%	0%	0%	2.4%
Number small errors – phase 2	0%	2.1%	0%	4.3%	2.4%
Time – phase 3	0%	0%	0%	2.2%	0%
Time big errors – phase 3	18.8%	14.6%	27.8%	10.9%	11.9%
Time small errors – phase 3	0%	10.4%	11.1%	8.7%	14.3%
Number big errors – phase 3	0%	10.4%	22.2%	8.7%	14.3%
Number small errors – phase 3	6.3%	8.3%	0%	10.9%	4.8%
Total time	0%	0%	0%	0%	0%
Total time big errors	0%	10.4%	11.1%	6.5%	7.1%
Total time small errors	0%	4.2%	5.6%	2.2%	4.8%
RST3	25%	8.3%	11.1%	10.9%	19%
Correct responses – phase 1	0%	4.2%	5.6%	4.3%	0%
% Delayed reactions – phase 1	0%	2.1%	0%	4.3%	4.8%
Omissions – phase 1	0%	2.1%	5.6%	2.2%	0%
% Errors – phase 1	12.5%	0%	5.6%	0%	4.8%
Correct responses – phase 2	6.3%	2.1%	11.1%	0%	0%
% Delayed reactions – phase 2	0%	0%	0%	0%	0%
Omissions – phase 2	0%	2.1%	5.6%	0%	0%
% Errors – phase 2	0%	2.1%	5.6%	4.3%	2.4%
Correct responses – phase 3	0%	2.1%	5.6%	2.2%	2.4%
% Delayed reactions – phase 3	0%	0%	0%	0%	7.1%
Omissions – phase 3	0%	2.1%	5.6%	2.2%	7.1%
% Errors – phase 3	12.5%	0%	5.6%	2.2%	2.4%