Effects of low alcohol dosages
A review of the literature

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1. Basic characteristics of the review

Quite a lot of countries discuss a lowering of their existing BAC limits. The arguments used for low limits are often an extrapolation of the knowledge about the effects of high doses. This is not justified. To use a picture: alcohol effects at low doses form the widespread roots of a unified stem at high doses. The few existing reviews on low doses (here operationalized as BACs less than 0.08%) do not take this reality into account. This is the consequence of two limitations they have:

a. most oftenly **only qualitative evaluations** were done based on frequencies; there is no attempt to reach at least a semi-quantitative interpretation of the data
b. the central scope of reviewing are the **changes in performances**. Only at the periphery are emotional and sociotropic effects included.

The review to be reported tries to overcome these shortcomings.[1] Which alcohol effects predominate is largely dependent on the nature of the system by which the effects are classified. The systems ordinally used represent a mix of classification according to morphological behavioral domains, behavioral functions, types of tests, and experimental methods. This deficit is understandable, as a generally accepted human ethogram comprising the domain of internal processes (like feelings, mood, and cognitive processes) as well as that of external behavior does not exist today. Nor do we possess an accepted model of driving or drinking behavior.

We here propose a new classification system (see table 1) which first makes the basic distinction between subjective and objective features.

A trivial fact is: Alcohol is a psychotropic substance which must be consumed before having effects. This raises the question: what does the user want to achieve? What are the effects of the alcohol from the viewpoint of the consumer? These effects have to be contrasted to the effects as measured by objective methods, mainly in the domain of performances. Therefore, the crucial point is that the effect must be construed doubly:

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[1] Note: An extended description of the review can be found in KRÜGER (1990), KRÜGER et al. (1990), KRÜGER, KOHNEN & PERRINE (1993). The review was founded by the German Bundesanstalt für Straßenwesen (FP 8707). I am indebted to Elliot Moreton for his critical help in the redaction of this article.

Table 1: Classification system used for the review.

alcohol effects	subjective	side effects	feeling intoxicated	experienced intoxication
				unpleasant physical sensations
				tiredness
				subjective rating of performance
				general well-being
		main effects	positive mood	pleasure
				dominance
				arousal/activity
			social feelings	aggressive feelings
				sexual feelings
				social feelings
	objective	interactive behavior	expression and social behavior	aggressive behavior
				sexual behavior
				physiological parameters of sexuality
				behavioral measures of social activities
		functions		eye movements
				binocular vision
				complex perceptual functions
				physiology of the eye
				vigilance
				memory
				physiological measurements
				posture
				tremor
		performances	automatic behavior	easy compensatory tracking
				easy pursuit tracking
				simple reaction time
				choice reaction time
				mental arithmetics
				cancellation tests
				categorization tests
				attention (concentrated)
				other attention tests
			controlling behavior	difficult compensatory tracking
				difficult pursuit tracking
				hand-eye-coordination
				information processing/en-decoding
				reaction to 2 stimuli
				reaction to 2 tasks
			driving	closed course
				driving simulator
				flight simulator

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- once **from the viewpoint of the consumer**: his or her subjective representation of alcohol's main and side effects
- once **from the viewpoint of science**, with objective measurement of behavior, especially of performance.

The subjective effects are those which can be remarked by the subject himself. They must be separated into main and side effects. **"Main effect"** is here understood to mean "the intention leading to consumption" - and they clearly must be searched in the domains of mood, emotionality, especially socio-emotionality. **"Side effects"** are those effects that are not desired by the consumer but are taken into the bargain. They must be found in the experience of being intoxicated, depressed mood, the feelings of impairment, and tiredness.

The question is always: Why do people drink so much? But a very crucial question has up to now not explicitly posed: Why do most people stop drinking before they are completely drunk? Is it because the main effects fall off, or because the side effects outweigh the main effects, or because the side effects become intolerable?

On the other hand, the objective changes in psychophysical state and behavior can be classified into

- **interactive behavior**, meaning expressive and social behavior,
- **psychophysical functions**, and
- **performances.**

In interactive behavior, the principal domains of investigation are those of aggression, sexuality, and social behavior. Observations are sometimes made of behavioral variables (like number of statements in partner situations), but most often of physiological reactions (like tumescence). Extremely little work has been done on the expressive components of behavior under alcohol.

The domain of function testing is investigated with tasks which test strength, speed, and/or precision of performance, chiefly of our sensory organs, but also of basal motor systems. This covers tests of vision and elementary psychomotoric behaviors such as standing steadiness, but also investigation of vigilance.

By contrast, performances are to be interpreted as "actions", which are accompanied by a number of cognitive processes, which then culminate in an overt behavior. To classify them we found a lot of good resasons to use the system as introduced by SCHNEIDER and SHIFFRIN (1984). In a clear analogy to the functioning of computer systems, they classify actions into

- **automatic processing** and
- **control processing.**

Automatic actions are taken to be those that are called up as a single unit, like a subroutine, and then executed as a single unit, without constant supervision by the main program. Automatic actions such as shifting gears are characterized, according to this view, by the fact that they take place at very low awareness, with very little (if any) attention and effort, and without making use of central functions. This relative independence from central processes has the consequence that they only can be imperfectly monitored (one does not know the individual movements involved in shifting gears), that they practically always take place as a single unit, and that their execution is not stored in long-term memory (one does not as a rule know whether one has shifted gears or not). It is likewise possible for several such automatic processes to run simultaneously (like shifting gears and signaling) thus providing the possibility of "parallel processing".

Control processes, in contrast, are characterized by high awareness, elevated attention, and subjective effort. They use a lot of central capacity. There, the parallel execution of several processes is not possible; rather, simultaneous control processes must be run sequentially.

While for automatized processes practice improves performance, control processes can only be practiced to a restricted degree in the short run. Only long practice can automatize control processes - an experience everyone has had learning to drive.

With the psychophysical functions, the automatic and control processing, we have a threefold dividion in the category of performance, which from the purpose of this study must in this review be extended to include a fourth class, driving behavior, into which fall all studies which directly investigate driving.

All the variables in the reviewed studies observed were classified by raters into this system.

2. Material and method

2.1. Material

If a study fulfilled one or more of the following criteria, it was **excluded** from further consideration:

a. The investigation was set up non-experimentally.
b. The study investigated only variables that are not specifically connected to abilites needed to drive a vehicle safely.
c. The study employed only animals, not humans as well, as subjects.
d. The population investigated by the study was composed exclusively of alcoholics.
e. The primary interest of the study was investigating medications.

The following **inclusion criteria** were set for a study to be accepted for processing:

a. The work must report on independent, empirically acquired observations for which there exists a probable connection with the safe driving of a vehicle.

b. For each paper, the expected BAC levels at the time the study variables were measured were computed according to the Widmark formula. At least one of the investigated BAC values calculated according to Widmark must have been lower than 0.84 mg/100 ml for the study to be accepted for review.

c. For each paper, the following must be known:

The quantity of alcohol consumed

The time between the beginning of alcohol intake and the beginning of measurement

d. The alcohol must have been administered orally.

Papers on the effects of alcohol are scattered widely over different research fields and are published in the medical, psychological, and legal literature as well as in the alcohol literature proper (to name only the most important areas). Nor did selecting the relevant papers from computer searches in bibliographical databases represent an unambiguous strategy for achieving completeness, for another reason: the thesaurus had no valid criterion for searching for "low" alcohol dosages. Specialized strategies were therefore preferred. They were employed on different levels:

- Computer searches in relevant databases
- References to usable papers in reviews, processed literature, and non-experimental publications
- The tables of contents and abstracts of relevant scientific periodicals

These criteria led to a check of more than 20 000 references. Applying the inclusion and exclusion criteria the first time resulted in a total corpus of 1057 publications. A more thoroughly second inspection, especially of the design and data, led to a total of 208 papers which make up the source material of this review. In them are described 220 experiments with a total of 1245 findings of effects at low alcohol concentrations, for a mean of about 5-6 findings (median 3) per paper.

In this report, the quantity of alcohol consumed is expressed in the internationally usable unit of grams of alcohol per kilogram of body weight. The alcohol concentration is given in milligrams of alcohol per 100 ml of blood, i.e., in units usual in traffic law.

2.2. Method

There has been an extended discussion on the methodology of meta-analyses. Especially the question of whether effect sizes (that means "degree of significance") should be used instead of vote counting ("significant" versus "non-significant") was raised. With regard to the diversity of experimental methods and the high variation in the methodological quality of the studies reviewed we decided to use the vote counting approach with a "yes" at the 5% level. But instead of using only proportions of significant results we introduced additional evaluations of these proportion by methods of regression and survival analysis. The basic assumption is that the frequency of significant results is also an estimator for the size of the effect.

3. Results 1: The "social window" of alcohol action

Figure 1 shows the effects of alcohol on the categories of the subjective domain, which is for a better understanding enlarged by the objective category of "social behavior". Significant deviations from placebo which are evaluated as positive (like "better mood") were signed as +1. Negative deviations (like "more aggressive") are signed with -1. The absence of a significant effect is coded with 0.

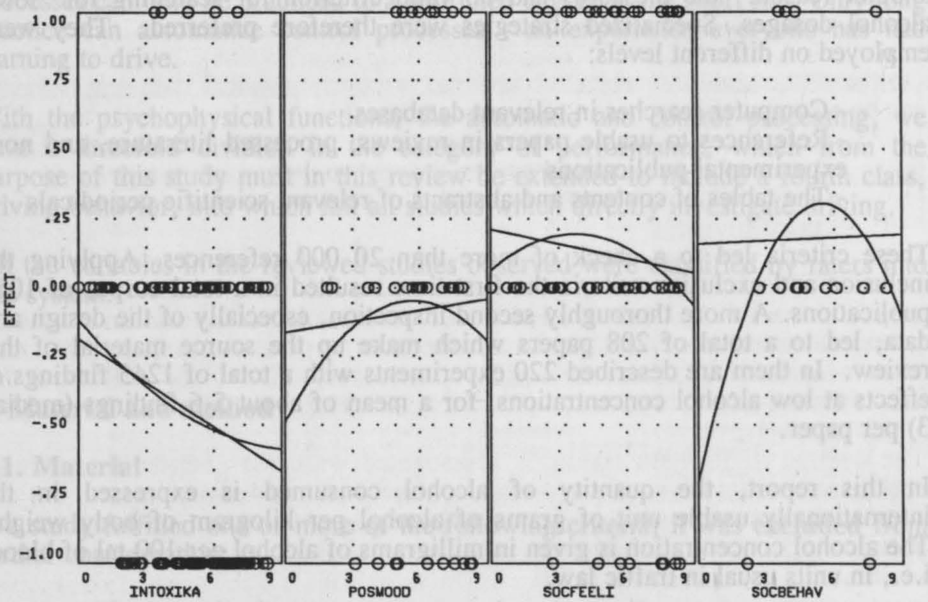

Figure 1: Proportions of effects per category. The abscissa gives BAC values multiplied by 100, a y-value of +1 means a positive, a value of -1 a negative significant result, whereas 0 stands for a nonsignificant finding. Two regression lines were fitted to the percentages, a linear and a quadratic function. INTOXIKA = feelings of intoxication, POSMOOD = positive mood, SOCFEELI = social feelings, SOCBEHAV = social behavior.

Instead of construeing BAC classes, we computed first- and second degree regression curves (as is done in the logistic regression approach). The linear regression should show the general trend, the quadratic regression tests whether there was a shift in the direction of the effect.

The category "intoxication" comprises all side effects of alcohol. There is a clear decrease with rising BAC, with the function only flattening out somewhat at the end. The category of "positive mood" shows a rising tendency with rising BAC. However, the quadratic regression suggests that a maximum of positive effects is attained at about 0.05 to 0.06%. From then on, the negative findings begin to pile up again. Something similar holds true for social behavior. The positive effects attain their maximum at 0.04/0.05% and at higher BACs plunges below the y-axis!

This presents a highly interesting picture for the subjective side of the alcohol effects. The main effects in social feelings are maximal in the region between 0.02 and 0.07%. Thereafter, more means less! This is true also for "positive mood". "Social behavior" behaves analogously to these two categories of subjective variables with a maximum at 0.05/0.06%.

It comes to no surprise that the entire mood curve lies below the y-axis. The majority of all the studies investigated performances. These were subjectively as well as objectively impaired by alcohol, with the consequence of a rather negative mood in the test subjects. Only a few studies realized a situative context in which the effect of alcohol can be experienced positively - these include a part of the social studies. From these studies stem the variables of the category "social feeling" which as a consequence show a preponderance of positive effects.

In the category "social behavior" an increase of aggression, a decrease of sexual reactivity and a decrease of the output of social behavior was signed as -1. Comparable to "positive mood" and "social feelings" a bitonic or U-function can be found with a maximum at 0.05/0.06%. A nearer inspection shows that the decrease of the function mainly is caused by an increase of aggressive behavioral acts.

These positive effects are opposed in subjective experience, even at the lowest values, to negative side effects which increase with the BAC. The two taken together yield an interesting dynamic on the subjective side: in order to get the positive effects, negative ones must be taken into the bargain right from the very beginning. Therefore, the amount of alcohol consumed is the result out of a counterbalance between positive and negative effects. The consumption is not limited by an abrupt starting of negative effects, rather by a decrease and ending of positive effects. The credit of the wanted has to be payed with the debit of the unwanted. This balance is positive for low BACs.

4. Results 2: The objective effects

4.1. Results

In general, alcohol impairs all performances. Even at lowest levels of BAC we only found a negligable number of studies which reported from better performances. Thus, the fact that deterioration may occur is relatively unimportant. Much more interesting is the dynamic of deterioration described by the question: how does the deterioration induced by an increase in BAC depend on the initial BAC?

The method of answering this question comes from survival analysis. In applying this rationale, we make two assumptions: That if an effect is found at one BAC, it will be found again at any higher BAC (i.e., that the intensity of an alcohol effect increases monotonically with increasing BAC), and that a study which found an effect at a particular BAC would not have found one at any lower BAC. The first assumption is obvious; our rationale for the second one is that experimenters are not naive - they want to find out at what threshold BAC a given effect fist emerges, have a pretty good idea of what that level must be, and hence will do their testing there.

The following procedure is employed: The "survival time" of a study is defined as the BAC at which it finds an effect. We say that a study has "survived" at a given BAC b if that study found (or would have found) no effect at b, i.e., if it either tested at this level and found no effect, or tested at a higher level. We define the "survivorship" at b to be the ratio between the number of survivors and the number of studies having real or assumed results at b.

Table 2: Calculating survivorship. "Yes" means that a study found or would have found an effect at that level, a "no" means the opposite. Studies which under our assumption may or may not have found an effect at the given BAC are marked "-".

BAC	0.00	0.01	0.02	0.03	0.04	0.05	0.06
Study 1	no	no	no	no	yes	yes	yes
Study 2	no	no	no	no	no	no	yes
Study 3	no	yes	yes	yes	yes	yes	yes
Study 4	no	no	no	no	no	-	-
Survivorship	1.00	0.75	0.75	0.75	0.50	0.33	0.00

In the example of Table 2 a review evaluates 4 studies. The first finds an effect at 0.04%, the second at 0.06%, the third at 0.01%. The fourth study uses 0.04%, but fails to find an effect. These are the boldface entries; the other "yesses" and "noes" come from our assumptions. At each BAC, the survivors are the "noes", and the survivorship is the ratio of "noes" to "noes plus yesses". Note how Study 4 drops out of the pool after 0.04%; this is because neither the data nor our assumptions allow us to infer whether the study would have found any effects at higher levels.

The empirical survivorships were computed for all categories of the model. The function comprising all study results from the group of objective measurements of performances is shown in Figure 2.

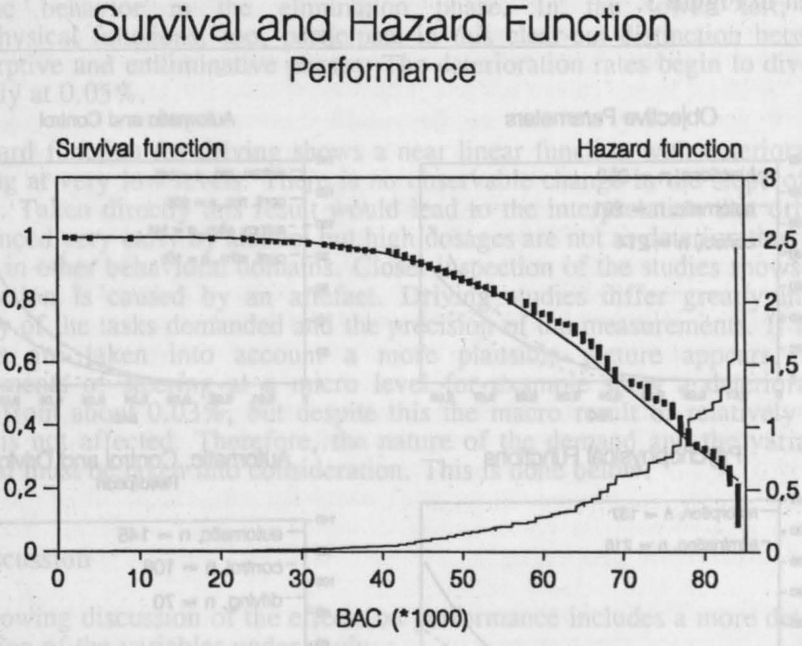

Figure 2: Empirical survival function, its hazard function, and the fitted WEIBULL function for the data from performances. The survival function gives for each BAC level the percentage of studies which did not find a significant deterioration. The WEIBULL function fits the empirical values nearly perfectly.

Evaluation shows that these empirical distribution can be fit splendidly by what is known as a WEIBULL distribution. How good this approximation is is clear from Figure 2, in which both the empirical values of the survivorship and the approximating curve can be seen for all performance variables.

An important quantity of a survival distribution is the hazard rate. Let n objects still be "alive" at a given time (which here means BAC). In the subsequent time span, x of them will "die". Then the proportion x/n is the hazard rate. It refers to the proportion of objects of a survival distribution which are "going to die" at the next interval. This hazard rate is given as well in Figure 2. It is apparent that it rises steeply at about 0.06%. That is, above this boundary, the deteriorations attributable to rising BAC become more and more dramatic.

The same calculation were carried out for all performance categories, the psychophysical functions, and the category driving, and were additionally subdivided into absorptive and eliminative phases. All studies which tested the effects of alcohol starting from drinking up to one hour after consumption were classified as belonging to the ascending limb of the BAC curve, the rest of them were assigned to the descending limb of the curve where elimination processes dominate. The resulting hazard rates of the approximated survival functions are given in Figure 3.

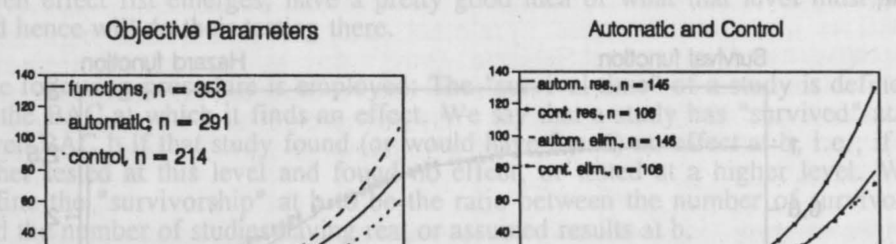

Figure 3: The hazard functions for different behavioral categories, together with resorption versus elimination.

In general, all hazard functions show a pronounced rise in the hazard rate at values over 0.05/0.06%. The rise is rendered recognizable when one attempts to approximate the hazard function by eye with a straight line through the origin. At the point where the deviation becomes too large, we can assume a pronounced change in steepness. Such a change in steepness means that the relative performance losses because of additional alcohol are getting bigger and bigger.

As the functions in the upper left of the Figure 3 show the category of functions and performances follows a similar course up to about 0.05%, where it then diverges. Control behavior reacts most strongly, automatic behavior the least, while the psychophysical functions lie in the middle. The figure in the upper right reveals the importance of the resorptive/eliminative distinction, at least at BAC values above 0.05%. An extreme reduction in performance is observable for control behavior in the resorptive phase, and an extraordinarily small loss in automatic behavior in the elimination phase. In the lower left, the psychophysical functions, too, participate in this clear-cut distinction between the resorptive and emliminative phases: The deterioration rates begin to diverge noticeably at 0.05%.

The hazard function for driving shows a near linear function with deterioration beginning at very low levels. There is no observable change in the slope of the function. Taken directly this result would lead to the interpretation that driving is influenced very early by alcohol but high dosages are not as deteriorating as is the case in other behavioral domains. Closer inspection of the studies shows that this function is caused by an artefact. Driving studies differ greatly in the difficulty of the tasks demanded and the precision of the measurements. If these variables are taken into account a more plausible picture appears. Fine measurements of steering at a micro level for example show a deterioration starting from about 0.03%, but despite this the macro result of relatively safe driving is not affected. Therefore, the nature of the demand and the variables measured must be taken into consideration. This is done below.

4.2. Discussion

The following discussion of the effects on performance includes a more detailed description of the variables under study.

4.2.1. Psychophysical functions

The category of psychophysical functions is so heterogeneous that it seems scarcely justified to lump together the individual functions. The effects of alcohol are correspondingly diverse. Vision is interfered with even at very low BACs (noticeably so below 0.03%), when precise measurements of the coordination of both eyes (binocular vision) and of the eye movements (saccades, tracking movements) are adduced. However, the quality of perception (depth and motion vision) is preserved over a broad range of BACs (beyond 0.05%). Sensitivity to differences in brightness and colors change likewise at a low level (below 0.03%) in the direction of dark adaption, without ascertainable impairment of perceptions below 0.05%. The visual system thus presents a heterogeneous picture of effects. Though dynamic subfunctions are interfered with very early, the overall system is still apparently flexible enough to maintain the perceptual result qualitatively for a long way.

The second domain of functional testing involves motoricity. Low-level hand tremor "calms down" even at the lowest alcohol doses, whereas the larger body movements (especially body swaying) increase noticeably. Depending on what demands a psychomotor task makes on gross and fine motoricity, motoricity will alter differently under alcohol - which also shows itself in a nonuniform result structure. It is not that the effect is unclear, but rather that it depends on the demands made by the task.

Tests of memory performance belong likewise to the category "functions". It turns out here that under undisturbed conditions, alcohol in dosages below 0.08% does not noticeably alter storage and recall of information - unless at the same time complex encoding processes are involved, which are impaired by alcohol at very low levels.

Vision and motoricity are the best-understood functional complexes. Their alteration by alcohol are most readily understood from the viewpoint of physiology. If groups of funtions are governed physiologically by means of inhibition (as with the activity of the CNS), low dosages of alcohol, with their selectivity for the inhibiting system, lead to a disinhibition, which then shows itself in behavior as heightened excitability. By contrast, excitatory systems are inhibited and excitability thereby reduced. In the context of this explanatory paradigm, alcohol in low dosages must raise and lower both behavior rates and behavior precisions depending on how the individual functions are physiologically steered. It is therefore mistaken to expect from alcohol a general reduction of function as long as its sedative component does not prevail over all systems, which first occurs in dosages over 0.1%.

4.2.2. Automatic processing

The finding: The first losses among automatized actions appear starting at about 0.04/0.05%, and then increase continually with rising BAC. However, some studies, especially in the elimination phase, find no significant effect even at and above 0.05%.

Comparable statements are true of the remaining tasks subsumed under "automatized actions": They are all highly practiced (or at least come quickly with practice) and are aided by the fact that the attention is more strongly focussed. This focussing can take place in two ways:

- Active cenetering of the attention on the action, or
- Passively reducing peripheral information by constricting perceptual breadth.

Low alcohol quantities probably induce a process of passive centering, the perfomance-enhancing effect of which can compensate in the long run for the impairments induced through other groups of functions. Thus, a clear-cut effect can only be expected among automatized actions above 0.05%.

4.2.3. Control actions

The finding: at BACs as low as 0.03%, especially in the resorption phase, losses of perfomance appear, which increase very sharply with increasing BAC. When the BAC in the resorptive phase attains values above 0.07/0.08, every sub-perfomance is regularly impaired.

The distinguishing characteristic of control actions is that their execution has to be continuously governed and supervised. A concise example is furnished by difficult forms of tracking, especially compensatory tracking, in which unforseeable aberrations must constantly be brought back under control. Automatisms are here of limited application. Rather, every action demands its own explicit triggering, its own supervision, and the evaluation of its effect by a governing central processing unit (CPU).

This CPU is called upon in a similar fashion when multiple tasks are to be accomplished. This includes tasks like visual scanning of a video screen for a target stimulus while additionally reacting with a pushbutton to certain signals independently of the first task. Perfomances of this sort call upon the CPU chiefly when the subtasks must be processed in parallel on the same sensory channel. Only nimble time management (itself representing a separate, additional perfomance) can bring success here.

Precisely on multiple tasks - when there is a lot to do - does it become clear that lower alcohol does not in general hinder high perfomance. It does not involve the opposites "much/little demand", nor necessarily "easy/hard"; the difference lies rather in the opposition betweeen "horizontal-cumulative" and "vertical-hierarchical" perfomance. Only the latter is noticeably affected by low alcohol concentrations from about 0.04/0.05% on.

The serial (sequential) processing of parallel (simultaneously given) demands among control actions is only possible when the demands of each task are broken down into sub-actions, which are then placed in a temporal sequence and processed one at a time. For this, however, it is necessary to temporarily store information from one task while the next is being processed. This capability is tested through certain tasks in the category "encoding and decoding of information". Masking experiments proved especially susceptible to alcohol effects. In them, a piece of information is given (usually by tachistoscope), which is shortly thereafter masked by a second piece of information. The test subject's task is to reiterate the first one at the end of the trial.

4.2.4. Driving studies

As mentioned, the task of driving is so variable that a pooling of effects would lead to false conclusions. It is absolutely necessary to refer the performance to the task demand. That is why in the following the effects are reported in dependence from the driving situation.

When a closed-course study demands highly practiced performances in a normal environment without unforeseen incidents, this is basically a description of automatized processes. Effects are accordingly not found there until 0.06/0.7%. When such studies require driving backwards through obstacles or negotiating complex courses, or when objects are by night unexpectedly thrown into the track, these demands can only be mastered using controlled actions.

The distinction between automatized and controlled is thus mirrored in traffic situations and makes possible an objective definition of types of actions based on components of the situation. That the effects of alcohol appear at comparable concentrations each time makes this identification all the more plausible. Taken together, alcohol has

- obvious effects from about 0.03/0.04% in traffic situations requiring a large degree of control processes. Such processes are called upon when driving must be adapted to quickly changing, unforseeable situations. Similarly, drivers dal poorly with situations which place a multiple demand on them.

- obvious effects from about 0.03/0.04% in traffic situations which have social valence. This especially affects such situations as contain aggression-triggering stimuli (e.g. crowding, being overtaken, fight-of-way conflicts, etc.). The social conditions in the vehicle belong here likewise (occupants, kind of communication), which under alcohol take on a different meaning for the driver. Processes of both higher risk acceptance as well as higher caution can be demonstrated here.

- effects only above 0.05% in situations which can be resolved through the use of automatized behavior. This includes the so-called standard situations like turning, overtaking, etc., which, though they objectively heighten the demands, are so well practiced that they can be carried out under low-level behavioral supervision.

- effects only at 0.07/0.08% in nondemanding situations. Here, the demands on psychic functions are so small that a light to middling impairment is imperceptible, either because the already- impaired performances are simply not being used, or because a potential decrease can be compensated for by other functions or by an increase in effort.

The BAC values given are valid for the resorptive phase. Approximately 0.03% must be added to get comparable effects of the impairment in the eliminative phase.

4.2.5. Effect modification by time

All behavioral domains show the large difference in the action of alcohol during the resorption and elimination phase. The restitution of the deteriorated functions in the descending limb of the BAC curve is of about 0.02 and 0.04%. That means, to get alcohol effects comparable to those at a BAC of x% during the ascending limb, a BAC of at least of x+0.03% is needed during the elimination phase.

Up to now the reasons are not fully understood. It is possible that the restitution is caused by psychological processes of systemic compensation or by adaptation of the system. In the same way, metabolic processes may be responsible. Regardless to the lacking explanation it must be stated, that a discussion of alcohol effects only is possible with respect to the time dimension.

5. Consequences for legislation

Scientific knowledge about alcohol effects are only one building block in the foundations of legislative measures. The decision to legally prohibit a certain BAC on the road can be founded on four arguments. The BAC of the alcohol limit

- impairs all important psychophysical functions (the **all-functions argument)**
- leads to marked losses in all persons (the **all-persons argument)**
- leads in all traffic situations to lower driving safety (the **all-situations argument)**
- has at least one particular effect under all drinking conditions (the **all-drinking-conditions** argument).

This review demonstrates that such a general endangerment probably only takes effect at BAC values at or above 0.07/0.08%.

Only above this limit do all the differences blur which come from different effects on different subsystems of behavior (e.g. automatic vs. control), or from different types of driver and drinker (expert drivers vs. novices, experienced drinkers vs. "learners"), or which involve different traffic situations (easy vs. difficult), or result from different drinking conditions (resorption vs. elimination).

For any given BAC value below this limit of 0.07/0.08%, an ample number of conditions can be specified under which no noticeable impairment occurs.

If one wants, therefore, to justify a limit lower than this, one needs additional arguments. These could proceed from, say, consideration of public safety, principles of deterrence, or pedagogical behavior modification. Considerations of public safety could lead in the introduction of special limits for praticularly dagerous groups as truck drivers (as has happened in the USA with the 0.04% limit). The deterrence polica may justify itself with the claim that the prohibition of BAC values that are not dangerous in traffic keeps drivers from drinking themselves into BAC ranges where they lose control of their alcohol consumption. Behavior modification may demand an absolute prohibition of alcohol, since it is easier to learn a general prohibition than one with many special cases.

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