



# The role of traffic psychology in psychopharmacological research ☆



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## ABSTRACT

After the definite breakthrough of the awakening to the negative effects of alcohol on traffic safety, some 50 years ago in the sixties of the past century (see Borkenstein et al., 1974), authorities began to worry about drugs, initially medicinal drugs. After World War II, the prescription and administration of medicinal drugs expanded enormously. Pharmaceutical research was booming, for instance leading to the extremely successful introduction of Benzodiazepines, a group of depressing drugs administered for various symptoms. Laboratory studies gave strong indications that at least some medicinal drugs were likely to affect traffic safety. However, contrary to alcohol, no unambiguous effect with respect to traffic safety could be assessed easily by standard methodology, i.e. epidemiological research. Thereupon a new line of experimental research was developed, in the field itself, by means of instrumented vehicles. People were administered medicinal drugs, and placebo in double-blind within-subjects cross-over designs, driving on closed circuits or in some countries even out on the public road under strict surveillance. Several performance measures were registered, of which “swerving” or “weaving”, i.e. the control over lateral position as measured by the standard deviation of lateral position (SDLP) came forth as the most promising. To date SDLP proved itself as the most valid and reliable indicator of performance deterioration, and is at the basis of recently developed categorization systems of (medicinal) drugs.

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## 1. Introduction

With the fast popularization of driving motor-vehicles after the Second World War, all kinds of side-effects surfaced. Traffic density increased, the infrastructure had to be adapted to the fast rising number of vehicles, while increasing numbers of crashes (accidents as they were called in those days) quickly claimed attention and took its toll. Within this new context, driving motor-vehicles demanded ever more skills and alertness of the driver, needed constant attention and control. For instance, while in the old days a man could perhaps visit a bar and ride home on his horse under influence of alcohol, this became a hazardous enterprise (see Holcomb, 1938). However, authorities that keep watch over traffic safety were not becoming conscious of the dangers until police reports confirmed the anecdotes and newspaper alarms about driving under influence. In 1960 the pharmacologist Borkenstein accepted the assignment to establish a relationship between alcohol and

\* Editor's Note: This paper was invited and peer-reviewed for a special section on History of Traffic Psychology. The special section included a wide range of manuscript styles, from those typical of this journal to other styles just as important for sharing the discipline's history. Authors contributed reasoned viewpoints from experience and literature on where the discipline has come from and where it may be heading, to an investigation of trends and topics in the discipline since the early 20th century.

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traffic safety. Borkenstein et al. (1964 in: Borkenstein, Crowther, Shumate, Ziel, & Zylman, 1974) designed a so-called epidemiological case-control study (for a treatise on this type of studies, see Berghaus, Ramaekers, & Drummer, 2007; Houwing, 2013; Houwing, Mathijssen, & Brookhuis, 2009) to determine definitely the crash and injury risks associated with driving under the influence of various occurring levels of the psychoactive substance alcohol. The results of the study were quite dramatic, it turned out that the relationship between alcohol and accident likelihood was straightforwardly quadratic of nature. In practice it meant that each additional glass of alcoholic beverage increased the risk of being involved in a crash around double than the last glass already did. In Fig. 1 the so-called Borkenstein Curve (Borkenstein et al., 1974) is depicted.

In fact, all psycho-active substances, i.e. active chemical compounds that pass the blood–brain barrier, run a similar risk. Performance in all kinds of tasks is likely to be affected in a negative manner. Operators in all kinds of hazardous circumstances, under the influence of psycho-active substances run (unknown) risks. What was established in 1964, and published in 1974, for alcohol, was largely terra incognita for all other substances. Although it seemed quite clear that at least some recreational drugs, such as the group of opioids had devastating effects on performance, medicinal drugs were not suspect a priori. Medicinal drugs were designed, developed and tested for positive effects on health and well-being, so positive effects on performance, including driving ability, should be expected. However, again anecdotal and newspaper rumors initiated doubts in that respect (see for a review O'Hanlon, 1984).

In particular some members of the in those years new chemical family of Benzodiazepines had sometimes vast inhibitory effects on activation and alertness, leading to obvious phenomena such as drowsiness, dozing and inertia. For instance, the popular anxiolytic diazepam (Valium®, inhibiting anxiety) showed such effects as reported, at least in the higher dose (10 mg) that is prescribed for serious complaints. Laboratory tests such as will'-of-the-wisp, a tracking performance test, indicated that lateral control over the vehicle perhaps would deteriorate to a level that driving would be irresponsible under medication with diazepam. In order to validate this type of laboratory data, O'Hanlon's team developed an on-road test specifically for this purpose, based on the ability to keep a motor-vehicle adequately within a specified traffic lane (O'Hanlon, 1984; O'Hanlon, Haak, Blaauw, & Riemersma, 1982). They demonstrated in a cross-over design that even professional drivers, in this case police driving instructors, were not able to keep the car neatly within the right traffic lane on a highway. On the contrary, the amount of weaving, or swerving, as reflected in the standard deviation of lateral position (SDLP) was considerably and significantly larger after medication than in the placebo condition (O'Hanlon et al., 1982). This highly relevant difference was the start of a new line of research into unintended and unwanted side-effects of psycho-pharmaceuticals, ultimately leading to the international acknowledgement of SDLP as the representative parameter to measure the influence of drugs.

Another popular and well-sold Benzodiazepine, but prescribed for sleep inducing purposes to people with sleep problems, was flurazepam (Dalmadorm®, in 15 mg or 30 mg dose depending on the seriousness of the insomnia complaint). After a newspaper report that drivers dozed off the next morning, and crashes were attributed to the administration of this hypnotic (sleeping pill), the manufacturer sought (contra) expertise and found that at the Traffic Research Centre within the University of Groningen, the Netherlands. The manufacturer argued that the hypnotic would be beneficial to the patient and therefore improve driving performance. The Traffic Research Centre, i.e. the Drugs & Driving Department (led by J.F. (Jim) O'Hanlon) received the assignment to study the matter. The method of measuring weaving during prolonged driving on a highway was now standardized, for hypnotics' after-effects this time. Participants (called "subjects" in those days) self-administered specific dosages of hypnotics or placebos, in a double blind cross-over design. The next morning, 10–11 h after administration, they were tested to their driving capabilities by means of a standard driving performance test over 100 km (see below). In the afternoon, 16–17 h after administration, the whole exercise was repeated, to check whether possible early effects would be gone in the afternoon, depending on the metabolic speed. Flurazepam in the 15 mg dose turned out to affect weaving highly significantly, certainly in the morning, while the effect of the 30 mg dose was simply devastating (for a preview, see also Fig. 7).

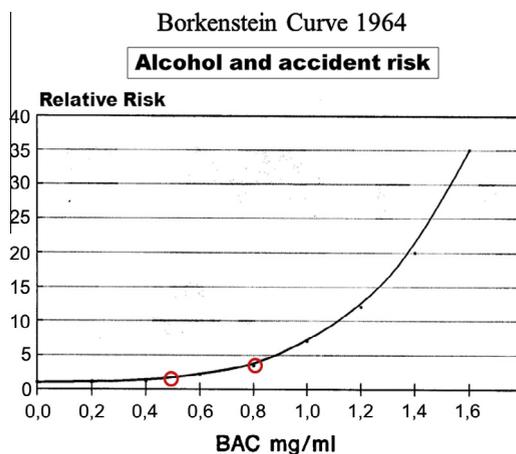


Fig. 1. The relationship between blood alcohol concentration (BAC) and relative likelihood to be involved in traffic accidents (Borkenstein et al., 1974).

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