

SUMMARY OF SCIENTIFIC EVIDENCE BEHIND

“JUST ONE DRINK IMPAIRS DRIVING”

NOVEMBER 2005

Alcohol is a sedative.¹ Drink it and, after it passes through the liver, some of the alcohol will hit the brain within minutes.² When alcohol reaches the brain this mind-acting drug will begin to impact on the brain cells and brain systems.³

What happens next has been verified by a mass of scientific research into the effects of alcohol upon the brain and upon behaviour. This is not to say that we know everything, yet, but clearly we know enough from decades of scientific evidence to reach reasonable and well-founded conclusions about how any alcohol impairs driving – even from the first drink.⁴

ONE IMPAIRMENT LEADS TO ANOTHER – AND ANOTHER

The first impact of alcohol on the brain is that it begins to close down mental activity.⁵ This effect feels relaxing, even pleasurable, but is progressively damaging for the complex skills needed to drive safely. The skills most critical to driving - the brain's ability to observe, interpret and process information from the eyes and other senses – is impaired by alcohol at the lowest levels that can be measured reliably.⁶

In April 2000, Professor H. Moskowitz⁷ and Dary Fiorentino, published a review of 112 scientific studies into the Effects of Low Doses of Alcohol on Driving Related Skills.⁸ The findings are shown in Chart A – “Impairment and Blood Alcohol Concentration”. Their study reveals that at under 1/8 of our legal limit (the limit is 80 milligrams of alcohol per 100 millilitres of blood) both basic Driving Skills and Divided Attention ability were found to be impaired in half or more of the behavioural tests. The ability to divide attention between different sources of information on the road is a crucial requirement of safe driving – and this ability starts to be impaired at the lowest doses of alcohol. The evidence is that impaired drivers tend to focus more on steering when Divided Attention ability is affected – and thus they miss out on vital happenings in their peripheral field of vision⁹ - the child about to cross the road, the truck emerging

from a side road, the danger round the next bend which would be quickly spotted and assessed when sober.



Given this evidence of impairment of crucial driving skills at under 1/8th of our legal limit for Blood Alcohol Concentration, Professor Moskowitz confirmed in July 2001 that

*"There is no BAC level at which impairment does not occur"*¹⁰

Between 1/8th and 1/4 of our legal limit, impairment of Wakefulness was found in half or more of the tests, producing Drowsiness in impaired drivers at low BAC levels. Further evidence of this danger came in 2002 from Professor Jim Horne and scientists at the Sleep Research Centre in Loughborough University, who found that:

“...because of the natural afternoon “dip” in alertness, even after a normal night’s sleep, then a modest alcohol intake at lunchtime (giving BACs well within the “pass” range for police roadside breathalysers) presents a potential danger to driving at this time...”¹¹

Research has shown that the complete impact of a road crash is over in one fifth of a second ¹² - which is why a millisecond’s doze at the wheel due to drowsiness caused by a low intake of alcohol, can have such fatal and tragic consequences, with driver sleepiness a factor in about 10% of road crashes in France,¹³ 16% on major roads in England and over 20% on midland motorways in England.¹⁴

But drowsiness is not the only impairment found at under ¼ of our legal limit.

Impairment was also found at this low BAC level for Psychomotor Skills (for instance body balance and skilled physical tasks); for Tracking (for instance steering within lane limits while monitoring the driving environment); and for Cognitive Tasks (information processing, such as the time a driver needs to read a street sign or recognise and respond to a traffic signal, or make a decision).

The impairment of Information Processing skills at low BAC levels takes us to one of the greatest dangers of the first drink’s effect upon driving ability.

Alcohol impairs sensible decision-making.¹⁵ It distorts our ability to process information and therefore impairs our ability to assess our own competence to drive.¹⁶ After a drink, you may not feel intoxicated and may believe you can drive safely.¹⁷ This is due to impairment of your brain’s cognitive processing capability. As Forensic Physician Dr Morris Odell puts it:

“The problem is that most people feel fine at low blood alcohol levels, so they don’t realise they’re already at risk.”¹⁸

This is why the decision to take the first drink, when intending to drive, can be the fatal decision – because it leads to a downward spiral of impaired decisions to have one more, then another, then another.

And this is why the new TV campaign says:

“Before you decide to drink and drive, take a look at the decisions you may be forcing on others...”

At under 1/3 of our legal limit both Visual Functions (including the brain’s control of the eyes) and Choice Reaction Time (multiple responses involving information processing as well as simple reaction time) were beginning to show impairment.

At under 1/2 of our legal limit Vigilance (including alertness) was impaired in half or more of the scientific tests – and Perception skills (including hazard perception) were beginning to show impairment.

By 3/5 of our legal limit both Perception skills and Visual Functions were impaired in half or more of the scientific tests.

By 3/4 of our legal limit Tracking skills were impaired in half or more of the tests.

And by 4/5 of our legal limit half or more of the tests were showing impairment in Cognitive Tasks, Psychomotor Skills and Choice Reaction Time.

The combined effect of all these impairments after low alcohol intake is that:

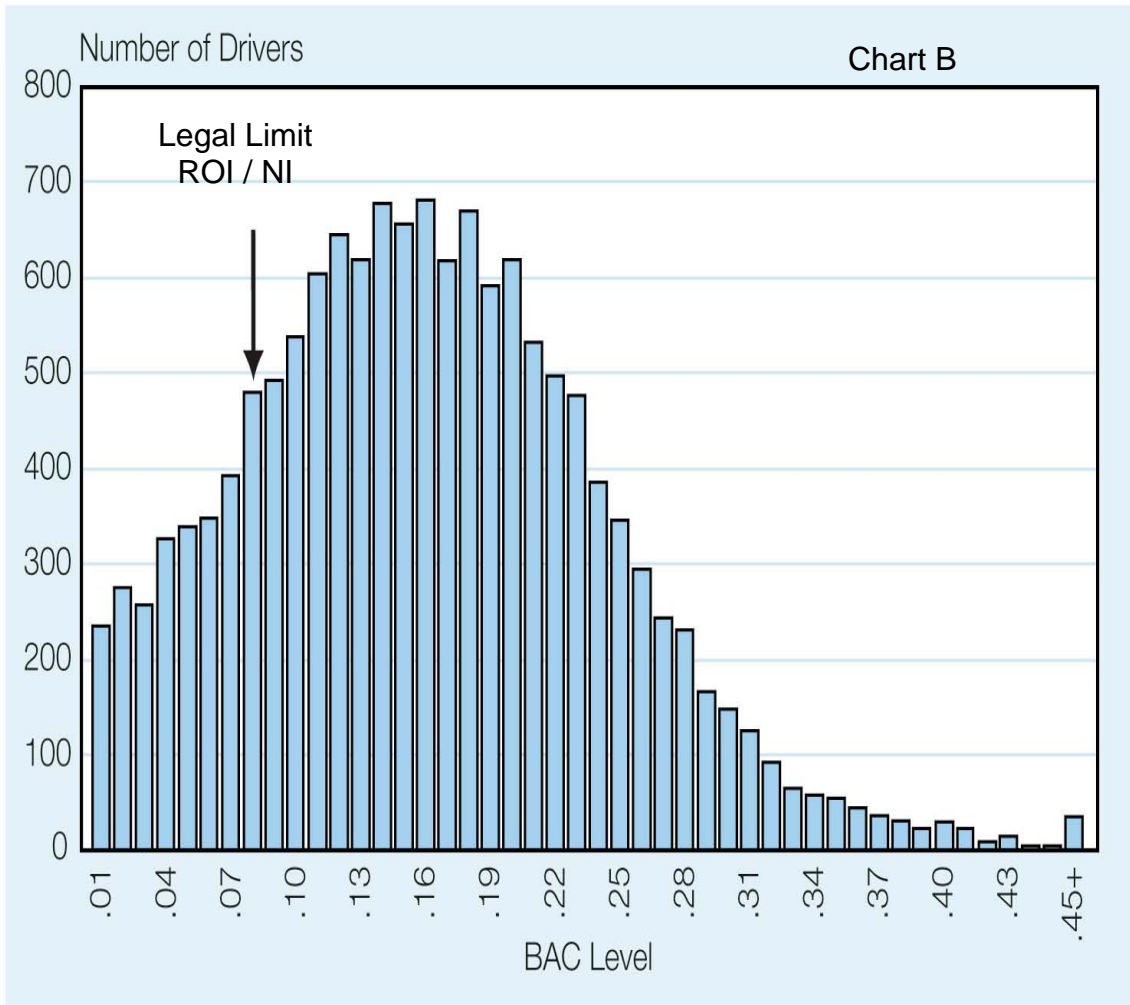
- The driver’s ability to judge distances is reduced at low BACs
- The driver’s speed of scanning the total road environment is much slower and people, objects or dangers may be missed
- The impaired driver takes too long to make all the vital decisions made second by second at the wheel – or even makes the wrong decisions
- The driver’s judgement is impaired – for instance increasing the willingness to take more risks when driving¹⁹

The cumulative result is that, just as one drink leads to another, so one impairment leads to another. The conclusion of Professor Herbert Moskowitz is:

“As the BAC level increases, more and more components of behaviour are involved in producing a more complex set of impairments”²⁰

Chart B below illustrates the result of these complex impairments, from USA data.

Distribution of BAC Levels for Drivers Involved in Fatal Crashes with BAC .01 or Higher



Source: National Highway Traffic Safety Administration: National Center for Statistics and Analysis / 2004 Data

This proves that driver involvement in fatal crashes does not start at our Legal Limit. It builds steadily from BACs at one eighth of our Legal Limit, demonstrating that low BACs are a danger factor.

THE OUTCOME – ANY ALCOHOL INCREASES RISK

Impairment due to alcohol is not an obscure laboratory theory. Impairment has consequences – real, horrific, brutal, heart-breaking consequences. As a leading researcher puts it:

“...let us begin with an obvious conclusion supported by the preponderance of research evidence in this field; namely that the higher the BAC level of a driver, the greater the probability of a fatal crash.”²¹

But where does the higher risk of a crash begin? The evidence from Professor Herbert Moskowitz is:

“Crash rates increase with any departure from zero BAC”²²

The finding is clear that any amount of alcohol in the system of a driver increases the risk of a crash.²³

“Research has shown, however, that crash risk increases almost monotonically with BAC level when drinking experience (tolerance) is controlled for, and drivers at even the lowest BAC levels can represent increased risk.”²⁴

Impairment increases with each drink.

The risk of a collision increases with each drink.

But the highest risk of collision, starting at the lowest BAC levels, is among young drivers²⁵ – hence the focus of the new campaign.²⁶

THE MYTH BURIED

On 23 July 2001 this body of scientific evidence finished off one of the enduring myths of drinking-driver folklore – the delusion that a few drinks make you a more relaxed, less risky driver. As Hans Laurell of the Swedish National Road Administration said:

“For 30 years I have had a hard time fighting off the hordes of people who claim that small amounts of alcohol actually improve performance. Herb (Moskowitz) permits me to bury this myth.”²⁷

The overall impact of this evidence is challenging for both individuals and for all of society –

- Every drink impairs driving
- Every drink increases the risk of collision
- Just one drink before driving increases the risk of death and injury for other road users
- Therefore drinking and then driving is shameful
- It follows that society and everyone involved should promote safe choices – using designated drivers, taxis, public transport, walking, or just refusing to drink and drive.

THE MORNING AFTER

Alcohol is cleared from the body at a rate equivalent to about 15 milligrams of alcohol per 100 millilitres of blood in one hour.²⁸ That’s equivalent to about $\frac{3}{4}$ of a half-pint of standard strength beer, eliminated per hour. Therefore a heavy drinking session – such as a Christmas office party – which raised a driver’s BAC to a total of 200 milligrams of alcohol per 100 millilitres of blood (well over the 80mg/100ml legal limit for driving) by midnight, could take **13.33** hours to clear the body – that’s until after lunchtime or 1.30pm the next day.

Therefore the Morning After is a dangerous zone for impaired driving.

However, the danger of counting units and trying to calculate personal BAC by the hour is revealed by new scientific evidence published in October 2004, by researchers at the University of Ulster and Queen’s University.

A total of 48 social drinkers, between 18 and 43 were tested in a hangover and no hangover state, approximately one week apart. The results demonstrated that memory and psychomotor performance were impaired on the morning after heavy social drinking, despite blood alcohol levels of zero or very near zero.²⁹

This evidence indicates that the fly-wheel effect of impairment from alcohol continues into the next day, even after a return to zero BAC.

Therefore the only safe advice is – never ever drink and drive, including on the morning after and even the daytime after a major night out.

CONCLUSION

Scientists report that *“it is important to increase public understanding of the impairing effects of low levels of alcohol in order to encourage changes in attitude and behaviour.”*³⁰

Muriel D. Vogel-Sprott, Professor of Psychology at the University of Waterloo, Ontario has stated:

*“It seems that drinkers may not expect BACs below the legal definition of impairment to cause any appreciable behavioural impairment. Information to correct and change this expectancy could be helpful in promoting safety. Forewarning drinkers to expect impairment at these lower BACs may aid them in resisting it, and making better informed decisions about what activities may be hazardous to undertake.”*³¹

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¹ Edwards, G. (2004) *Matters of Substance – Drugs and why everyone’s a User*. London. Allen Lane: Penguin Books, pp.xvii. (Griffith Edwards is Emeritus Professor of Addiction Behaviour at the National Addiction Centre at the University of London)

² “When swallowed, the alcohol is absorbed from the stomach and the small intestine. Absorption will be slowed by the presence of food, or can be somewhat speeded if the drink has been chilled or has been aerated with bubbles of carbon dioxide. Less concentrated drinks may have their alcohol more rapidly absorbed than stronger ones, so iced champagne drunk on an empty stomach can be an effective way of getting alcohol to the brain quickly. After a preliminary pass through the liver, some of the alcohol will be reaching the brain within minutes. The blood or brain alcohol level will then slowly increase for the next thirty to sixty minutes as the absorption of a single drink is completed. Several drinks taken together or spaced out in a series of drinks will result in the alcohol level going upwards longer and higher. But enormous variation in absorption rates can occur between individuals and on different occasions.” Edwards, G. (2002) *Alcohol, The World’s Favourite Drug*. New York: Thomas Dunne Books, St. Martin’s Press, pp. 6-7

³ Ibid, pp 8-9

⁴ "The papers by Moskowitz (2001a), Vogel-Sprott (2001) and Burns and Fiorentino (2001) provide a summary of laboratory research concerning the effect of blood alcohol concentration on motor skills and cognitive processing. Overall they found, what we have come to expect, which is that impairment begins....practically after the first drink."

Holder, H.D. (2001) *Implications of Research for Policy Concerning Low Blood Alcohol Concentration in traffic Safety*. Paper presented at Summer Workshop on Low BACs, Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of the National Academies in Woods Hole, Massachusetts, July 23-24, 2001 pp109. (Harold D. Holder is Director and Senior Scientist of the Prevention Research Center, Berkeley, California)

⁵ Edwards, G. (2004) *Matters of Substance – Drugs and why everyone's a User*. London. Allen Lane: Penguin Books, pp. xvii

⁶ Moskowitz, H. and Burns, M. *Effects of alcohol on driving performance*. Alcohol Health and Research World, Winter 1990, Summary.

⁷ Dr. Herbert Moskowitz is professor Emeritus of Psychology at California State University, Research Psychologist at UCLA and President of Southern California Research Institute.

Dr. Moskowitz has been a researcher in psychopharmacology and engineering psychology for more than 40 years. His work included developing sensitive behavioural tests for skills performance to examine alcohol and drug effects. He has recently served as principal investigator of a large scale epidemiological study of accidents as a function of BAC with improved methodology so as to update the relationship between BAC and crash rate. Dr. Moskowitz has more than 135 publications in the field. He has served as a member of the International Council on Alcohol Drugs and Traffic Safety for 30 years, on the committee of the U.S. Transportation Research Board and the U.S. National Safety Council. He is a fellow of the American Psychology Association, and the American Psychology Society. He is a member of the American Psychology Law Association, Society of Engineering Psychologists, Research Society of Alcoholism, etc. He has received the A.R. Lauer award from the Human Factors Society and the Widmark award from ICADTS.

He has received grant awards for his research from the National Institute of Alcohol Abuse and Alcoholism, the National Institute of Drug Abuse, the National Institute of Occupational Safety and Health and the U.S Department of Transportation, as well as non-governmental agencies such as the Insurance Institute for Highway Safety and the American Automobile Association Foundation.

⁸ Moskowitz, H. and Fiorentino, D. (2000) *A review of Literature on the Effects of Low Doses of Alcohol on Driving-Related Skills*, DOT HS 809 028, U.S. Department of Transportation, National Highway Traffic Safety Administration, Washington, DC.

⁹ Moskowitz, H. and Burns, M. *Effect of alcohol on driving performance*. Alcohol Health and Research World, Winter 1990.

¹⁰ Moskowitz, H. (2001a). *Laboratory studies of the effects of low BACs on performance*. Paper presented at Summer Workshop on Low BAC's, Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of National Academies in Woods Hole, Massachusetts, July 23-24, 2001, pp19.

¹¹ Horne, J.A., Rayner L.A., and Barrett, P.A. (2003) *Driving Impairment due to Sleepiness is Exacerbated by Low Alcohol Intake*. Occupational and Environmental Medicine, **60**, 689-692

¹² Forman, P. Transport Research Laboratory

¹³ Philip, P., Vervialle F., Le Breton P., et al. *Fatigue, alcohol and serious road crashes in France: factorial study of national data*. British Medical Journal, 2001; **322**, 829

¹⁴ Horne, J.A. , Reyner, L.A. *Sleep Related vehicle accidents*. British Medical Journal, 1995; **310**, 556-557

¹⁵ Edwards, G. (2002) *Alcohol, The World's Favourite Drug*. New York: Thomas Dunne Books, St. Martin's Press, pp. 189.

¹⁶ "While performance on a variety of cognitive and psychomotor tasks is measurably impaired at very low levels of BAC, overt, observable behaviours are not dependably changed by alcohol. Thus, an individual's driving performance may be impaired while their behaviour is not obviously affected by alcohol. This situation makes individual judgements about fitness to drive unreliable." Stewart, K.G. *Low Blood Alcohol Content: Performance, Safety and Policy*. Paper presented at Summer Workshop on Low BACs, Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of the National Academies in Woods Hole, Massachusetts, July 23-24, 2001, pp.5.

¹⁷ Burns, M.M. and Fiorentino, D. *The Effects of Low BACs on Driving Performance*. Paper presented at Summer Workshop on Low BACs, Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of the National Academies in Woods Hole, Massachusetts, July 23-24, 2001, pp21.

¹⁸ www.tacsafety.com.au (go to Campaigns, then Drink-Driving)

¹⁹ www.tc.gc.ca/roadsafety/tp/tp1535/behav.htm

²⁰ Moskowitz, H. (2001A) *Laboratory studies of the effects of low BACs on performance*. Paper presented at Summer Workshop on Low BACs, Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of the National Academies in Woods Hole, Massachusetts, July 23-24, 2001, pp19

²¹ Helander, C. *Epidemiology: Crashes at Low BACs*. Paper presented at Summer Workshop on Low BACs Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of the National Academies in Woods Hole, Massachusetts, July 23-24, 2001, pp67

²² Moskowitz, H. (2001b). *Epidemiology of Crashes at low BACs*. Paper presented at Summer Workshop on Low BACs Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of the National Academies in Woods Hole, Massachusetts, July 23-24, 2001, pp.81

²³ Holder, H.D., *Implications of Research for Policy Concerning Low Blood Alcohol Concentration in Traffic Safety*. Paper presented at Summer Workshop on Low BACs, Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of the National Academies in Woods Hole, Massachusetts, July 23-24, 2001, pp. 110

²⁴ Helander, C. *Epidemiology: Crashes at Low BACs* Ibid pp.76

²⁵ "These data support the conclusion that younger drivers are at higher risk at lower levels of alcohol, which makes sense given the relative inexperience of younger drivers at both drinking and driving. Simpson (1985), in fact, has shown that underage (16-19) drivers have the highest fatal crash risk at every BAC level". Helander, C. Ibid, pp71.

Simpson, H.M. 1985. *Polydrug Effects and Traffic Safety*. Alcohol, Drugs and Driving: Abstracts and Reviews, Vol. 1, University of California, Los Angeles

"In general, the relative risk of involvement in a fatal vehicle crash increased steadily with increasing driver BAC in every age/gender group among both fatally injured and surviving drivers. Among 16-20 year old male drivers, a BAC increase of 0.02% [note, a quarter of our legal limit] was estimated to more than double the relative risk of fatal single-vehicle crash injury". Zador, P.L., Krawchuk, S.A., & R.B. Voas. 2000. *Alcohol-Related Relative Risk of Driver Fatalities and Driver Involvement in Fatal Crashes in Relation to Driver Age and Gender: An update using 1996 Data*. Journal of Studies on Alcohol, Volume 61, No. 3, Center of Alcohol Studies, The State University of New Jersey, Rutgers.

²⁶ In both the Republic of Ireland and Northern Ireland young male drivers 17-24 are consistently the most over-represented group of road death victims and also of drivers responsible for fatal collisions. Where statistics are available on drivers or riders responsible for deaths or serious injuries due to driver/rider alcohol or drugs, young male drivers 17-24 are also consistently the most over-represented group, five times more likely to be responsible (NI, 1993-2003)

²⁷ Laurell, H. *Comment on the Effects of Low BACs* Paper presented at Summer Workshop on Low BACs Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of the National Academies in Woods Hole, Massachusetts, July 23-24, 2001, pp.47

²⁸ Edwards, G. (2002) *Alcohol, The World's Favourite Drug*. New York: Thomas Dunne Books, St. Martin's Press, pp7.

²⁹ McKinney, A. and Coyle, K. (2004) *Next Day Effects of a Normal Night's Drinking on Memory and Psychomotor Performance*. Alcohol and Alcoholism, **39**, No 6, pp 509-513

³⁰ Stewart, K.G. *Low Blood Alcohol Content: Performance, Safety and Policy*. Paper presented at Summer Workshop on Low BACs Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of the National Academies in Woods Hole, Massachusetts, July 23-24, 2001, pp.6

³¹ Vogel-Sprott, M. (2001) *Low BAC policies: Results and mechanisms*. Paper presented at Summer Workshop on Low BACs Committee on Alcohol, other Drugs and Transportation, the Transportation Research Board, Center of the National Academies in Woods Hole, Massachusetts, July 23-24, 2001, pp.39

