Links between driving a motor vehicle and operating a boat under the influence of alcohol: an overview

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1. General considerations

The medical and psychological literature describes clear links between driving a motor vehicle under the influence of alcohol and operating a boat under the influence of alcohol. The underlying evidence can be distinguished into three categories:

- Studies on the statistical association between the two behaviours;
- Indirect links via personality factors such as sensation seeking;
- Indirect links via similarity of behaviours.

The study of the statistical associations between driving a motor-vehicle and operating a boat under the influence of alcohol has not received much attention (section 2). The main reason for this lack of direct associations is that scientific inquiry strives to establish and test more general theories (Popper, 1934/1982) (Popper 1982), and thus associations between randomly selected behaviours are not the focus of scientific inquiry unless they are instrumental in testing wider theoretical statements.

There are hundreds of publications on how certain personality characteristics are linked to risk behaviour, such as operating machinery under the influence of substances, but as the links are indirect, it is assumed that these characteristics will also have an impact on many similar risk behaviours, including drunk driving or drunk boating. The major link will be discussed in section 3.

Second, for practical purposes, there is also a vast amount of literature on how to deal with and prevent the operation of boats under the influence of alcohol, most of which is based on the experiences from drunk driving legislation and other preventive efforts in this area. This indirect evidence is summarized in section 4.

2. Direct studies on the statistical association between the two behaviours

Logan and colleagues (Logan et al., 1999) conducted a randomly dialled national telephone survey with 5,238 adult respondents in the US, who reported on their operation of boats, alcohol use, and other potential injury risk behaviours. Data were weighted to obtain national estimates and percentages.

They found that operating boats under the influence of alcohol was associated with other motor vehicle risk taking behaviours such as operating a motor vehicle under the influence of alcohol and not using seat belts. In the words of Logan et al. (p. 279):

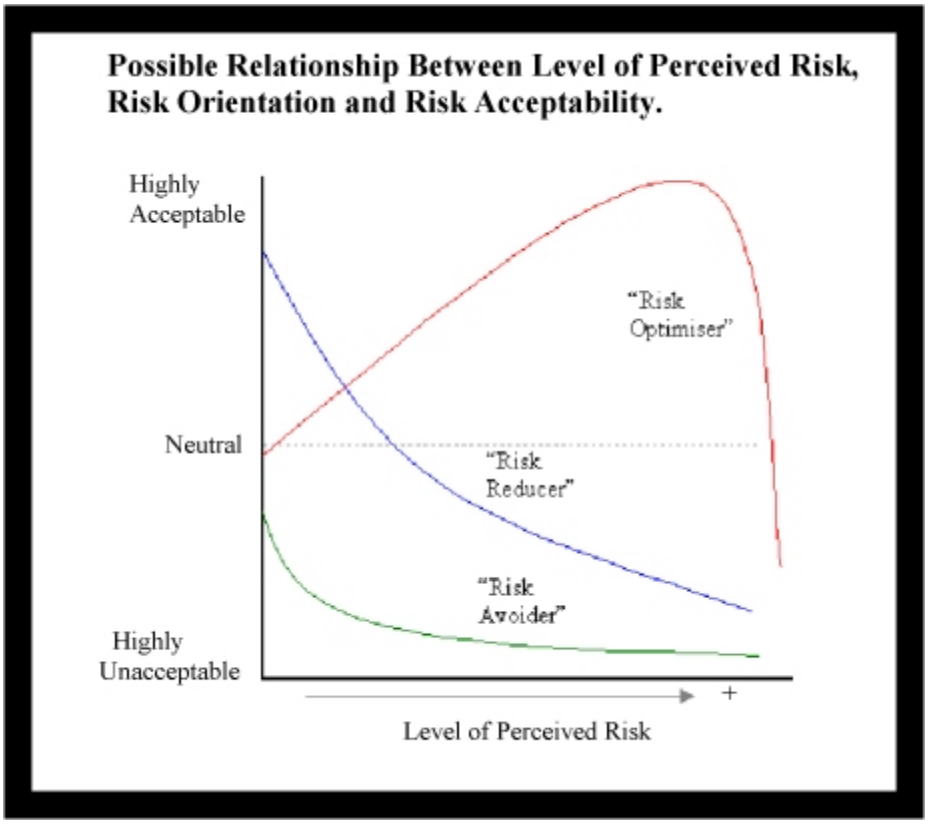
Alcohol-influenced motor boat operation was also associated with other risk-taking behaviors. Driving a motor vehicle while under the influence of alcohol was more common among those who drove motor boats while alcohol-influenced (11.8%) than those who were sober when operating a motor boat (4.0%), ($p < 0.01$).

3. Indirect links via personality factors such as sensation seeking

A scientific definition by David J. Llewellyn states that risk taking behaviour is the voluntary participation in behaviours that contain, or are at least seen to contain, a significant degree of risk (http://www.risktaking.co.uk/concepts.htm#behaviour; accessed December 19, 2008) (Llewellyn 2008). In practice there is often a surprisingly high degree of agreement between the lay person's intuitive and the scientist's systematic

assessment of risk, and so there is high agreement of what constitutes a significant degree of risk. According to most definitions, risk-taking is the taking of action that may result in an unpleasant or undesirable outcome. The different approaches people adopt to risk are labelled "risk orientation", of which there are three different risk taking categories, namely "risk avoiders" (who avoid medium and high risk activities due to the risks involved), "risk reducers" (who participate in high risk activities more than risk avoiders and less than risk optimisers), and "risk optimisers" (who participate in high risk activities partly due to the risks involved). Figure 1 from Llewellyn illustrates the different risk orientations.

Figure 1: Possible Relationships between level of perceived risk, risk orientation and risk acceptability according to D. Llewellyn
http://www.risktaking.co.uk/concepts.htm#behaviour



While risk orientations may change from situation to situation, most evidence suggests that risk orientations and risk taking are fairly stable personality traits, and thus people's attitudes toward risk and risk behaviours can be predicted with a reasonable degree of precision. Specifically, there are clear indications that both biological and social factors impact the development of risk taking personality traits (Llewellyn 2008; Zuckerman and Kuhlman 2000). For instance, Zuckerman & Kuhlman (2000) found, that there was a significant association between risk taking in six areas studied (smoking, drinking, drug taking, sex, driving and gambling) and certain personality characteristics such as sensation seeking, aggression and sociability. These study results corroborate many other studies (a limited search in the PubMed medical databank revealed 227 article under the key words of "personality characteristics" and "risk taking" alone), and based on overall current knowledge, we could expect a significant correlation of risk behaviours such as driving a motor vehicle under the influence of alcohol and operating a boat under the same influence.

4. Indirect links via similarity of behaviours

In the following I will give a number of studies which provide indirect evidence regarding the similarities of driving a motor vehicle under the influence of alcohol and operating a boat under the influence of alcohol. This evidence describes similarities of these behaviours without in general referring to a shared personality trait as a common underlying factor. However, the cited articles of course do not exclude such traits as potential explanations for the similarities of these behaviours.

The two closest indirect lines of evidence are

- that people with identical types of frequent heavy drinking, who often started drinking early in life are at the most risk for any kind of injury (i.e., traffic injuries, drowning, other kinds of injuries) and
- that people convicted with driving under the influence of alcohol have a much higher risk for any death from injury (i.e., traffic injury mortality, drowning, other intentional injury; other unintentional injury).

For instance, Hingson and colleagues (Hingson et al., 2000) analyzed one of the largest representative US surveys (more than 42,000 respondents) and found that the age of onset of drinking, frequency of heavy drinking, and involvement in any unintentional injury while under the influence of alcohol, were all strongly related. For example, the risk of unintentional injury was about 3 fold for people who started to drink at age 14, compared to those who started at 21; after adjustment for many potential confounding variables such as age or family history of alcoholism. Thus, certain patterns of drinking are linked with alcohol-attributable injury per se, and as alcohol is causally related to all kinds of injury (Rehm et al., 2004; Rehm et al., 2003b), including motor vehicle and boating related (see also (Rehm et al., 2003a; Smith et al., 1999; Smith et al., 2001)), it is reasonable to conclude that both kinds of behaviours, i.e., drunk driving and drunk boating, stem from the same patterns of drinking, and are thus related.

Similarly, several studies have demonstrated that drivers under the influence are more likely to die from any accidental and violent causes, including boating accidents and drowning (Mann et al., 1993; Skurtveit et al., 2002). Mann and colleagues studied a sample consisting of all individuals convicted of a second driving under the influence (DUI) offence in two Ontario cities (Oshawa and North Bay) between 1973 and late 1978. By the end of 1986 there were 53 deaths (51 males, 2 females) in the sample. Significant excess total mortality was observed among men compared to the general population (Standardized

Mortality Ratio -SMR[1] = 1.7; $p < 0.001$); similar trends were also observed among women. The largest number of deaths occurred in the accidental and violent death category (i.e., unintentional and intentional injury), with the observed number about twice what was expected.

Skurtveit and colleagues (Skurtveit et al., 2002) aimed to identify the mortality rates and causes of death among drunken and drugged drivers during the years after their apprehension; only the results for drunken drivers are relevant here and will be reported in the following. Their study used a population follow-up study (prospective cohort design) on all Norwegian apprehended drunken drivers in one year (1992), a follow-up period of 7.5 years, and mortality (death) as the main outcome variable. Apprehended drivers aged 20-39 years old who provided samples positive for alcohol (n=2531) constituted the total national samples of this category in 1992. The mortality rate among male drunken drivers was higher than in an age-matched Norwegian population (SMR=3.7 times the mortality rate of the general population; in 95 out of 100 repeats of the study the value would range between 2.9 and 4.7; this is the Confidence Interval of the SMR = CI); women drunken drivers showed a similar elevated risk SMR=4.3 (CI: 1.2-11.0). The dominant causes of death among drunken drivers were unintentional and intentional injury (suicide). Overall, these studies show that people convicted of driving under the influence of alcohol have an elevated risk for all kinds of injury, including unintentional injury, a category to which boating injury belongs.

Further indirect evidence is based on studies that demonstrate that drowning (including boating) fatality rates show a similar relationship to *per capita* consumption of alcohol as other well-known causes of death attributable to excessive alcohol use such as drinking and driving, cirrhosis, or suicide (Mann et al., 2001). This evidence was obtained by statistically examining the *per capita*

[1] A standardized mortality ratio compares the probability of death of a certain group with the population in general, assuming the same age and sex distribution.

consumption rates as a predictor for different categories of mortality, including drowning mortality or other injury and chronic disease mortality in Ontario, Canada, for the period 1977-1996. Research has also demonstrated that alcohol consumption is linked to drowning as much as to other kinds of injuries on not only on an aggregate level, but also on an individual level. In the largest alcohol and injury meta-analyses to date, Smith et al. (Smith et al., 1999) found 15 studies with more than 3,500 drowning cases. More than 34% of those tested had a blood alcohol concentration (BAC) of more than 100 mg/dL[2], usually taken as a conservative estimate for a causal effect of alcohol in alcohol epidemiology. Clearly, not all injuries with a BAC above this threshold are causally attributable to alcohol, but there are also many injuries causally attributable to alcohol, which happen to people with BACs below this threshold (for a specific dose response-relationship between alcohol consumption and fatal boating injuries, that shows, that lower doses of alcohol already have a considerable risk for mortality in boating see (Smith et al., 2001); for general considerations on dose of alcohol consumption and effects on central nervous system and psychomotor abilities see (Eckardt et al., 1998)).

Smith and colleagues (Smith et al., 2001) also conducted a case-control study that demonstrated that the risk of dying in a boating accident increases with increasing BAC in the same manner that the risk of being involved in a fatal collision does, and thus, the same patterns of drinking are responsible for both. The underlying research here was a case-control study of recreational boating deaths among persons aged 18 years or older from 1990-1998 in Maryland and North Carolina (n=221) which functioned as cases, compared with interviews obtained from a multistage probability sample of boaters in each state from 1997-1999 (n=3,943) which functioned as controls. Additionally, Khiabani and colleagues (Khiabani et al., 2008) showed that the distribution of BACs among

[2] The permissible BAC limit for Canada in the Criminal Code is .08 (80 milligrams of alcohol in 100 millilitres of blood), which would be 20% lower than the threshold used.

suspected impaired drivers and boaters is similar (although mean BAC in boaters is higher).

The last piece of indirect evidence cited here concerns the fact that the occurrences and situation for selecting designated drivers while being under the influence of alcohol, seem to be similar for people driving a motor vehicle and operating a boat (Cheong et al., 2006).

5. Conclusion

Overall, the evidence from three different fields of research:

- Studies of the statistical associations between driving a motor vehicle under the influence of alcohol and operating a boat under the influence of alcohol;
- Explorations of the relationships between personality characteristics and risk taking;
- Analyses of the similarities of drunk boating and drunk driving,

This evidence converges to indicate that there is in fact an association regarding the act of and the type of people who would drive a motor vehicle under the influence and operate a boat under the influence, hence that people who drive a motor vehicle under the influence of alcohol are more likely to operate a boat under the influence of alcohol, and vice versa.

6. References

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