Effects of Central Nervous System Depressants on Driving

What is the Drug-Impaired Driving Learning Centre (DIDLC)?

The Drug Impaired Driving Learning Centre (DIDLC) is a fully bilingual, web-based educational resource that was developed by the Traffic Injury Research Foundation, in partnership with Desjardins Insurance.

This comprehensive, accessible tool was created to inform the development of an evidence-based drug-impaired driving strategy. It was designed to meet the needs of a wide spectrum of diverse stakeholders who are seeking more information about priority issues.

The objective of the is to support the work of governments and road safety partners by sharing current knowledge about research and practice, and increasing awareness about drug-impaired driving. A consolidated base of knowledge is essential to build a common understanding of the drug-impaired driving problem, inform discussion, and achieve progress in reducing it.

The Learning Centre contains several modules that are structured in a question and answer format, similar to other TIRF educational programs. Module topics include:

- magnitude and characteristics of the problem
- effects of drugs on driving
- legislation and penalties
- tools and technologies.

To view more fact sheets, or to get more information about drug-impaired driving, visit http://druggeddriving.tirf.ca

What functional abilities are necessary for safe driving?

Driving is a complex self-paced task that requires many skills and abilities to be completed simultaneously, and it requires that information be processed at a rapid pace while utilizing visual (ex: ability to scan the road for hazards), cognitive (ex: ability to divide attention between multiple concurrent events) and motor skills (ex: ability to perform physical movements such as turning the steering wheel, pressing acceleration and brake pedals). The processes drivers use to operate a vehicle can be divided into three steps: perception, decision and reaction. These three steps are assumed to happen consecutively, and depend on the driver's visual, cognitive and motor abilities. Impairment in any or all of these abilities can lead to unsafe driving.[1]

What are the different types of drugs that can impair driving?

Drugs that can impair driving are categorized according to the seven drug categories, established by the International Drug Evaluation

[1] Dewar et al. 2007

and Classification Program (DECP). These include: cannabis[2], central nervous system (CNS) depressants, central nervous system (CNS) stimulants, hallucinogens, dissociative anesthetics, narcotic analgesics, and inhalants.

There are also New Psychoactive Substances (NPS) that are frequently not included under the international drug control conventions. There are currently over 450 NPS being monitored by the European Union, with over half being reported since 2013.[3] An NPS is a synthetic drug that is designed to mimic the pharmacological effects of existing controlled substances. It is unlikely that synthetic drugs are detected using the common standardized drug test.[4] An NPS is characterized by the following features: psychoactive properties; a level of potential harm comparable to internationally controlled drugs; and newly available, rather than newly invented.[5]

How do researchers measure the impairing effects of drugs on driving abilities?

Laboratory tests. Researchers use laboratory tests that measure cognitive or psychomotor abilities thought to be related to or involved in driving. These tests are typically validated and reliable measures to assess specific cognitive capacities and physical motor coordination.

Cognitive tests evaluate the effects of a drug on these specific capacities: attention (simple and divided), perception (auditory, time and visual), memory (long and short-term), vigilance, logical

reasoning, problem-solving and decision-making. Examples of validated tests include the Tower of London task, the Wisconsin Card Sorting Task, the Time Wall test, and the Object Movement Estimation under Divided Attention (OMEDA).

Psychomotor tests measure the effects of a drug on participant performance during actions such as body sway, motor coordination and reaction time. Examples of specific tests commonly used to evaluate the effects of drugs include Simple Reaction Time and the Critical Tracking task.[6]

Simulator tests. Researchers also employ driving simulators to evaluate how the administration of a drug can affect driving. Driving simulators can vary in terms of the level of immersion, which can range from a simple desktop display to a full car cabin with a 360 degree display. Regardless, all simulators display an interactive virtual roadway (i.e., driving scenario) and the participant is directed to perform specific navigational and driving tasks on the virtual roadway via a steering wheel, accelerator and brake pedal. Drivers are

2 The term "cannabis" refers to the cannabis plant that contains more than 100 cannabinoids. The primary psychoactive component of cannabis is delta-9-tetrahydrocannabinol, commonly known as THC. THC and its psychoactive metabolite, 11-hydroxy-THC or 11-OH-THC, and primary inactive metabolite, 11-nor-9-carboxy-THC or THC-COOH are frequently measured in biological fluids to document cannabis intake.
3 New psychoactive substances in Europe: An update from the EU Early Warning System 2015
4 Patil et al. 2016
5 New Psychoactive Substances Review: report of the expert panel 2014
6 Verstraete et al. 2014

administered a specific drug dose or placebo and instructed to complete a driving scenario during which they must perform a variety of actions. Measures typically include: lane weaving behaviours (variability in lateral lane position), speeding behaviours (average speed, speed variability), headway maintenance (the amount of headway distance maintained between the driver's vehicle and the vehicle in front), braking reaction time, and near-crash and collisions.[7]

On-road tests. On-road driving tests involve study participants operating a real vehicle, in the presence of a driving instructor who has a secondary set of vehicle controls, either on a closed track or on a public road. Test cars are usually fitted with devices to measure speed, lane positioning, acceleration/ brake use, and video cameras to record the driver's actions/errors.[8]

What are the limitations of the current research that measures the effects of drugs on driving ability?

Laboratory tests of cognitive and psychomotor capacities often only measure a single skill or ability related to driving performance, and it is well-known that driving ability engages a combination of cognitive, psychomotor and motor functions.[9] Even when a series of tests are used, they are administered independently of each other and many are short and relatively simple, and consequently fail to replicate the complex skills or engage the precise psychomotor and cognitive capacities required for driving.[10]

Driving simulators also have limitations since they can never fully replicate authentic driving. Participants may be less careful, as they are aware that it is a safe and artificial environment. As a result, driver errors and risk-taking behaviours may be exaggerated.[11] Additionally, driving scenarios are often short, involve few elements, engage a limited range of cognitive and psychomotor capacities, and thus do not replicate

the complicated conditions that drivers may normally experience.[12]

The central limitation of on-road driving tests is the safety concern associated with placing drug-impaired drivers on the road, though these can be mitigated by using closed course tests and the presence of driving instructors who can take control of the vehicle when necessary.

What are central nervous system (CNS) depressants?

CNS depressants slow down the activity of the central nervous system resulting in sedation, relaxation, and impaired motor coordination.[13] Drugs included in the CNS depressant category can be medicinal, legal or illegal. For the purpose of this curriculum, alcohol was excluded from this category. More information about alcohol and its impairing effects can be found at Change the Conversation. Examples of CNS depressants include barbiturates and benzodiazepines, and non-benzodiazepines. The short-term effects of CNS depressants involve sedation that slows body and brain functions, including drowsiness and reduced vigilance, impaired motor coordination and reaction time, and information processing

---

[7] Verstraete et al. 2014
[8] Schulze et al. 2012; Verstraete et al. 2014
[9] Leufkens et al. 2007
[10] Ramaekers et al. 2004
[11] Dassanayake et al. 2011; Wolff et al. 2013
[12] Verstraete et al. 2014
[13] DECP 2016; Jonah 2012

speed. Larger doses can result in confusion, amnesia, and disorientation. There is some evidence that prolonged use can result in the development of partial tolerance to some effects; however, an increased dose can produce impairing effects by overriding the partial tolerance.

There also are NPS with depressant-like effects (such phenazepam, methoxetamine) that are synthetic drugs with effects similar to benzodiazepines.

Which CNS depressants are most frequently detected in drivers?

Anti-depressants and benzodiazepines are the most frequently detected CNS depressants in drivers involved in serious injury or fatal crashes other than alcohol.[14]

Can CNS depressants impair driving abilities, and if so, how?

Experimental studies examining the effects of CNS depressants on driving performance have focused on benzodiazepines, anti-anxiety tranquillizers and non-benzodiazepine hypnotics. Results consistently showed impaired information processing, attention, concentration, memory and reaction time following use of benzodiazepine and several non-benzodiazepine hypnotics. These drugs significantly impaired divided attention abilities and increased lane weaving, speed variability.[15]

Studies show that the use of benzodiazepines and non-benzodiazepine hypnotics is also associated with a moderately elevated crash risk.[16] Furthermore, the use of benzodiazepines with

driving was associated with 5 times the risk of injury (odds ratio 5.05).[17]

Are the effects of CNS depressants on driving ability impacted by other factors, such as alcohol, or sleep deprivation?

Alcohol increases the impairing effects of benzodiazepines and non-benzodiazepine hypnotics.[18] Sleep deprivation can also exaggerate the impairing effects of a CNS depressant, resulting in greater reduction in concentration and vigilance while driving.[19]

[14] Drummer & Yap 2016;

[15] Bocca et al. 2011; Leukens et al. 2007; Mets et al. 2011; Staner et al. 2005; Verster et al. 2002a; Verster et al. 2002b; Verster et al. 2011

[16] Drummer & Yap 2016

[17] Movig et al. 2004

[18] Simpson & Rush 2002; Maxwell et al. 2010

[19] Drummer 2002

TIRF

Traffic Injury Research Foundation

The mission of the Traffic Injury Research Foundation (TIRF) is to reduce traffic-related deaths and injuries. TIRF is a national, independent, charitable road safety institute. Since its inception in 1964, TIRF has become internationally recognized for its accomplishments in a wide range of subject areas related to identifying the causes of road crashes and developing programs and policies to address them effectively.

In partnership with: