Risk homeostasis: accept, reject or modify?

- Part 1 -

Gerald J.S. Wilde, Ph.D.,

Professor Emeritus of Psychology,
Queen’s University, Kingston, Ontario, Canada

ICTCT Workshop, Valencia, Spain,
Oct. 25-26, 2007
We programmed our new super-computer to design a simple safety device for every car and truck on the road.

Something to improve driver alertness. A prevention against careless and reckless driving, tailgating, drunk driving, inattentiveness, and last-minute braking.

...inexpensive to produce.

What is it?
A NEW STEERING WHEEL.
DO SEAT BELTS KILL?

BY KEVIN KRAJICK
Accident rates: Basic distinctions:

# per km driven
# per hour of road use
# per head of population per year

Important distinction: “safe cigarette”

# per cigarette smoked
# per smoker
# per head of population per year
What is more important?

to reduce accidents

per km driven?

per head of population?
Sometimes the criterion of success is obvious:

**suicide rate**
- per km of available rope?
- per cubic meter of gas?
- per head of population

**murder rate**
- per gun?
- per capita
What is the goal of traffic accident prevention?

- fewer deaths per unit distance of mobility, that is: more mobility per case of death?
  - or
- fewer deaths per head of population?
Traffic death rate per distance travelled, traffic death rate per capita, and the road distance travelled per capita in the U.S., 1923-1996

- In 1987 the fatal traffic accident rate per capita was about the same as it had been in 1927;
- In 1996 it was about the same as in 1923 (National Safety Council, various years).
- In the absence of a dominant upward or downward trend in the course of the larger part of this century, there have, however, been **major fluctuations** in the annual traffic death rate per head of population; from a **low** of 16.1 per 100,000 residents to a **high** of 30.8 in the time period considered.
Traffic deaths per distance driven and per capita, and distance driven per capita in a period of economic growth; Ontario 1955-1972
Annual variations in the unemployment rate and the traffic death rate per capita in the USA, 1948-1987
Actual (DEADTRAF ACTUAL) and modelled (MODELLED DEADTRAF, i.e., predicted by the ARIMA procedure) traffic death rate per 100 residents in Switzerland on the basis of the index of industrial production; quarterly data (after Wilde and Simonet, 1996)
Variaciones anuales en la tasa de desempleo y la tasa de muertos en accidente de tránsito per cápita.

Chile: Blue: jobless rate – Red: traffic deaths per capita

Source: Francisco Fresard (Santiago de Chile, personal communication, 2007)
Four factors that determine the target level of risk:

+ ★ The expected advantages of risky behaviour alternatives:
  Examples: gaining time by speeding, making a risky manoeuvre to fight boredom, rush production to meet a deadline, trying to catch up after having been delayed.

− ★ The expected costs of risky behaviour alternatives:
  Examples: automobile repair expenses after an accident, insurance surcharges for being at fault in an accident, equipment wear and tear.

− ★ The expected benefits of safe behaviour alternatives:
  Examples: an insurance discount for accident-free driving, building a reputation of responsibility.

+ ★ The expected costs of safe behaviour alternatives:
  Examples: using an uncomfortable seatbelt, being called a wimp by one’s peers, time loss.
Theoretical representation of road users as net benefit maximizers and thus as risk optimizers. They choose an amount and manner of mobility such that the associated level of subjective risk corresponds with the point at which the expected net benefit is maximal. **This is the smartest level of risk!** (Note that the curve $y_3$ has been drawn so that each $y_3$ value equals the corresponding value $y_1$ minus the corresponding value $y_2$ absolute.)
3 different levels of accepted risk (of bicycle theft)
Opportunities Missed

There was a very cautious man
Who never laughed or played;
He never risked, he never tried,
He never sang or prayed.

And when he one day passed away
His insurance was denied;
For since he never really lived,
They claimed he never died!
Homeostatic model relating the accident rate per head of population in a jurisdiction to the level of caution in road-user behaviour and vice versa, with the average target level of risk as the controlling variable.
Homeostatic model relating house temperature to heating system activity and vice versa: relating heating system activity to house temperature, with the set-point (target) temperature as the controlling variable.
Various amplitudes and wavelengths of fluctuations of homeostatically controlled variable (solid curves) around a value that is stable when averaged over time (dotted line).
Accident Causation as a Closed-Loop Control Process

[Sweden. 1967; Iceland, 1968]
Accident rates per million vehicle miles (m.v.m.) related to average total travel time per mile and moving speeds in various road sections of different road design (graph adapted after May, 1959).
ARE DRIVERS OF AIR-BAG-EQUIPPED CARS MORE AGGRESSIVE? A TEST OF THE OFFSETTING BEHAVIOR HYPOTHESIS*

STEVEN PETERSON,
Virginia Commonwealth University

GEORGE HOFFER,
Virginia Commonwealth University

EDWARD MILLNER,
Virginia Commonwealth University

ABSTRACT

An increasing number of researchers have hypothesized that regulatory attempts to improve automotive safety through product design would be at least partially offset by driver behavioral changes. This article analyzes two independent data sets to test whether differences in driver behavior exist between cars equipped with air bags and those not so equipped. An analysis of an insurance industry generated data set reveals that relative injury claims increase following adoption of an air bag system. Since there is no indication that the increase diminishes over time, the results appear to be attributable to offsetting behavior as opposed to a sorting of auto buyers. Analyses of 1993 Virginia State Police accident reports indicate that air-bag-equipped cars tend to be driven more aggressively and that aggressiveness appears to offset the effect of the air bag for the driver and increases the risk of death to others.
Graph showing the effectiveness of seat belts in reducing driver fatalities and injuries at different impact speeds. Data base 28,870 accidents.
Bars at top indicate dates on which law came into effect in different countries. (Adams, 1985)
R.C. James (photographer). Courtesy of the photographer.
The first impression one typically gets from this fragmented figure is a meaningless pattern of black polygons against a white background. The figure becomes meaningful, or reorganized, when the viewer is told that the pattern depicts a dog sniffing the ground.
R.C. James (photographer). Courtesy of the photographer.
**Behavioural adaptation to antilock brakes:**

**Drivers keep a shorter distance**

Drivers of taxis with antilock braking systems (ABS) have shorter time headways than drivers of taxis without such brakes. This is one of the results from a new research programme concerning taxi drivers’ behavioural adaptation to airbag and antilock brakes, performed at the Institute of Transport Economics.

**Road lighting increases safety**  [that is per km driven]

- *But motorists drive slightly faster and pay less attention*

The introduction of road lighting leads to drivers slightly increasing their speed and paying less attention. The traffic safety effect of road lighting will therefore not be as significant as it could have been, according to a research report from the Institute of Transport Economics. Road lighting is nevertheless an effective means of reducing accidents in darkness.

**Mandatory course of driving on slippery roads does not reduce the accident risk**

The mandatory course of driving on slippery roads for drivers of heavy vehicles, which has been introduced in parts of southern Norway, has not resulted in a reduced accident risk. This is the conclusion in a report from the Institute of Transport Economics. Some of the analyses indicate in fact that the accident risk has increased as a result of the course.
Orande forskningsresultat:
Trafiktränade barn löper större olycksrisk

“Children with traffic safety training run a higher accident risk”

From *VTI aktuellt* (Linköping, Sweden), 4, 1997.

“Der helikopter wird mich schon herausholen”. Chancen und Risken neuer Methoden im Flugrettungswesen.


“The helicopter will get me out for sure.” Opportunities and risks of new methods in rescue operations by air.

“Smokers regulate their nicotine ingestion, compensating for lower yields by smoking more cigarettes, puffing more frequently, and inhaling more deeply.”

“Survey evidence demonstrates that the public, and particularly smokers, perceive low tar and nicotine cigarettes as carrying less risk [....].”

“Combined, nicotine compensation and switching instead of quitting suggest the very real prospect that the existence of low tar and nicotine cigarettes has actually caused more smoking than would have occurred in their absence and thereby raised the morbidity and mortality associated with smoking.”
It's all to do with our personal risk thermostats.

The message seems to be that these relationship are all enjoyable, and safe so long as people use the advertised product.

It has been estimated by Patrick Dixon in *The Truth About Aids* that condoms fail in their contraceptive function about one time in 12, and that their Aids-prophylactic failure rate is likely to be even higher. They make sex safer, but not safe.

Whether or not condom advertisements impede the spread of Aids depends on whether the decreases that condoms effect in the risks associated with a particular sexual encounter are offset by the increases that the advertisements stimulate in the numbers of encounters. If the advertising results in more people, more often, attempting manoeuvres with defective safety equipment that they would not try without it, it is likely to promote the spread of Aids.
The four utility factors that determine the target level of risk.

- A. PERCEIVED BENEFITS OF RISKY BEHAVIORS
- B. PERCEIVED COSTS OF CAUTIOUS BEHAVIORS
- C. PERCEIVED BENEFITS OF CAUTIOUS BEHAVIORS
- D. PERCEIVED COSTS OF RISKY BEHAVIORS

INCENTIVES/REWARDS

DISINCENTIVES/PENALTIES

E. TARGET LEVEL OF RISK
Drop in accident rate and annual accident costs in German trucking fleet after institution of safe-driving incentive program in 1957.
The “Triple E” approach versus the “Single M” approach

**E** for Engineering

**E** for Enforcement

**E** for Education (safety training)

Two crucial issues here:

- The *ability* to be safe vs the *willingness* to be safe
- The desire to *avoid a fine* vs the desire to *be safe*
M for Motivation

“To protect people from the negative consequences of risky behaviour is to encourage risky behaviour”

“To offer people positive consequences for cautious behaviour is to encourage cautious behaviour”

To reward or to punish? Incentives vs disincentives
Problems with disincentives/penalties

1. The “self-fulfilling effect of attribution,” labelling effect

2. Process controls can never be exhaustive; low enforcement rates; “accident migration” and “accident metamorphosis;” reactance

3. Negative side effects of punishment: resentment, antagonism, sabotage
General conclusions from incentive studies

1. Lost-day case rate or doctor’s cases per 100,000 hours worked reduced by 50 to 80%

2. Benefit-cost ratios usually at least 2 to 1; ratios as high as about 25 to 1 have been reported

3. Effectiveness usually does not dwindle over time. Some programmes have been in effect over some 30 years without losing effectiveness

4. A company can make money on its safety incentive programme. Who is paying for the added safety?
Side effects of incentive programmes

1. **Negative:** under-reporting of minor accidents

2. **Positive:** improved (company) morale, leading to more productivity and less personnel turn-over
“Simple Safety Song”

Give me a ladder that is twice as stable,
And I’ll climb it twice as high.

But double the cause for caution,
And I will be twice as shy.
• Asociación Mexicana de Higiene y Seguridad, México, 2001; translation by Daniel Ramirez, P. Eng.: www.darsegu.com/content/view/22/74/

2) Translation by Prof. Reinier Rozestraten, published by www.casadopsicólogo.com.br (São Paulo, 2005)
“Target Risk 2” in Japanese translation, Tokyo, Feb. 2007

Titled: "Why do traffic accidents keep on happening?"
With subtitle "The psychology of risky behaviour"
Thank you so much for your interest in the risks of driving!
Further evidence

- Munich taxicab experiment
- Dutch seatbelt wearing experiment
- US motorcycle helmet laws
- US seatbelt wearing rate and accidents
- Accident migration – German Autobahn
- Accident metamorphosis – alcohol, BC
- US flood protection and flood victims
- Skydiver parachute ripcord
- Michelangelo computer virus
- Railway crossing visibility improvement
Sample features of safety incentive programmes

**Target Group:** Industrial employees, truck and van drivers, passenger car drivers, public transit bus drivers

**Scope:** workers/drivers only workers, foremen, supervisors and middle management
### Sample features of safety incentive programmes

#### Nature of bonus:
- cash, savings bonds, public praise, certificates of merit, merchandise, extra holidays, lottery tickets, insurance discounts/rebates, free driver’s licence renewal, savings stamps for merchandise

#### Type of bonus:
- for individual performance only,
- for team performance only,
- for both.
## Sample features of safety incentive programmes

<table>
<thead>
<tr>
<th>Condition for eligibility:</th>
<th>being accident-free, displaying specified safety behaviours, a combination of both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incubation period:</td>
<td>one month, three months, six months, one year</td>
</tr>
<tr>
<td>Penalty for failure to report an accident:</td>
<td>yes, no</td>
</tr>
</tbody>
</table>
Sample features of safety incentive programmes

Implementations: incentive programme only, or combined with other accident countermeasure (usually safety training/education)

Programme evaluation: sometimes high standard, sometimes weak methodology, sometimes absent
The yearly number of work-related injuries, per million person hours worked, requiring 1 or more days lost from work.
Conditions favouring incentive effectiveness

1. *Managerial vigour and commitment*

2. Program designed *in cooperation* with target group

3. Involve *multiple levels* in the organization

4. Keep rules simple

5. Equitable judgement of responsibility for accidents (with appeal procedure in place)
## Conditions favouring incentive effectiveness

6. Reward accident-free performance, not some safe behaviour

7. Choose attractive rewards

8. **Progressive** rewards for longer periods of being accident-free

9. Insure that reward is being perceived as equitable

10. Insure that reward is being perceived as attainable
Conditions favouring incentive effectiveness

11. Consider supplementing incentives with safety training

12. Discourage under-reporting of (minor) accidents

13. Strengthen *peer pressure* toward safe conduct

14. Keep incubation periods short

15. Maximizing *net savings* versus benefit/cost ratio

16. Provide a research and evaluation component
Why are incentive programmes so effective?

They enhance the expected value the future and hence the desire for safety and health. “Expectationism”

People can be expected to be more careful with their health and safety:

1. as they rate the value of their future higher than the value of present time,
2. as they more actively plan for the future.
Future-orientedness

Study participants: 628 undergraduate students at Queens’ University (Bjorgvinsson and Wilde, 1998).

Health and safety habits under study:

1. Safe driving
2. Regular seatbelt use
3. Not smoking
4. Healthy diet
5. Regular exercise
6. Moderate drinking

These habits were more common in people who:

• place less value in present time,
• place a higher value on future time, and
• who have a stronger tendency towards future planning.
Inuit stop sign