Risky driving: Altering drivers' speed choices through risk perception

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Long record of driver behaviour research

Truck driver fatigue – for Road Safety Trust
Overtaking lane design – for Transfund
Assessment of hazard warning signs – for Transfund
Curve speed management – for Transfund
Distractive effects of cellphone use – for Land Transport NZ
Self-explaining roads – for FRST/PGSF

Driver risk from blood alcohol levels between 50 and 80 mg/100ml – for NZTA
The prevalence and impairment effects of drugged driving – for NZTA

Today – Perceived risk, speed and countermeasures for AA Research Foundation
It has long been assumed that drivers modify their behaviour according to the risk they perceive

‘Field of safe travel’ (Gibson & Crook, 1938)
Zero risk model (Näätänen & Summala, 1974, 1976)
Task-Capability-Interference and Risk Allostasis models (Fuller, 2000, 2008)

But how well do drivers perceive risk?

Road situations where drivers’ perception of risk is lower than the objective risk may result in significant danger

Watts & Quimby (1980) compared drivers’ verbal ratings to crash history
Kanellaidis & Dimitropoulos (1994) compared verbal ratings to road features assessed against German Guide for Traffic Evaluation of Highways
Study 1: A comparison of drivers’ perceptions of risk and objective risk on New Zealand state highways

Identified 36 sections of State Highway in the Waikato Region

Used KiwiRAP road protection scores (RPS) as the measure of objective risk

Compared to continuous risk ratings from 69 participants “driving” the roads in the simulator (and 14 participants’ on-road ratings)
Comparison of risk ratings to objective risk

With intersections

\( n = 77 \) locations
Comparison of risk ratings to objective risk

Excluding intersections
n = 57 locations

Over-rated risks
(compared to objective risk)
- narrow lane
- horiz. curve
- wire rope

Under-rated risks
- ditch
- poles
- narrow shoulder

$R^2 = 0.5945$
In general, drivers experience low levels of risk (3.29 out of 10)

Intersection risk and roadside hazards are significantly under-rated

What do drivers use to form their perceptions of risk?

Multiple regression using 13 RPS component scores

Best combination of predictors:
- Horizontal Alignment
- Lane Width
- Shoulder Width
- Terrain
- RHS Roadside Risk (divided median)

Adj $R^2 = .785$, $F (1,69) = 54.966$, $p < .001$
Study 2: What is the relationship between drivers’ perceptions of risk and the speeds they choose?
(and what are the effects of rural road countermeasures on drivers’ perceptions of risk and speeds?)

75 participants “drove” a series of roads in the simulator

**Median treatments** (dashed white lines, double yellow lines, wide centre lines, and wire rope barriers) in both high & low traffic

**Two warning treatments**
(high crash area sign and police car)

**Speed reduction treatments**
Narrow lanes and lower speed zone
Participants drove each road twice

**Speed**

“Use the brake and accelerator to choose the speed you would drive if you were in your own car and use the steering wheel to ‘steer’ through the video”

**Risk**

“As you watch the video, steer the car and this time tell us how risky each road feels by moving the thumbwheel up and down with the bottom of the scale indicating safe (completely at ease), to unsafe (immediate danger)”
In general, higher perceived risk was associated with choice of lower speed.

Mean speed and risk ratings at each location

\[ r(39) = -0.625, \ p < 0.001 \]
Overall, speeds decreased with high levels of oncoming traffic.

In high traffic, double yellow lines produced large speed reductions (also wide centre line).

Wire rope barrier speeds did not change in the presence of high traffic.

High traffic associated with lower speeds $F(1,72) = 464.92$, $p < .001$
Significant differences between the four median types $F(3,216) = 68.11$, $p < .001$
Significant interaction between traffic and median $F(3,216) = 39.94$, $p < .001$

Risk ratings increased with high levels of oncoming traffic.

In high traffic, double yellow lines were associated with much higher levels of rated risk.

Wire rope barrier risk ratings did not change in the presence of high traffic.

Risk ratings higher under the high traffic conditions $F(1,69) = 130.21$, $p < .001$
Significant differences between the four median types $F(3,207) = 25.46$, $p < .001$
Significant interaction between median type and traffic $F(3,207) = 38.67$, $p < .001$
The effect of warnings

Crash area speed warning signs did result in reduced speeds

But speed reductions nowhere near as great as a police car

Crash area speed warning signs did result in higher ratings of risk

Increase in risk was much higher for the police car

Significant before-after effect $F(1,71) = 160.52, p < .001$
Significant difference between car and sign $F(1,71) = 67.41, p < .001$
Significant interaction $F(1,71) = 63.00, p < .001, \eta^2_p = .470$

Significant before-after effect $F(1,68) = 50.32, p < .001$
Significant difference between the car and the sign $F(1,68) = 5.16, p = .026$
Significant interaction $F(1,68) = 23.70, p < .001$
The effect of lane width

Narrow lanes resulted in speed reductions
(as low as a 70 km/h speed zone)

Wide lanes resulted in speed increases

Speeds significantly different for the three road widths
F\( (2,142) = 1517.72, p < .001 \)
Speeds on wide lanes significantly higher than control roads, p < .001
Speeds on narrow lanes significantly lower than controls, p < .001
Speed on narrow lanes not different to road with 70 km/h limit

Speed reduction for narrow lane was accompanied by higher perceived risk
(but not for speed zone)

Significant difference in risk across the three road widths
F\( (2,136) = 108.11, p < .001 \)
Narrow lanes had significantly higher risk ratings, p < .001
Implications

For road design

Most effective stimulus to reduce speed and increase risk is a police car

Double yellow lines, wide centre lines and narrow lanes also increased perceived risk and decreased speeds

Combination of double yellow lines & wide centre lines may be an inexpensive safety measure for hazardous rural roads

For understanding driver behaviour

Drivers do perceive risk and respond in predictable, orderly ways

Double yellow lines acquired “risky” status through use at locations where oncoming traffic represents a hazard – serves as a cue for risk when oncoming traffic is present

Wide centre lines have yet to be consistently paired with any meaning, current effect may be due to novelty, until their meaning is established
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