Road user behaviour, road design and safety

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Principal Adviser
Motoring Policy

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What is the AA and why does it care?

- Club with 1.25m Members
- Not for profit advocacy
- 17 AA Districts adopt Champion projects
- Create public impetus to make roads safer
- Motorists pay majority of national land transport fund
- Members support road safety
International Clubs

Make Roads Safe: FIA
www.makeroadssafe.org/

www.who.int/roadsafety/week/en/
I don’t have any faults
I’m a great driver

Even though all drivers have experienced a near miss 86% rate themselves better than average
Motorists 101

You Driving

Blind and dangerous to your lack of skills
Two thirds of fatal crashes involve one vehicle and one driver who over-estimated their ability to drive quickly, stay awake, master the weather or get through the intersection.
Motorists 101

With tragic results

A moment’s distraction by a child and into one of thousands of kilometres of deadly roadside ditches.
“Highly practised tasks become automatic. *Most drivers are driving without awareness, most of the time.* The most highly-practised routes are where drivers are most likely to have their crashes.”

When driving is automatic, we don’t adapt to suit changing conditions - the unexpected.

Think about it when next driving home
Fear of heights: yes
of equivalent speed: no
Built in fear of heights

No built in fear of speed
Car vs Pole at…

- 30 km/h
- 50 km/h
- 70 km/h
KiwiRAP

- New Safer Roads tool
- International initiative
- NZ successful collaboration model
- A communication tool to help gain support and funding
KiwiRAP

- KiwiRAP is part of the international Road Assessment Programme carried out by Highway authorities and motoring clubs.
- Last year the AA published the NZ Highway Risk Maps.
- Next year we will publish star safety ratings of our highways based on roadside crash risk criteria.
- KiwiRAP is informing the $40 million safety retrofit programme.

Rumble strip and wire-rope medians have excellent BCRs on high volume roads.
Risk maps

- State Highways
- Risk of injury or death on stretches of state highway
- Audience is general public
- Not all roads are equal
- Helps communicate need and urgency to public and politicians
Which is why many of our “black routes” look like this:

Dear Ed,

I am puzzled as to why both you and the Express are printing stories and perpetuating the myth that the Raupara Road is New Zealand’s most dangerous.

Whoever decided that must be nuts. Your car in the ditch photo was better displayed in the Express last week. At least it showed it in perspective, a perfectly straight road as far as the eye could see, and it was supposedly the fault of the road, c’mon.

And as for the bleating of the locals and showing the bridge rail that apparently obscures oncoming traffic, it is of 50mm pipe for goodness sake, the only thing it could possibly obscure would be a low flying sparrow, and even that would be doubtful.

N. Paul
Which is why many of our “black routes” look like this
25% swung wide on corners. It's not speed limits but the physical limits in different conditions. We need to teach young drivers to leave a safety margin.

Fatigue kills truck drivers, old people and tourists. In the South Island especially low cost engineering would help a lot.

Maori make up half of those killed by drunk drivers, many of whom are Maori. We need new approaches to the drink driving message that Maori will listen to.
Causes of death: 2008

20% were not licensed, and breaking speed and alcohol laws. We need to make licences mean something and clamp down on unlicensed driving.

25% were old people. They don’t intend to die but misjudge roads and are fatigued. More effort is needed on this group.

10% were 40-60 year old men on big bikes. We have to tell them there are better ways of proving they still have it.
Contributing Factors to Near Misses: AA Member Survey 2004

★ maybe inattention
100-Car Naturalistic Driving Study

Virginia Tech Transportation Institute (VTTI) 2005
100 cars: 1 yr, 241 drivers, 43000 hrs, 2 million miles

Not looking where going within 3 sec of
- 80% of crashes
- 65% of near-crashes
- 93% of rear-end-striking crashes

Previously, inattention thought a contributing factor in
~25% of crashes

4 categories: secondary tasks, fatigue, driving-related inattention, non-specific eye glance
Headlamps on in Daylight

- Field data indicates reduces daytime frontal crashes 50%, pedestrian injuries 15%
- Can be implemented today

Dr Laurie Sparke
Chief Engineer, Holden Innovation

$150 fine
1. Inattention, loss of concentration, not just distraction
2. THE largest road safety risk – top priority
3. Need data on inattention – current CAS data inadequate
4. Forgiving roads and roadsides; rumble strips
5. User-friendly control mechanisms (thresholds vs signs)
6. Reduce in-vehicle distraction (ban cellphones, texting; monitor GPS and other technology)
7. Widespread public education needed
Fatigue

- Fatigue a contributing factor
- 12% of crashes
- 10% of near-crashes

Previous estimate was 2-4% of crashes
- Much bigger factor than realised
Fatigue

Keep pushing the known messages

1. Need better data on fatigue
2. Forgiving roads and roadsides; use KiwiRAP to target fatigue crash areas
3. Educate about fatigue
4. Target tourists, older drivers, young drivers and shift workers
5. Funding to identify and treat sleep disorders

240,000 undiagnosed OSA in NZ
Cheaply treatable
Speed

- Most speed-related crashes not over speed limit: “too fast for conditions”
- Majority cornering
- Can’t be managed by speed enforcement
Speed at corners

“Errors associated with horizontal curves appear to be the result of three inter-related problems:
• failure of driver attention,
• misperception of speed and curvature and
• poor lane positioning”

Dr Sam Charlton
Cornering crashes

Asymmetrical design principles

• roads traditionally symmetrical (equal width lanes, shoulders and clear zones each side of road)

• Crash analysis indicates that an asymmetrical approach would be more effective.

• Wider shoulders/ clear zones on the outside of the curve

• Asymmetrical road markings also tested; far more effective
Asymmetrical design layout for reverse curves with radii less than 1000m

Source: Levett, S. (2008) *Retrofitting road safety to existing rural roads*
The asymmetric herringbone marking gave “very strong effect” on lane position.

Aging Population

2006

2026

Female

2046
Vision
• Peripheral vision deteriorates
• Need more light to read paper
• Side impact crashes more likely after 40
Older drivers injuries more severe
Rib fractures life threatening for the elderly but not for the young
40% of older drivers killed have broken ribs
Turn Left!
System designers are responsible for the design, operation and use of the road system and thus the level of safety in the entire system.

Road users are responsible for following the rules for using the road system set by the system designers.

If the users fail to comply with these rules due to a lack of knowledge, acceptance or ability.....

System designers are responsible for taking the necessary further steps to counteract people being killed or injured.
Walking and Cycling

Lots of elements including design

1. Drivers don’t see what they don’t expect
2. Drivers operate on automatic on most familiar roads – inattentional blindness
3. Lapse in concentration has higher effect on vulnerable users
Points to note

- Too high an opinion of our own driving
- Over-estimate our ability to handle speed, alcohol, fatigue, large motorcycles, aging and distractions
- Need a Safe System Approach: enforcement and punishment is not the answer
- New Zealand needs a cultural make-over to make driving less aggressive and less competitive
Overrepresented in fatalities

- Drugs
- Crims
- Hardcore drink drivers
- Unlicensed drivers

Do not obey other laws – how to manage?
Priority Issues

High concern
- Alcohol/drugs
- Young drivers
- Road & roadsides
- Speed
- Motorcyclists

Medium concern
- Fatigue
- Distraction
- Walking & cycling
- Heavy vehicles
- Light vehicles

Areas for continued focus
- Restraints
- High risk drivers

Possible other areas for further analysis: children, older road users, workplace vehicles
Public take roads for granted

- AAA research: “Safer Roads” backfires
- Making excuses for bad drivers
- Key message: Safer Drivers in Safer Cars on Safer Roads
- Aim: Public to realise roads are part of the equation
- No public awareness means no support for funding
- ...and they don’t recognise dangerous roads
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N. Paul
Why Roads

• Greatest potential to reduce road toll
• Long lasting
• Fiscally positive

Here’s how the NRSS says we could save the 700 lives every year

- Improved Roads
- Safer Vehicles
- Driver Behaviour
- New Technology

Source: aaa.asn.au
Contributing Factors to Near Misses: AA Member Survey 2004

- Affected by alcohol, drugs, medicines: 6
- Other Road feature: 7
- Fixed Hazard: 7
- Other Driver Action: 11
- Other Driver impairment: 4
- Drowsy / Sleepy: 14
- Find it hard to see at night /dusk: 14
- Narrow width of the road shoulder: 14
- Not enough space on road: 16
- Crossing the centre line: 22
- Speeding: 27
- Slippery road surface: 30
- Merging or changing lanes unsafely: 32
- Following too close: 32
- Overtaking unsafely: 36
- Failure to give: 39
- Distracted / a lapse in concentration: 50

rumble strips may help
### Potential Reductions (%) in Various Injury Crash Types

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Lost Control (Bends and Straights)</th>
<th>Head-on</th>
<th>Collisions with Roadside Objects</th>
<th>Intersection Collisions</th>
<th>Relative Cost to Implement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road signs – e.g. curve coming up, suggested speeds</td>
<td>15-35</td>
<td>15-35</td>
<td>15-35</td>
<td>15-35</td>
<td>$</td>
</tr>
<tr>
<td>Road marking (painted lines and white pickets)</td>
<td>10-40</td>
<td>10-40</td>
<td>10-40</td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>Reduce speeds (per 10km/h reduction in speed)</td>
<td>15-30</td>
<td>15-30</td>
<td>15-30</td>
<td>15-30</td>
<td>$</td>
</tr>
<tr>
<td>Rumble strips (edge lines or centre lines that generate a noise and vibration when driven over)</td>
<td>20-45</td>
<td>20-35</td>
<td>20-45</td>
<td></td>
<td>$$</td>
</tr>
<tr>
<td>Lighting</td>
<td>5-10</td>
<td>5-10</td>
<td>5-10</td>
<td>10-20</td>
<td>$$</td>
</tr>
<tr>
<td>Removal of roadside objects (e.g. power poles, trees)</td>
<td></td>
<td></td>
<td>60-80</td>
<td></td>
<td>$$</td>
</tr>
<tr>
<td>Roadside barriers</td>
<td>20-40</td>
<td>20-40</td>
<td></td>
<td></td>
<td>$$</td>
</tr>
<tr>
<td>Dedicated lanes for turning traffic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$$</td>
</tr>
<tr>
<td>Widen sealed edge of road</td>
<td>10-30</td>
<td>10-30</td>
<td>10-30</td>
<td></td>
<td>$$</td>
</tr>
<tr>
<td>Improved anti-skid road surface</td>
<td>10-40</td>
<td>10-40</td>
<td>10-40</td>
<td></td>
<td>$$</td>
</tr>
<tr>
<td>Overtaking lanes</td>
<td>20-40</td>
<td>20-40</td>
<td>20-40</td>
<td></td>
<td>$$$</td>
</tr>
<tr>
<td>Divided roads and median barriers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$$$</td>
</tr>
<tr>
<td>Roundabouts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$$$</td>
</tr>
<tr>
<td>Straighten out curvy roads</td>
<td>30-50</td>
<td>30-50</td>
<td>30-50</td>
<td></td>
<td>$$$</td>
</tr>
</tbody>
</table>

**NOTE:** The effect of combined treatments is not cumulative, as various treatments are often targeting the same types of crashes.

**KEY**
- $ Less than $50,000 per km or low cost
- $$ $50,000 to $500,000 per km or medium cost
- $$$ Greater than $500,000 per km or high cost
Vision Zero

• “Any well functioning man-machine system brings the failing human into the loop

• Blaming the victim approach is a catastrophe to prevention

• If 95% of the cause is driver “error”, is 95% of the solution to change the driver?”

The cheapest most effective solution is to change the roads
Roads and Roadsides

1. Forgiving roads – remove hazards; instal barriers; widen shoulders

2. Self explaining roads – road design encourages drivers to use appropriate speeds

3. Road hierarchy – protect safety and function of high speed high volume roads

4. Use KiwiRAP to communicate and prioritise

5. Rumble strips and reflective markings

6. High friction surfacing

7. Level crossings safety
Forgiving Roads

Roads that forgive human error

- Eliminate Roadside Killers
- Poles, trees
- Wide clear shoulders
- Median barriers
- Profiled markings
- Fill ditches
Health and Safety Principles
Consistent with OSH conventions in other settings
• Eliminate risk
• Isolate
• Minimise

Eliminate hazards: Move or remove poles, ditches, walls, trees (esp. within 2.5m)
**Minimise**: Upgrade line markings (incl. rumble strips); seal shoulders (esp. outside of curves)

**Isolate**: Install barriers and guardrails on immovable objects, steep slopes and against oncoming traffic
Minimise Conflict:
Slow vehicle refuges, slow vehicle bays, cycle lanes, passing lanes, four laning
• Drivers notice ~ 1 in 7 road signs
• Have poor memory for road signs they’ve just passed (6% recall - 9% recognition)
Audio Tactile: Next Major Step

- Three warning systems: Visual, Audible, Tactile
- Early warning of roadside hazards, oncoming traffic
- Protect cyclists from cars
- Assists wet night visibility
- Durable
- Save lives
Self explaining roads
Hierarchy of roads

Explains itself as 90kph

Explains itself as 110kph
Hierarchy of roads

Motorway

Arterial

Low speed
Motorists 101

Conclusions

“Society’s goal should be to fit transport systems to people’s desired living patterns rather than to fit people’s desired living patterns to transport systems”

– Dipl Ing Mario Rohracher, Director Public Policy, Austrian AA
So, I love my car

It's my loyal home-sweet-home on wheels
But your car is an unnecessary evil

It’s an environmental evil, a safety threat and a hindrance
Utility to me: less than none
Motorists 101

Mobile communications allows for new mobile services.

Domestic tourism is 2/3rds of our $9bn tourism industry. The car is essential.

Low cost cars keep poorer people participating in the economy and provide part-timers access to work.

Cars keep us in work
Projected population

Statistics
New Zealand
high (green)
medium
(blue) and
low (red)
population
growth
projections
show much
higher
growth in the
North than in
the South.

Population growth rates
by region to 2026

If we assume
car ownership
is approaching
saturation today
then human
population is a
good proxy for
vehicle numbers

Projected Auckland Car Population Growth 2007-2026

- High scenario
- Medium scenario
- Low scenario

Additional Cars in Auckland

2011 2016 2021 2026
Projected tourism

Tourism Projections - pressure from overseas

Visitor numbers [3.5% growth rate]

- Current Levels
- Tourism Research Council projection
- AA projection based on IATA and Japanese Aircraft Development Corporation forecast long-term growth rates
Imports, exports
tourists
Ports, airports
Physical barriers
Deprived areas
North of the North

South of the South
Benefits of Investing in NZ Road Infrastructure, Allen Consulting Group & Infometrics, 2004

NZ has
• Lower investment / GDP
• Worse safety record
• More congestion
• Less connection
Value of road network

1993-2000
• fell 40% as %GDP
• not keeping pace with economic activity
Intensity of utilisation doubled 1980-2000
10 years change
Connectedness

The Allen Consulting methodology emphasises that physical connectedness is required to obtain economic value from large transport investments.

Auckland’s disconnected network

<table>
<thead>
<tr>
<th>Motorways built or underway</th>
<th>Rail links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorways needed soon</td>
<td>Busway</td>
</tr>
<tr>
<td>Motorways not under active consideration</td>
<td>Ferries</td>
</tr>
<tr>
<td>Motorways that may be needed eventually</td>
<td></td>
</tr>
</tbody>
</table>
Specific Projects

- Criteria: large step-change, data available
- Funding
  > Auckland Western route (IA)
  > Wellington RLTS (GWRC)
  > Tauranga Strategic Road Network (Priority 1)
  > Transit passing lane strategy (AA)
- Not able to get: Public transport, four laning
Analytical Outcomes

- Downstream flow-on economic effects
- Small travel time savings do make a difference
- $1b per year better off financially
- $0.6b per year social benefits (leisure, health)
- Generates growth, extra tax take more than pays for the annual debt cost of the projects
- Fiscally positive for Government
- Other studies support this conclusion
Important implications

• The Government should fund from Crown account- surplus, Super fund, ACC - not take from petrol tax
• These roads fund themselves, don’t ‘need’ extra petrol tax, tolling, road pricing
• Government will not need to close any hospitals or schools in fact, can open more as a result
• Cost-benefit ratio is infinite (doesn’t cost anything)
• Should maintenance get first priority?
Important points

• These are not the only four projects, there may be many more that pay for themselves - stocktake
• RMA and other delays cost us $1.6b per year ($4m/day)
• Road pricing/traffic demand management makes a negligible difference until much closer to capacity (BCR 1-2)
• Until then, road pricing could distort economic growth
• Road bottlenecks are stifling our economy
• Funding need not be an issue
• We need long term large scale planning and investment
Why does it cost so much?

- It takes six times as long and costs twice as much
  - 30% added cost = 30% less projects
- What impact is the RMA having?
- Do we need larger or longer projects to get economies of scale?
- Are we getting too tolerant of waste and delay?
Impact of Consent Cycle

- In 21 years we can consent 3 projects, Australia 4
- Could consent 5

- Delay impacts forecasting risk, blight and cost
- MAG review of roading costs
- What could we have?
Time for engineers to put their case?

Tell it like it is