ICoRSI

Independent Council for Road Safety International

International Symposium

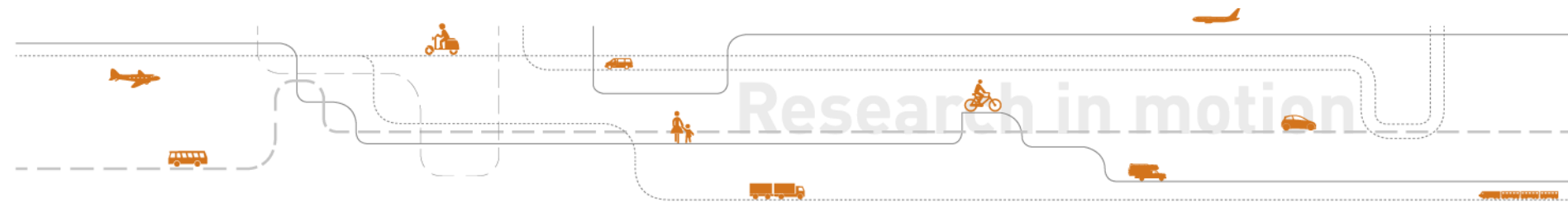# Road Safety Around the World:
Future Concerns

Paris, 19 March 2018

THE UNIVERSITY OF
CHICAGO
CENTER IN PARIS

VEOLIA

MAWANA SUGARS

toi

TATA TRUSTS
Norwegian Centre for Transport Research

The presentation is based on:

- Can evolutionary theory explain the slow development of knowledge about the level of safety built into roads?

- Accident Analysis and Prevention, 106, (2017) 166-172

- The paper is strongly inspired by a series of papers by Ezra Hauer

- He also reviewed my paper and helped me develop and improve it a lot

Institute of Transport Economics
Norwegian Centre for Transport Research

Two ways in which knowledge can develop

- Planned:
    - *By means of programmes for research and development*
    - *With clearly stated objectives for the results to be achieved*
    - *«By 2020 nobody shall be killed in a Volvo car»*
- Unplanned:
    - *By discovery by surprise (you did not expect to discover anything, but did all the same) – learning by doing*
    - *By trial-and-error (can be effective if error elimination is effective)*
    - *By imitation (you try to repeat what seems to work)*
- The development of knowledge about the level of safety built into roads has largely been unplanned

An evolutionary theory of knowledge

- Knowledge initially develop through learning by doing
- It is at that stage unintentional
- You simply discover changes that are favourable (successful mutations)
- You may then try to repeat the success by means of trial-and-error
- Practices that are believed to work well, are encoded so that they become a routine, or:
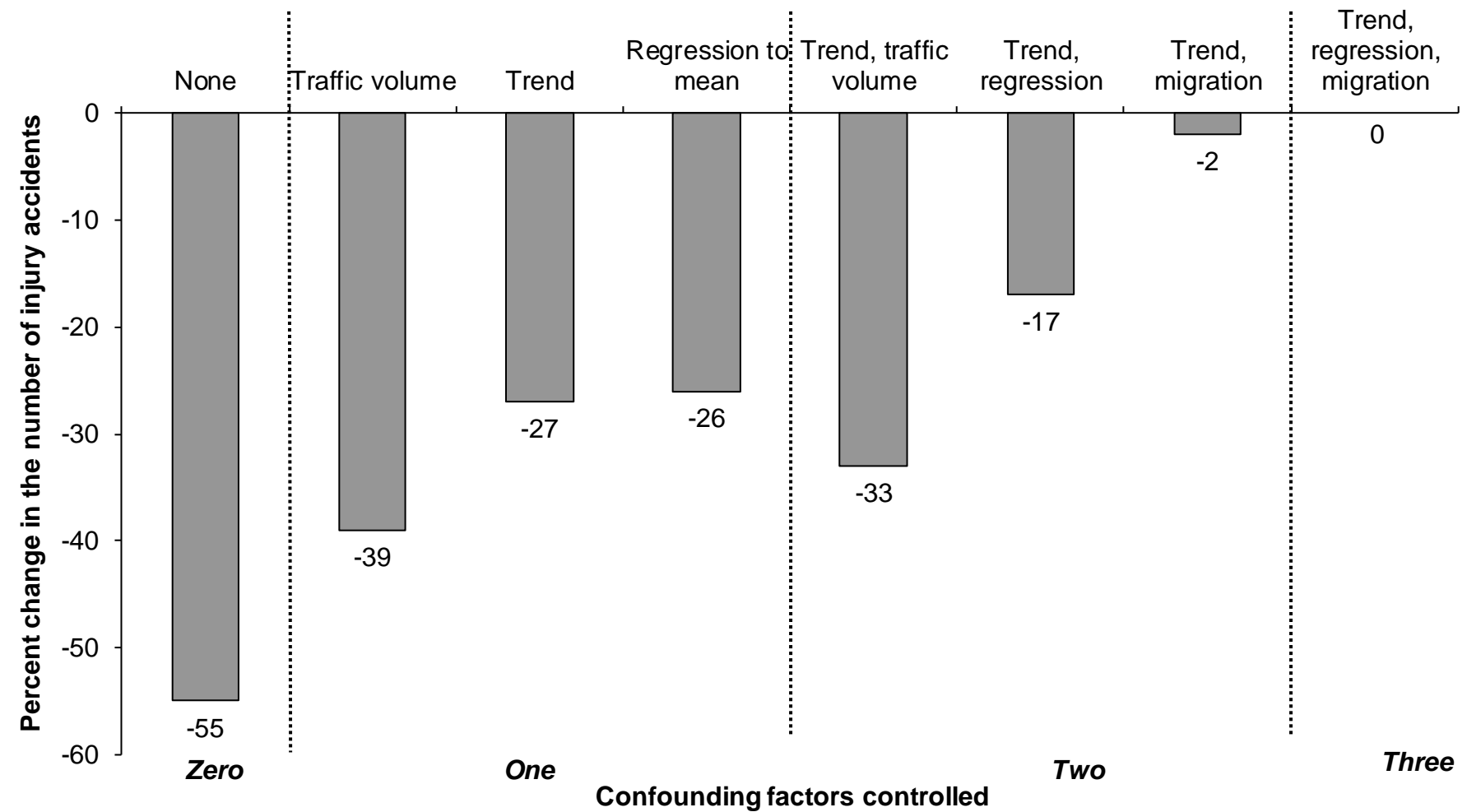- Successful mutations are carried forward to the next generation by means of routines

Institute of Transport Economics
Norwegian Centre for Transport Research

Learning by doing

"The boat builder may be very skilled, yet, no two boats are perfectly identical to the smallest detail. The differences arising this way must be regarded as random. But if a small difference between two boats is associated with a noticeable difference in performance at sea, it is not random if such a difference is detected. Sailors will urge the boat builder to copy the boat that performed best at sea. The boat builder will now try to copy the boat performing best at sea, and may embark on a set of trials, each involving a small change to the boat, in order to develop a boat that surpasses the performance at sea of any previously built boat."

Evidence of an evolutionary process

- Improvements in safety are discovered by simple observation:
  - *Naive before-and-after comparisons (the simplest and most widely available way of observing apparent changes in safety)*
- What you look for is what you find:
  - *You are looking for changes in safety; if you find them, you attribute them to the treatment*
- You try to preserve success by encoding it:
  - *Accident warrants are developed for the use of certain safety treatments*

Institute of Transport Economics
Norwegian Centre for Transport Research

Effects attributed to black spot treatment by control for confounding

Chart showing percent change in the number of injury accidents by confounding factors controlled.

X-axis: Confounding factors controlled

Categories and values:
- **Zero** — None: -55
- **One** — Traffic volume: -39
- **One** — Trend: -27
- **One** — Regression to mean: -26
- **Two** — Trend, traffic volume: -33
- **Two** — Trend, regression: -17
- **Two** — Trend, migration: -2
- **Three** — Trend, regression, migration: 0

Y-axis: Percent change in the number of injury accidents (0 to -60)

Institute of Transport Economics
Norwegian Centre for Transport Research

An accident warrant (MUTCD 2009)

"In addition, the use of YIELD or STOP signs should be considered … where one or more of the following conditions exist: …C. Crash records indicate that five or more crashes that involve the failure to yield the right-of-way at the intersection under the normal right-of-way rule have been reported within a 3-year period, or that three or more such crashes have been reported within a 2-year period."
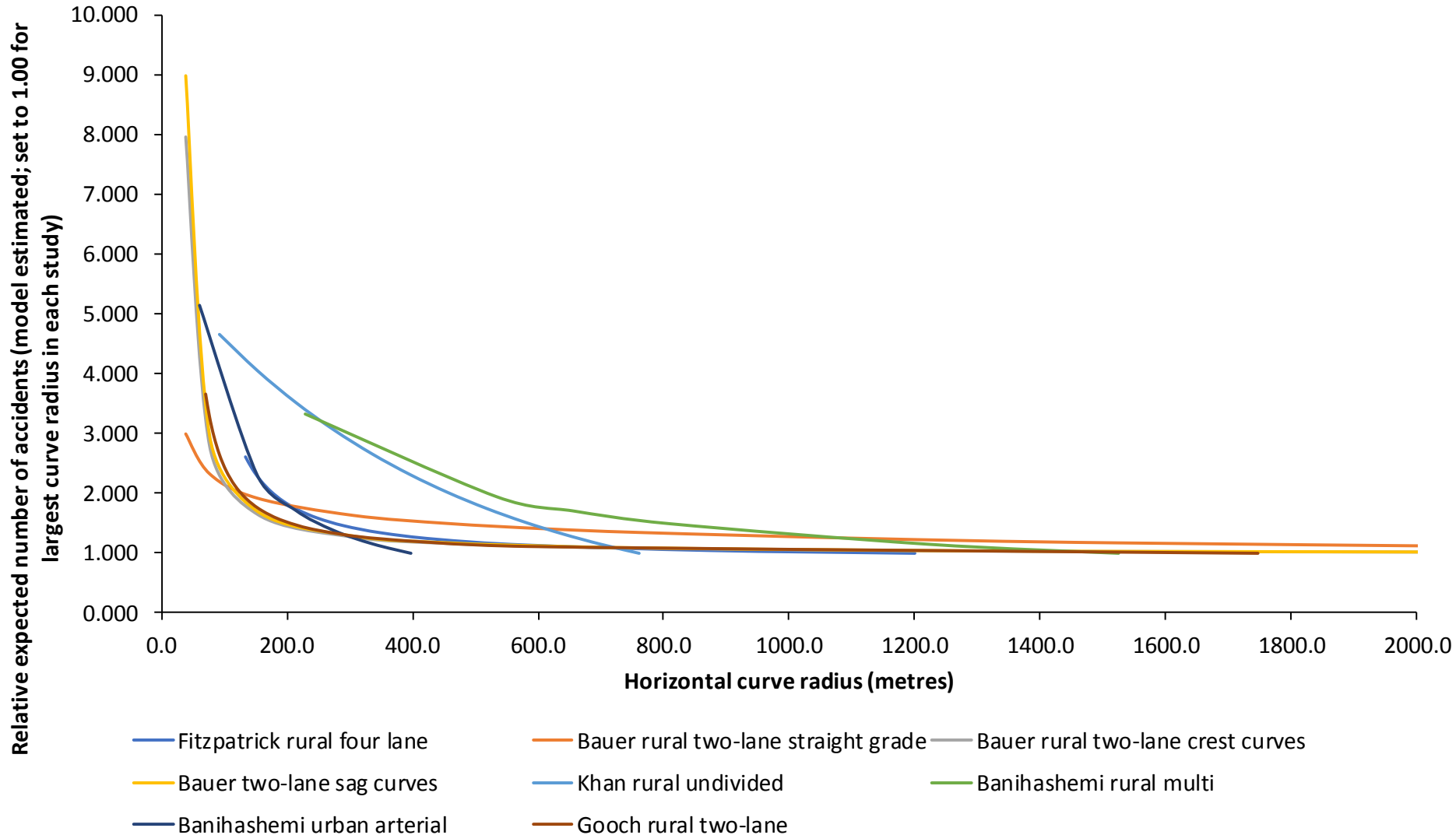
The denial of confounding

"There is much talk in statistical circles about this oscillation being a phenomenon of chance (the 'regression toward the mean' so often mentioned). But an examination of the personal files of the PUTCO drivers show that these oscillations are, on the whole, anything but chance-directed. In fact, any sudden improvement is usually closely associated with disciplinary action."

Institute of Transport Economics
Norwegian Centre for Transport Research

How to be completely wrong

Regression-to-the-mean in PUTCO accident data quoted by Shaw and Sichel (1971).

Number of accidents	Number of drivers	Total accidents	Accidents second period	Predicted number of accidents
0	52	0	47	47.8
1	44	44	45	46.8
2	26	52	27	31.4
3	16	48	27	21.7
4	3	12	4	4.5
5	0	0	0	0.0
6	1	6	4	1.8
Total	142	162	154	154.0
Mean per driver	1.141			
Variance	1.346			

Recent US studies of the relationship between horizontal curve radius and the number of accidents

Legend:
- Fitzpatrick rural four lane
- Bauer rural two-lane straight grade
- Bauer rural two-lane crest curves
- Bauer two-lane sag curves
- Khan rural undivided
- Banihashemi rural multi
- Banihashemi urban arterial
- Gooch rural two-lane

X-axis: Horizontal curve radius (metres)

Y-axis: Relative expected number of accidents (model estimated; set to 1.00 for largest curve radius in each study)

Institute of Transport Economics
Norwegian Centre for Transport Research

Predictions are at best imprecise

- The functions give quite different predictions about the difference in safety between curves with a radius of 150 metres and curves with a radius of 300 metres
- These differences depend partly on context (as far as it is known):
    - *Vertical alignment*
    - *Distance to adjacent curves*
    - *Design elements (transition curves, superelevation)*
    - *Etc, etc*
- Not all studies include all elements of the context; hence context is partly unknown
- Cross-sectional studies do not show what happens if you change the radius of a curve from 150 to 300 metres

Institute of Transport Economics
Norwegian Centre for Transport Research