John Stuart Mill

# Causes and Analogies

# Inductive Argument

- An inductive argument is one that is not deductive.

- The premises aim to provide support for the conclusion, increase its *probability*, but fall short of proving it conclusively.

- A strong inductive argument is one where the premises have *strong positive relevance* to the conclusion.

# Different kinds of inductive argument

1. Simple enumeration.  E.g.

   I have seen a lot of black ravens

   I haven't seen any non-black ravens

   ------------------------------------------

   All ravens are black

# 2.  Argument from analogy

E.g.  "The Problem of Other Minds"

1. I know that I am conscious, as I am aware of my own thoughts and sensations

2. You are similar to me in appearance and behaviour

---------------------------------------

You are probably conscious as well

3. Inference to the best explanation, e.g.

"My car always has trouble starting on Tuesday mornings. It's so weird. The rest of the week it's fine."

*What's the best explanation of that?*

I think it's because of those kids who always play hockey in the back alley every Monday evening. My car's parked back there, so as it gets dark maybe they get into my car and turn on the car headlights to keep playing longer. (I don't lock it.) That would run down the battery, causing it not to start.

# 4. Mill's (statistical) methods

- We are aware of the fallacy *post hoc ergo propter hoc,* and so distinguish between what happens *after* the event (*post* hoc) and what happens *because of* the event (*propter* hoc).


- But how can we tell the difference?
  - Mill's methods are a common-sense approach.
  - They're also the basis for the sophisticated statistical techniques used today.

# 1. Method of Agreement

- Look at cases where the effect is present. The cause is (probably) whatever is **in common** between these cases.

- E.g. Monday I drank whiskey and water, and got a hangover. Tuesday it was gin and water, and another hangover. Wednesday it was brandy and water, same thing.

- Conclusion: drinking *water* caused those hangovers.

- At a certain bank, money has often gone missing, and the branch manager suspects that one of her employees is stealing it. She compiles the following table, showing which of her five employees were at work each day, and the amount of money that went missing that day. The branch manager asks you to analyse this table using Mill's methods, and tell her who is probably stealing the money. What do you tell her? Briefly explain your answer, specifying which of Mill's methods you used.

| | March 4 | 5 | 6 | 7 | 8 | 11 | 12 |
|---|---|---|---|---|---|---|---|
| Jan | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Mike | | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Hazel | ✓ | ✓ | | ✓ | ✓ | | ✓ |
| Curtis | ✓ | ✓ | | ✓ | ✓ | ✓ | |
| Dan | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| | $210 | $0 | $0 | $90 | $130 | $0 | $75 |

# 2.  Method of Difference

- Compare cases where the effect occurs with those where the effect does not occur.  Any difference between these cases is probably the cause.
- It used to be that whenever I drank a cup of tea I got a stabbing pain in my eye.  Then I stopped putting sugar in my tea, and the pain is gone.
- I guess sugar is bad for the eyes.

- A study was conducted to see whether people prefer Pepsi to Coke, or Coke to Pepsi, or regard them as equivalent. In the experiment, the Pepsi glass is labelled 'Q', and the Coke glass 'M'. Of 100 people tested, 67 preferred Coke over Pepsi, while 12 preferred Pepsi, and 21 found them equivalent.
- Using Mill's methods, what can be concluded on the basis of these data? Briefly explain your answer.

# 3. Method of Agreement and Difference

- Do *both* of the previous methods. I.e. search for factors that are in present in all cases of E, and are absent in cases of not-E.

- After an office party, a number of people were off sick, with symptoms of food poisoning. Rachel, who feels ok, is trying to find the cause. She asked everyone what they ate at the party, and displayed the information on this table.

- Using Mill's methods, what can you conclude in this case? Briefly explain your reasoning.

| | Got Sick? | Spinach dip | Samosas | Cheese plate | Smoked salmon | Veggie plate | Liver nuggets | Sliced lard |
|---|---|---|---|---|---|---|---|---|
| Rachel | | ✓ | ✓ | | ✓ | | ✓ | ✓ |
| Chris | ✓ | ✓ | | ✓ | ✓ | ✓ | | |
| Donna | | ✓ | | | ✓ | ✓ | | ✓ |
| Janet | ✓ | ✓ | | ✓ | | ✓ | ✓ | |
| Kenton | ✓ | ✓ | | ✓ | | | ✓ | ✓ |
| Gurpreet | | | ✓ | ✓ | | ✓ | ✓ | |

# Laundry balls

"The laundry ball is filled with four types of mineral-derived ceramic beads and two magnets, each performing different cleaning functions. When these components come in contact with water, they form 'oxygenated' water with an increased pH level and an ability to eliminate germs and bacteria. The result is fresh, safe and clean laundry!"

- "I tried a load of laundry, using just the laundry ball, and the claims are true. It does indeed get my clothes pretty clean, without using any soap at all."

- Is this good evidence that the ball is effective?

- No!  Then you don't know if the laundry ball did anything, in addition to the water.

- Do *two* loads of laundry, with similarly-dirty clothes, same machine.  In one load use the laundry ball, in the other just plain water.

- Compare the clothes afterwards, to see if the load with the laundry ball is cleaner.  Any *difference* in outcome can then be attributed to the laundry ball.

- (Perhaps also do a load with standard detergent.)

"The Nirvana trials compared soap (brand unspecified), plain water, and 'The Laundry Solution'. A 100% cotton cloth was cut into three strips, each soiled with sidewalk dirt, bicycle chain grease, ketchup, mustard, olive oil, felt tip pens, ball point pen, cloth marker and coffee. The strips, washed under identical circumstances at the same (unspecified) temperatures, were then judged by people who did not know which was which. The soap-washed strip was pronounced much cleaner than the other two, which were rated about equal. Then, apparently, TradeNet, the 'Laundry Solution' distributor, threatened Nirvana with legal action for their pains."

(**WILL LAUNDRY BALLS WASH?** By Dorothy Stein)

# Evidence of *non*-causation?

- N.B. A trial of this sort can also provide evidence for a *negative* causal claim, i.e. that one thing does *not* cause other.

# Part 2

Concomitant Variations

# 4. Concomitant Variations

- This applies to causation between processes that vary continuously in time, such as the price of gold, the phases of the moon, crime rates in Vancouver, etc.

- If two such processes vary in sympathy with each other, i.e. they tend to rise and fall at the same time (or one rises while the other falls) then they're (probably) causally related.

# Examples

- The tides are correlated with the moon's position and phase.
  - At high tide, the moon is either at its highest point (overhead) or lowest point (under your feet).
  - The highest tides are when the moon is new or full.
- Is there a causal connection between the moon and the tides?

Moonrise at low tide. N.B. One cannot shoot "moonrise at high tide"!

# (Newton's theory of the tides)
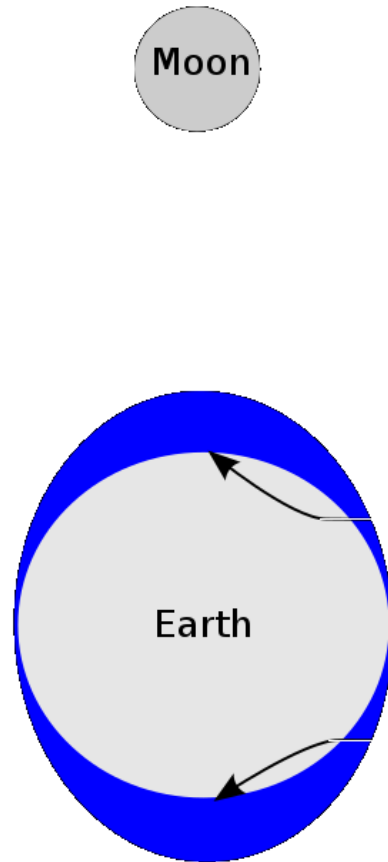
# January 2014



| Sun | Mon | Tues | Wed | Thurs | Fri | Sat |
|-----|-----|------|-----|-------|-----|-----|

**Week 1 (Wed 1 – Sat 4):**
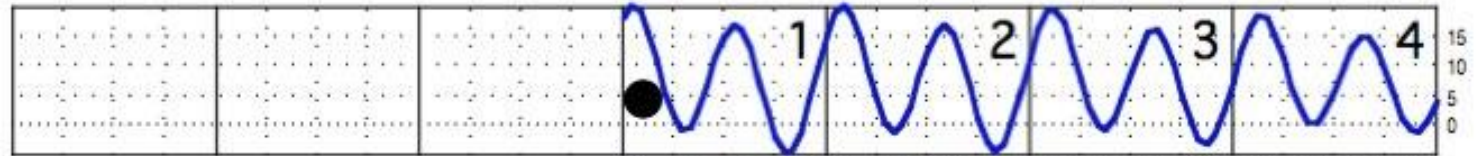
| | | | Wed 1 | Thurs 2 | Fri 3 | Sat 4 |
|---|---|---|---|---|---|---|
| | | | 20.1 -0.9 16.9 -4.8 | 20.3 -1.0 16.9 -4.3 | 19.7 -0.7 16.2 -3.1 | 18.5 0.1 15.1 -1.2 |
| | | | 1:11 7:21 1:11 7:23 | 1:53 8:04 1:55 8:07 | 2:36 8:47 2:40 8:51 | 3:19 9:32 3:27 9:36 |

**Week 2 (Sun 5 – Sat 11):** 6:38 am, 4:55 pm
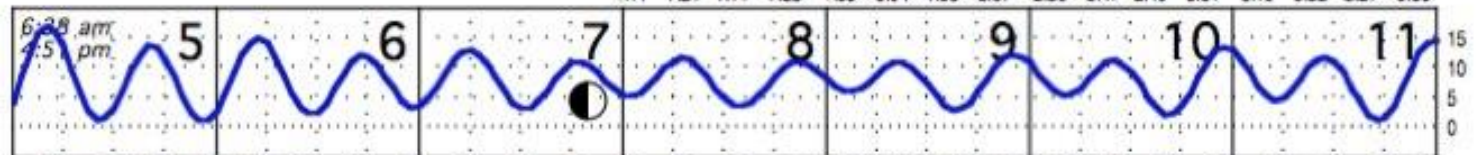
| Sun 5 | Mon 6 | Tues 7 | Wed 8 | Thurs 9 | Fri 10 | Sat 11 |
|---|---|---|---|---|---|---|
| 16.9 1.2 13.6 1.0 | 15.0 2.3 12.1 3.3 | 13.1 3.2 11.1 5.2 | 11.6 3.5 11.1 5.9 | 11.0 3.0 12.2 5.3 | 11.3 2.0 13.5 4.5 | 11.9 1.0 14.6 |
| 4:04 10:21 4:19 10:25 | 4:52 11:16 5:22 11:25 | 5:49 12:27 6:49 12:49 | 7:06 1:55 8:41 2:44 | 8:40 3:19 10:08 4:16 | 9:57 4:21 11:04 5:10 | 10:49 5:06 11:42 |

**Week 3 (Sun 12 – Sat 18):** 6:38 am, 4:57 pm
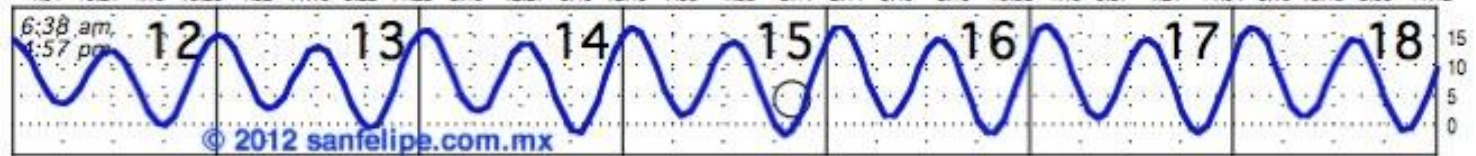
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| 3.6 12.6 0.2 15.6 | 2.8 13.3 -0.6 16.2 | 2.2 13.9 -1.1 16.7 | 1.7 14.3 -1.4 17.0 | 1.4 14.6 -1.5 17.0 | 1.3 14.7 -1.2 16.8 | 1.2 14.5 -0.8 |
| 5:50 11:28 5:41 12:14 | 6:21 12:01 6:12 12:42 | 6:47 12:30 6:40 1:07 | 7:13 12:57 7:06 1:32 | 7:38 1:23 7:32 1:56 | 8:02 1:49 7:58 2:21 | 8:27 2:16 8:24 |

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**Week 4 (Sun 19 – Sat 25):** 6:37 am, 5:03 pm
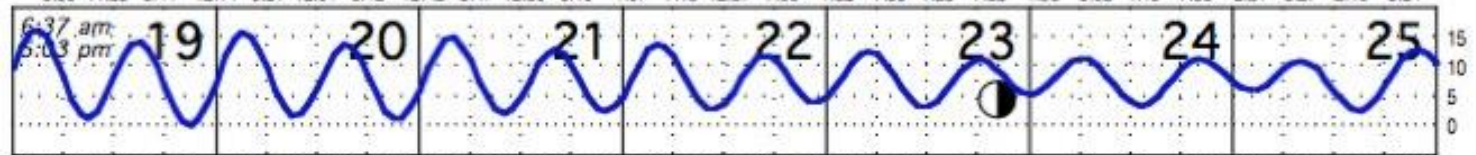
| Sun 19 | Mon 20 | Tues 21 | Wed 22 | Thurs 23 | Fri 24 | Sat 25 |
|---|---|---|---|---|---|---|
| 16.4 1.4 14.2 0.0 | 15.7 1.6 13.6 1.0 | 14.9 2.1 12.9 2.3 | 13.8 2.6 12.0 3.9 | 12.6 3.2 11.2 5.4 | 11.4 3.4 11.3 5.9 | 11.0 2.5 13.0 |
| 2:45 8:53 2:45 8:51 | 3:11 9:22 3:17 9:21 | 3:41 9:55 3:55 9:57 | 4:15 10:37 4:46 10:46 | 5:02 11:37 6:04 12:04 | 6:15 1:07 8:02 2:10 | 8:04 2:48 9:42 |

**Week 5 (Sun 26 – Fri 31):** 6:34 am, 5:09 pm
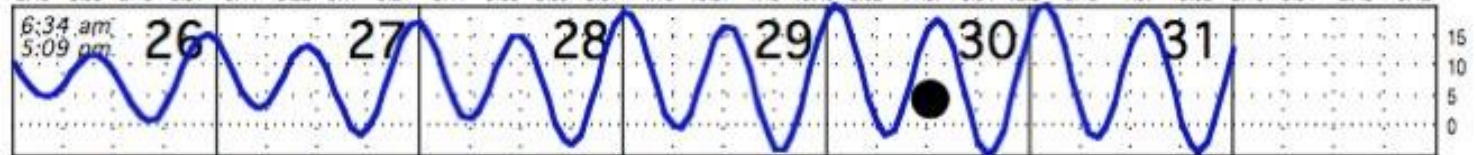
| Sun 26 | Mon 27 | Tues 28 | Wed 29 | Thurs 30 | Fri 31 | |
|---|---|---|---|---|---|---|
| 4.8 12.0 0.7 15.2 | 2.9 13.6 -1.4 17.4 | 1.1 15.3 -3.2 19.1 | -0.5 16.7 -4.4 20.2 | -1.6 17.6 -4.9 20.5 | -2.1 17.9 -4.6 | |
| 3:54 9:38 4:04 10:46 | 4:58 10:43 5:00 11:36 | 5:47 11:35 5:49 12:20 | 6:30 12:21 6:33 1:01 | 7:11 1:04 7:16 1:40 | 7:50 1:46 7:57 | |

San Felipe, B.C., Mexico - approx. (31°2.0'N, 114°46.0'W)

# Do we need to know the mechanism?

Is it a fallacy to say: "Obviously there's some causal connection between the moon and the tides, even though we don't know what it is"?

# e.g. Galileo on the lunar theory

[according to e.g. Kepler, the moon and sun] act upon the [tides] by making them greater or less at different parts of the lunar month and at different seasons of the solar year -- **almost as though** the moon and sun were taking part in the production of such effects. **But that concept is completely repugnant to my mind** …

… We see that the moon and the sun do not act upon small receptacles of water by means of light, motion, and great or moderate heat; rather, we see that to make water rise by heat, one must bring it almost to boiling. In short, we cannot artificially imitate the movement of the tides in any way except by movement of the vessel.

Galileo, *Dialogue,* the Fourth Day.

# Did women's fashion cause the Great Depression?

- E.g. Prior to about 1970, the stock market rose and fell in sympathy with women's skirt lengths. When the hems went down, so did stock prices.

# The standard theory …

strong economy

confident, buoyant mood

shorter skirts
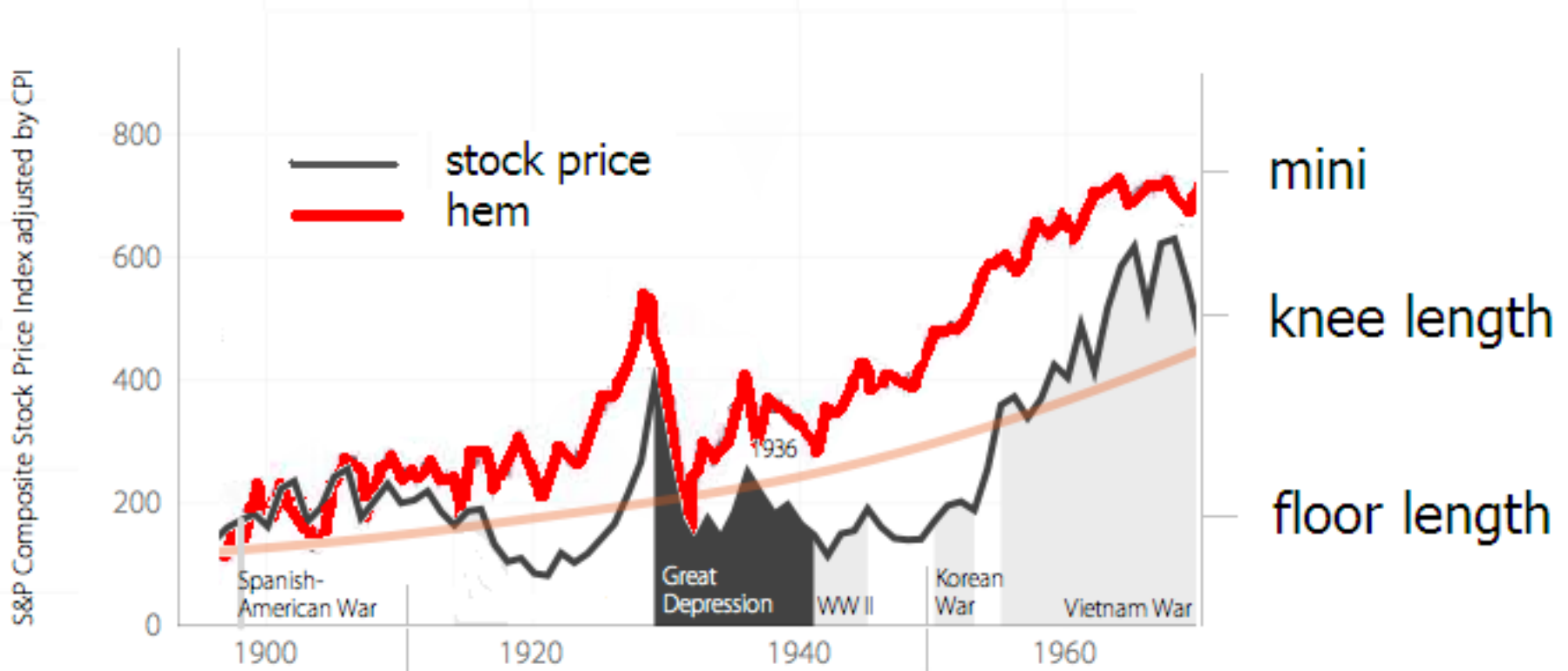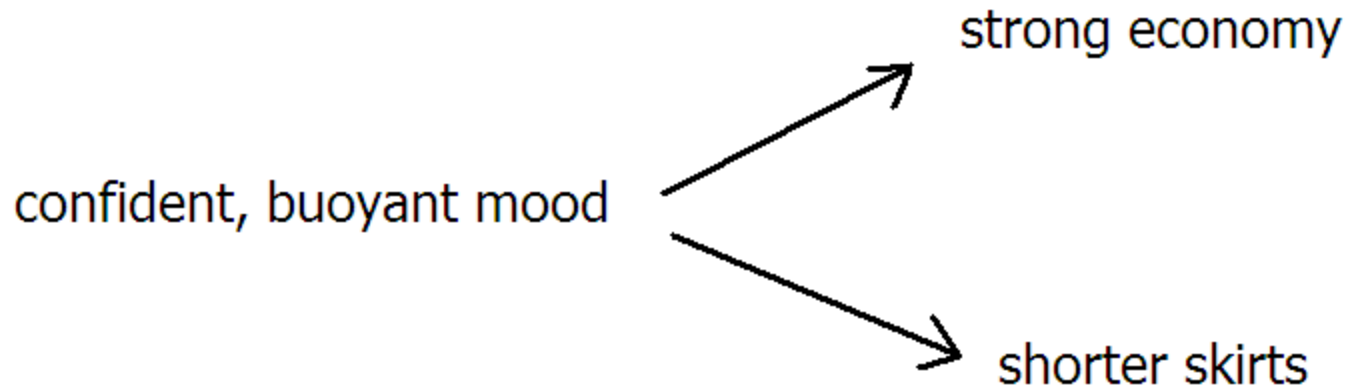
- I don't know for sure if this is true.  But (it seems to me) that the "concomitant variation" makes *some* causal connection likely, even if we can't find a plausible mechanism.
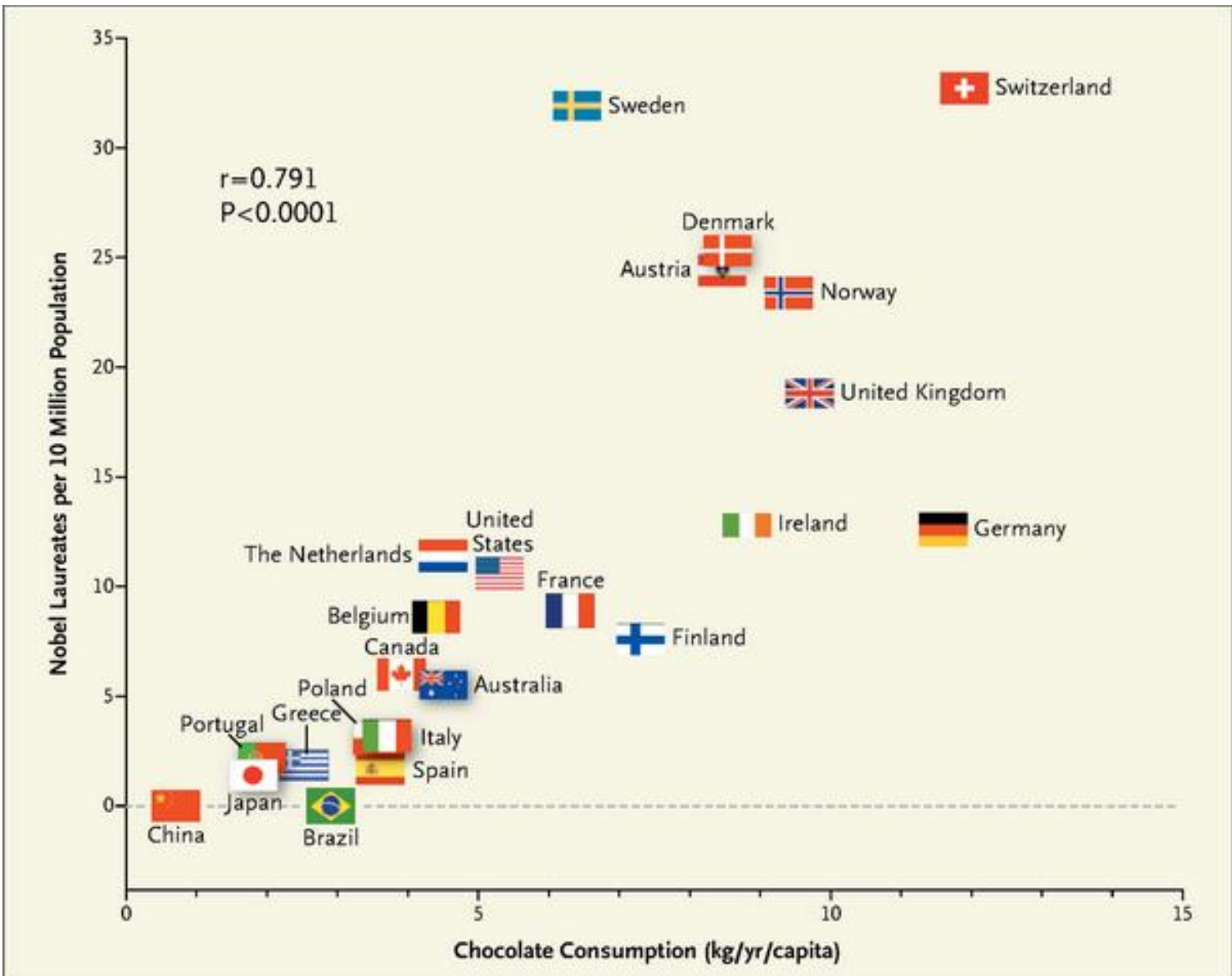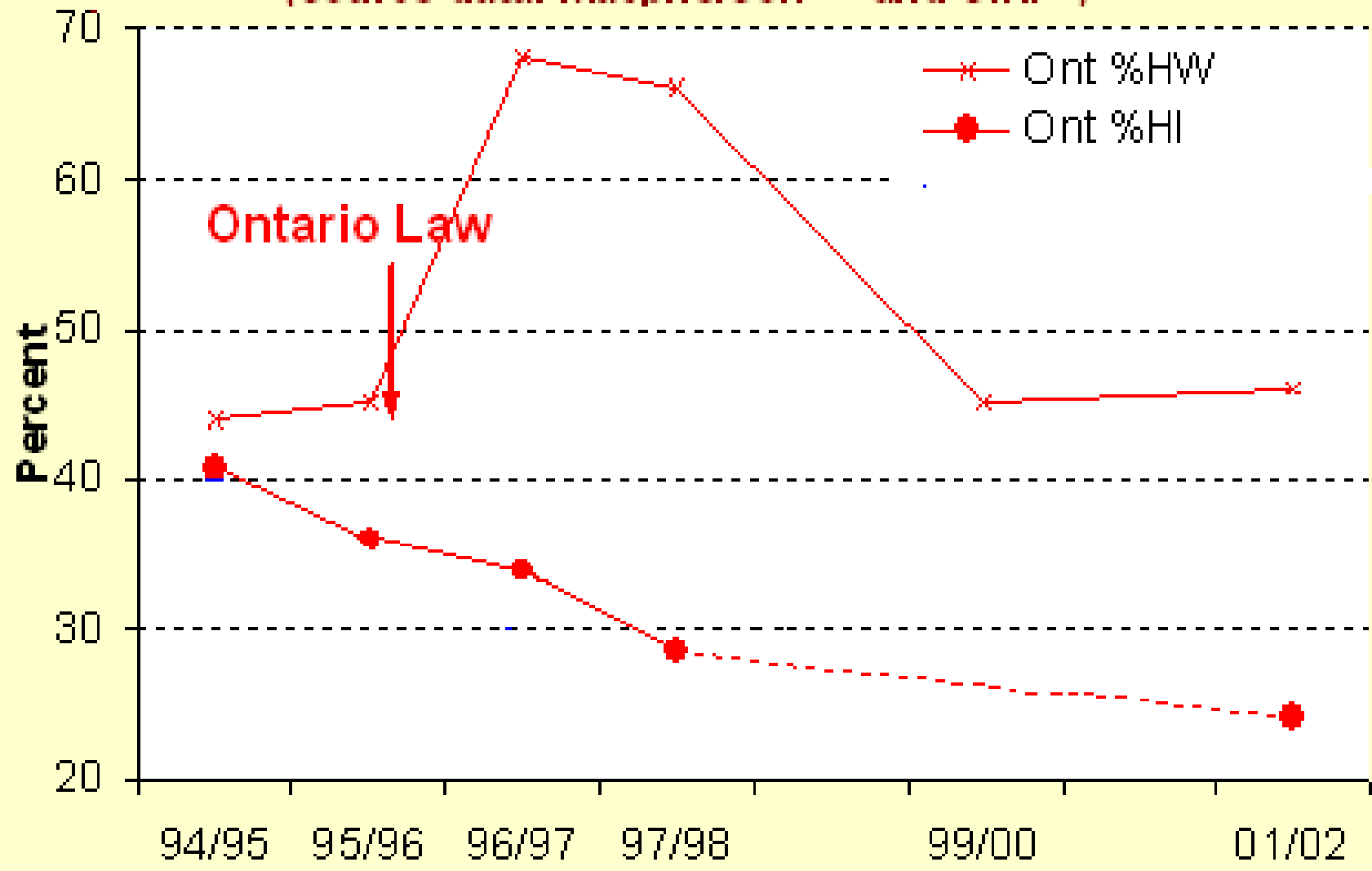
**Figure 1.** Correlation between Countries' Annual Per Capita Chocolate Consumption and the Number of Nobel Laureates per 10 Million Population.

Can we look at trends to determine the effect of helmet wearing on cycling head injuries?

Fig. 1 Helmet wearing (HW) and head injury (%HI) in BC and Ontario vs no-law provinces (source data: Macpherson[2,3] and CIHI[5])

- "On the basis of these and similar graphs, Dr. Dorothy Robinson has argued that **helmet wearing has little or no effect on cycling head injuries**. Explain how this conclusion can be obtained using Mill's methods."

- Does random breath testing (to discourage drunk driving) reduce road fatalities?

# Conclusion?  (Note the false zero)



**Figure 5.  Road fatalities in NSW by year**
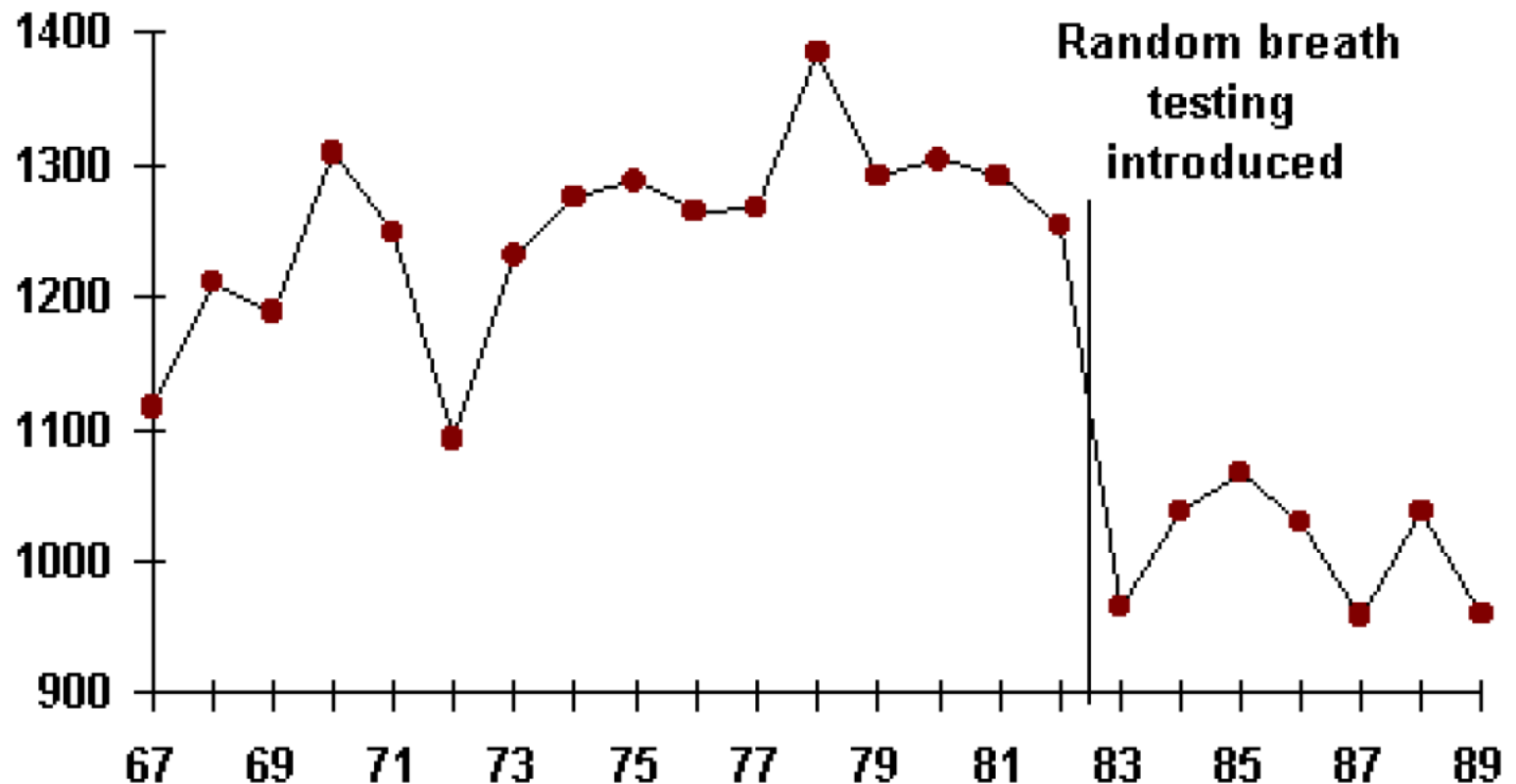
# Cherry picking

- A very general fallacy in inductive reasoning (not limited to Mill's methods) is "cherry picking".

- Cherry picking means selecting the data that support your hypothesis, while omitting data that do not.

- Using Mill's methods, one can also mislead people by omitting certain *variables* when looking for agreements, differences, concomitant variations, etc. (E.g. ignoring that gin, whiskey, brandy contain alcohol, or that sugar is added to tea using a spoon.)

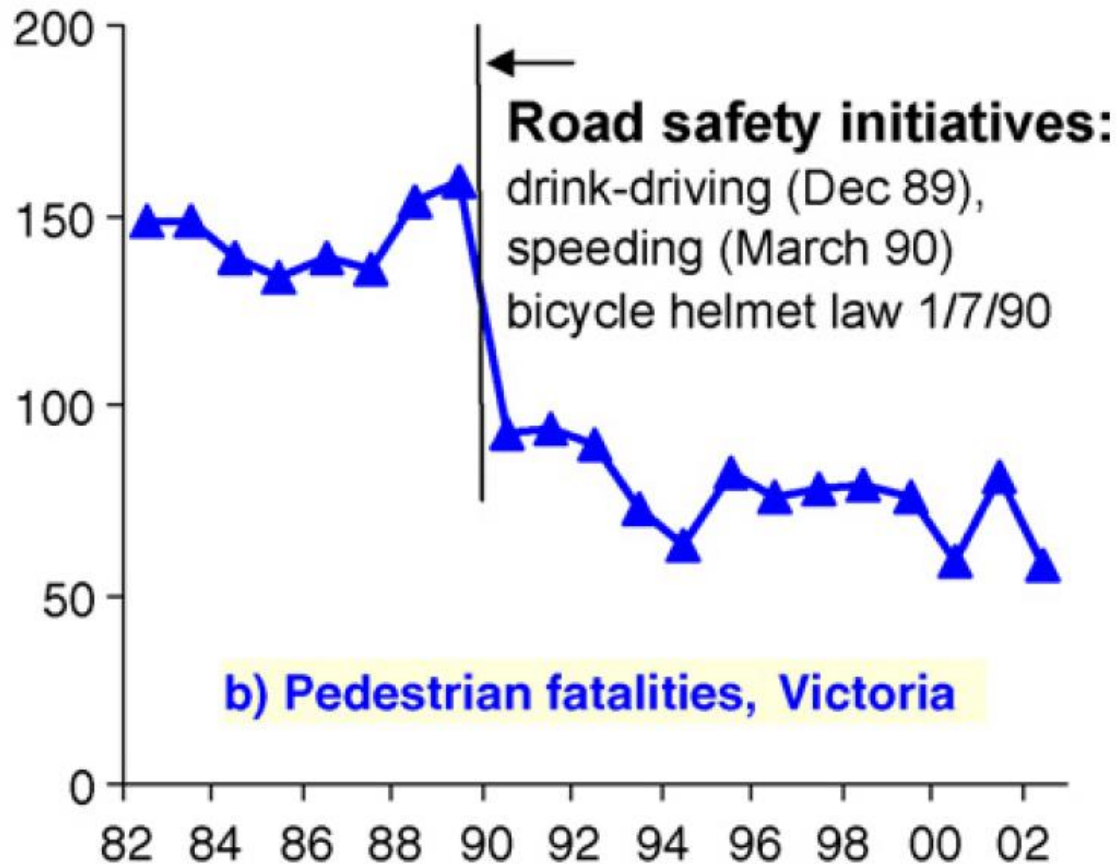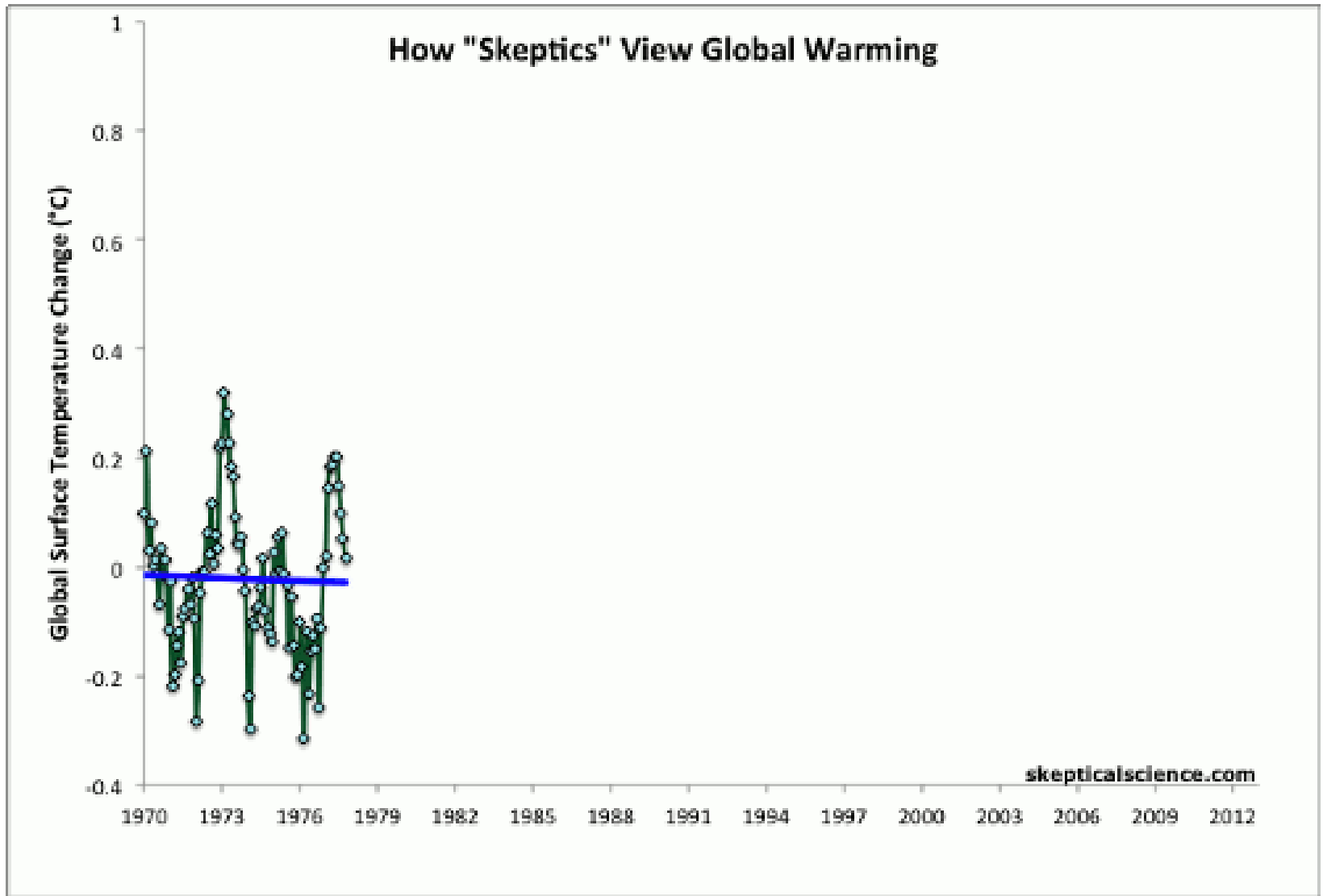# Bike helmets reduce serious head injuries!

# Or do they?
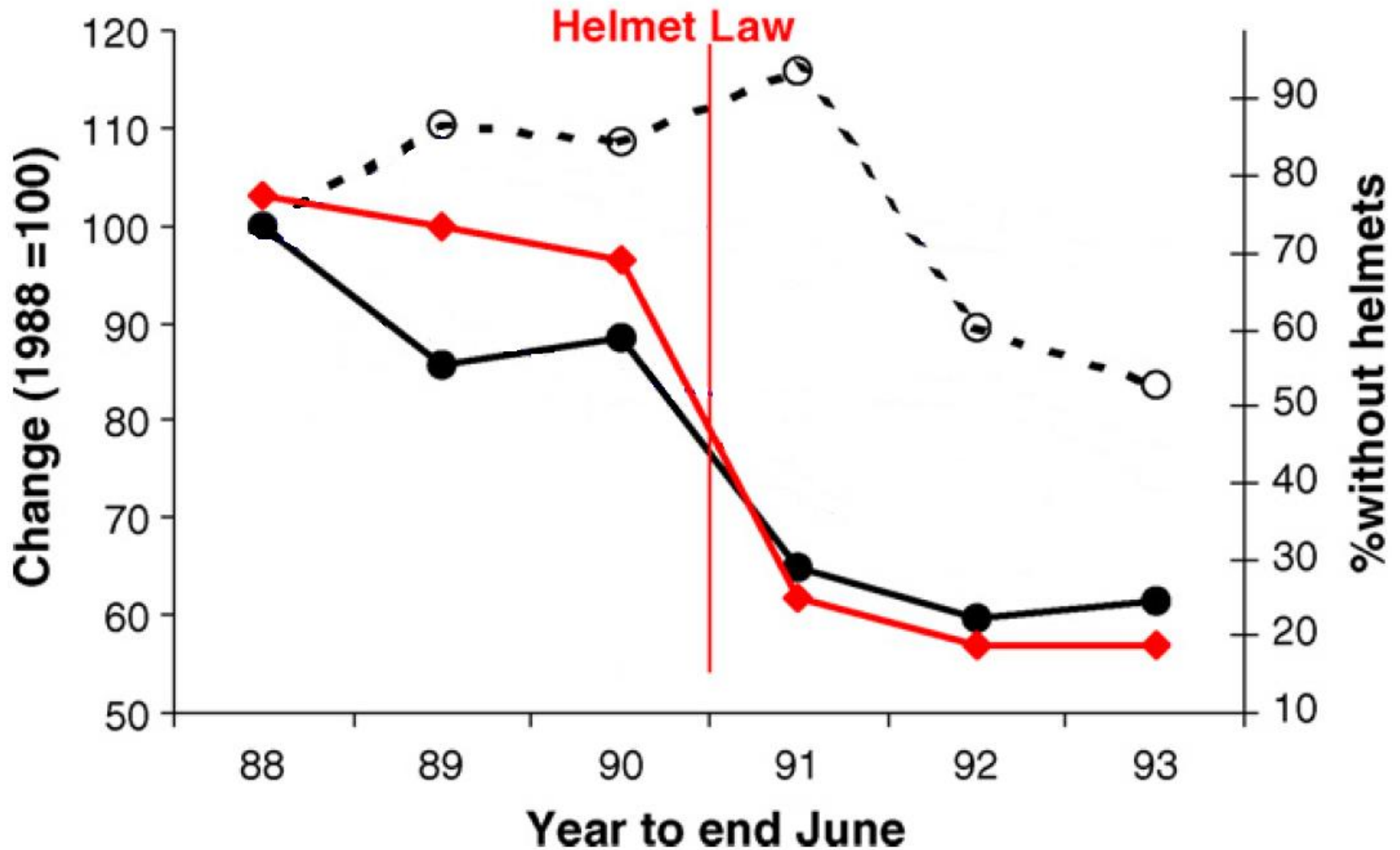
# The Need for Controls

- When trying to reach conclusions about causes, it's useful to have comparisons, or *controls*. (As many as you can get.)

- E.g. in measuring the effect of helmet wearing on head injury, measuring *non-head injuries* is a useful control.

- It helps to filter out confounding factors, such as declining cycle use and simultaneous road-safety measures.

# Another control – pedestrian deaths



Road safety initiatives: drink-driving (Dec 89), speeding (March 90), bicycle helmet law 1/7/90

b) Pedestrian fatalities, Victoria

How "Skeptics" View Global Warming

- Cherry picking intervals of time.

# Does legislating the use of car seat belts save lives?

- In July 1981 the UK parliament debated seatbelt legislation.  During the debate the MPs either lauded or denounced a study by geographer John Adams, claiming that seatbelt legislation had not reduced road fatalities in other European countries.

- Prior to the debate, the Department of Transport had commissioned J. E. Isles to check Adams' study.  His report was completed in April 1981, and *agreed with Adams*.  The Isles Report was suppressed, and unknown until 1985, two years after the UK introduced seatbelt legislation.

J. E. Isles' summary of the European experience with seat belt laws:

IMPLICATIONS OF EUROPEAN STATISTICS

SUMMARY

Available data for eight western European countries which introduced a seat belt law between 1973 and 1976 suggest that it has not led to a detectable change in road death rates. A simple model suggests that the law was followed by an 11% increase in injury rates. However, there is evidence that the model is too simple and it is concluded that the data are consistent with a 'no change' hypothesis. The results are not compatible with the Department's "1,000 plus 10,000" estimates (for front seat vehicle occupants) which are an extrapolation from the observed apparent savings among voluntary wearers.

(N.B. "1,000 plus 10,000" refers to 1,000 fewer deaths, and 10,000 fewer serious injuries.)

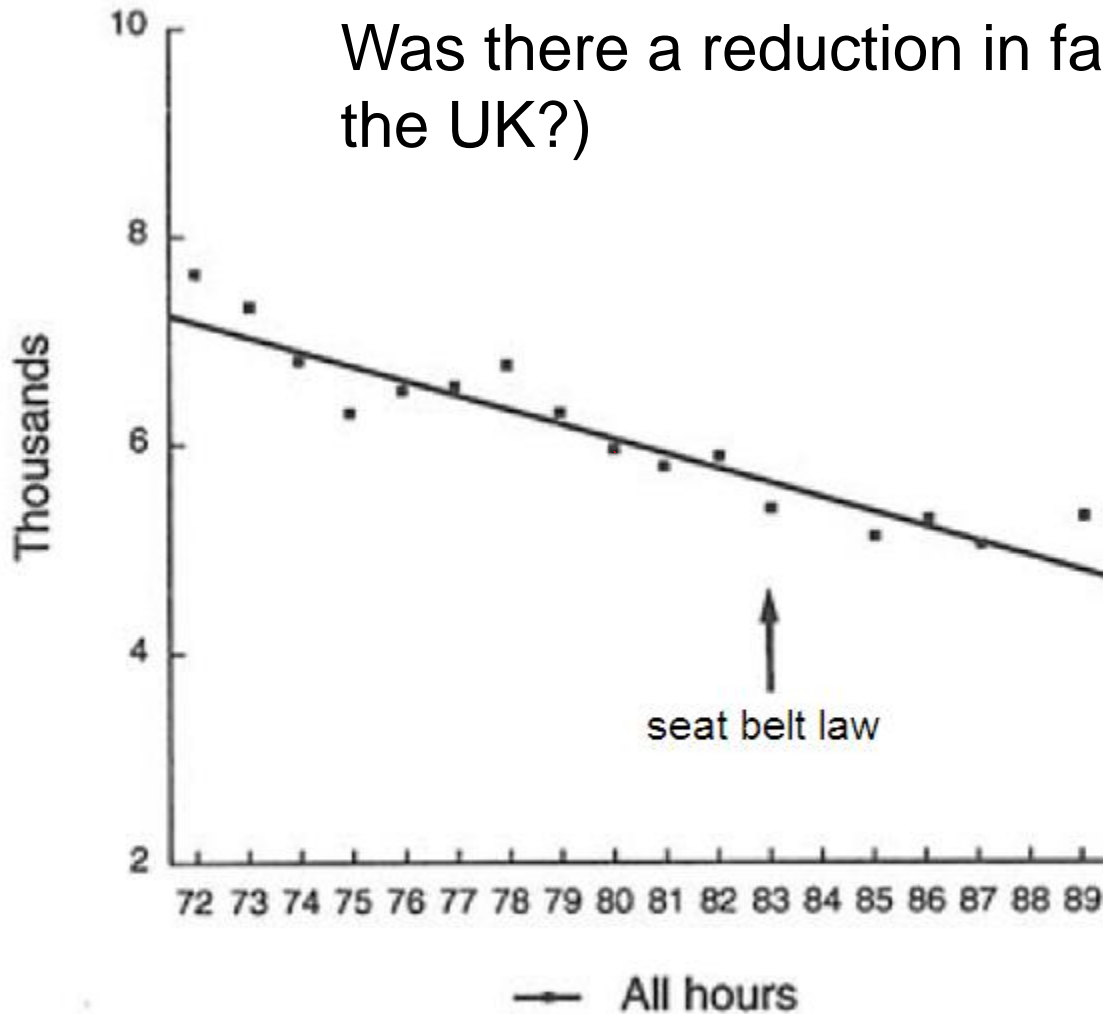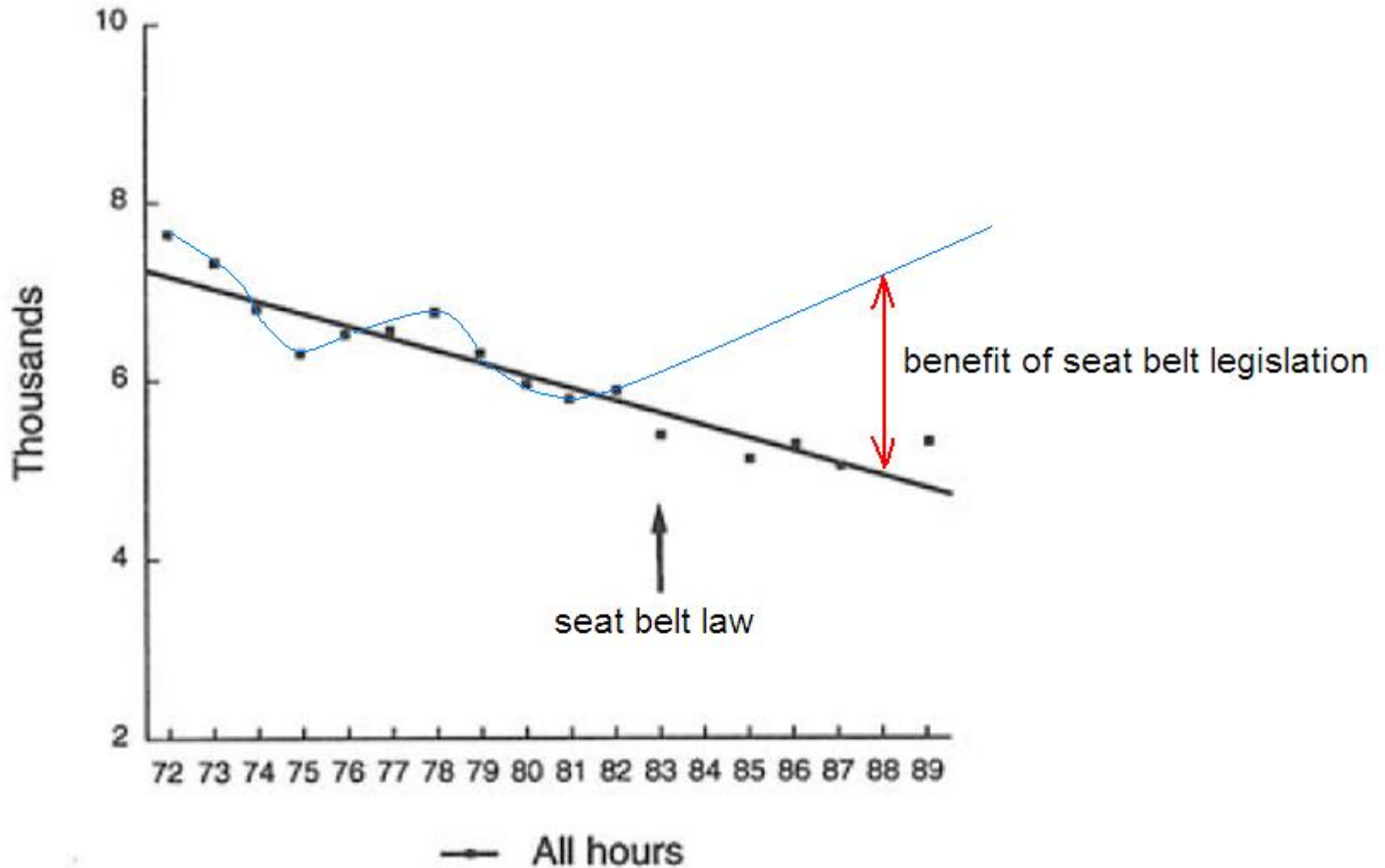Was there a reduction in fatalities in the UK?)

seat belt law

All hours

**Figure 6** Great Britain road deaths by time of day. Source: *Road Accident Great Britain*, HMSO, published annually.

# "Yes!" (using clever math)

# Part 3

Arguing by analogy

# Arguing by analogy

Another kind of inductive argument is the *argument by analogy.*

- Here one appeals to similarity between two cases. One of these cases is well understood, and a certain conclusion is known to hold there.

- One then argues that, in view of relevant similarities, a corresponding conclusion holds in the other (less well understood) case as well.

# Arguing by analogy

- It is hard for an argument by analogy to be inductively strong. Substantial evidential support from an analogy is *pretty rare*.

- However, analogies are very useful at:
  - *illustrating* a claim, helping an audience to understand what's being said, by giving parallel cases.
  - being *thought provoking*, making the audience look at a familiar issue in a new way
  - *putting opponents on the defensive*, requiring them to defend views that might have previously seemed self evident.
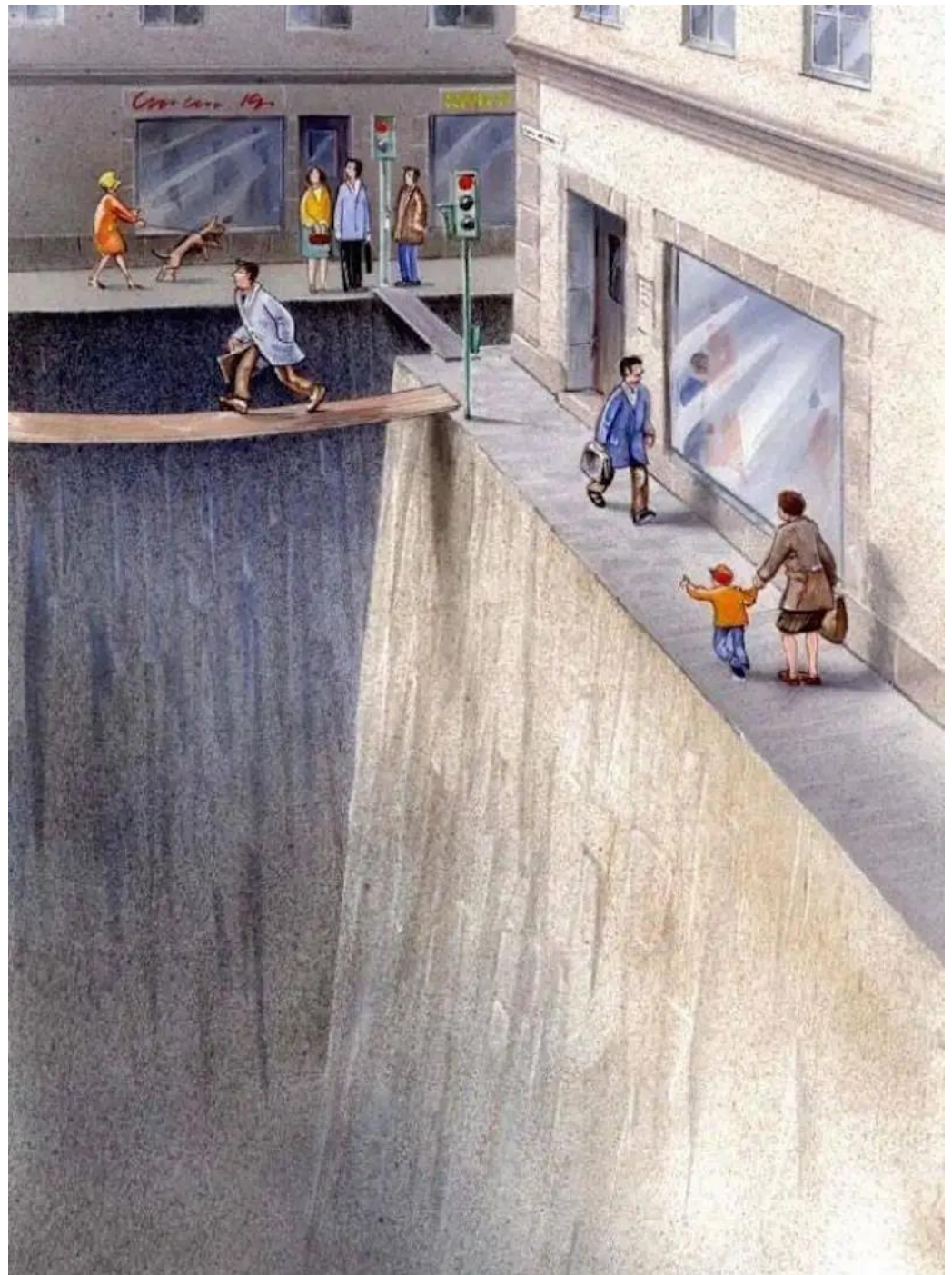
E.g.

What it's like to
be a pedestrian?

Image: Karl Jilg

# Arguing by analogy

- How can one criticise an argument by analogy?

- Usually by finding a *relevant* *difference* between the cases.

- Not just any difference will do.  It must be **relevant** to the conclusion being drawn.

# Differences of degree and scale

- Be wary of saying that mere differences of *degree* and *scale* weaken the analogy.

- E.g. "Households often need to cut back on luxuries, during hard times, in order to remain financially afloat.  In a similar way, Canada needs to reduce expenditures on luxuries, like the arts, in order to protect its long-term economic viability"

  – Is this analogy weak simply because Canada's economy is much *bigger* than that of a household?

- "When you throw a stone into a pond, it causes ripples that end up washing against the shore. In a similar way, when a meteor hits the ocean, it causes huge waves that can damage nearby coastlines."

- "Come off it. A meteor is much bigger and faster than a pebble!"

- In some cases differences of degree/scale will be relevant, no doubt.  E.g.

- "Assault is a serious crime that will land you in court, and possibly even in jail.  Now when one grade 2 student punches another during recess, this is basically the same thing, and the police should handle it."

# Examples

(i) People look down their noses at me just because I gamble a lot. They say I have a "gambling problem". But the fact is that those people all buy stocks in some form, whether through mutual funds or RRSPs. That's gambling too – in both cases we're risking some money to get more. And they risk much more money on the stock market than I do on horses! So I'm no worse than them.

- Some of these egghead scientists say that we humans will be immortal one day, or at least they'll find a way to halt the aging process. But no matter how finely you slice it, that's still baloney. Think about a car, for example. Will they ever make a car that will run forever? Not a chance. Sooner or later, stuff just wears out.

- Marriage is just a bad idea, when you think about it. Would you like to spend your whole life eating just one kind of food? Of course not – no matter how good it was at first, you'd soon get totally bored with it. Also, you wouldn't be getting all the nutrients you need. Breadth and variety are crucial to a rich, exciting and healthy life.

# Cyclists urged to wear body armour

**Calgary doctors' study says road, mountain bikers need better protection.**

CBC News   Posted: Sep 9, 2013 3:58 PM MT   |   Last Updated: Sep 9, 2013 5:33 PM MT

Photo credit: londonfilmgeek (Flickr)

# China's Newest Market Opportunity: Pollution Control

DIY entrepreneurs have developed ingenious—and affordable—products to satisfy the public's insatiable demand for pure air.
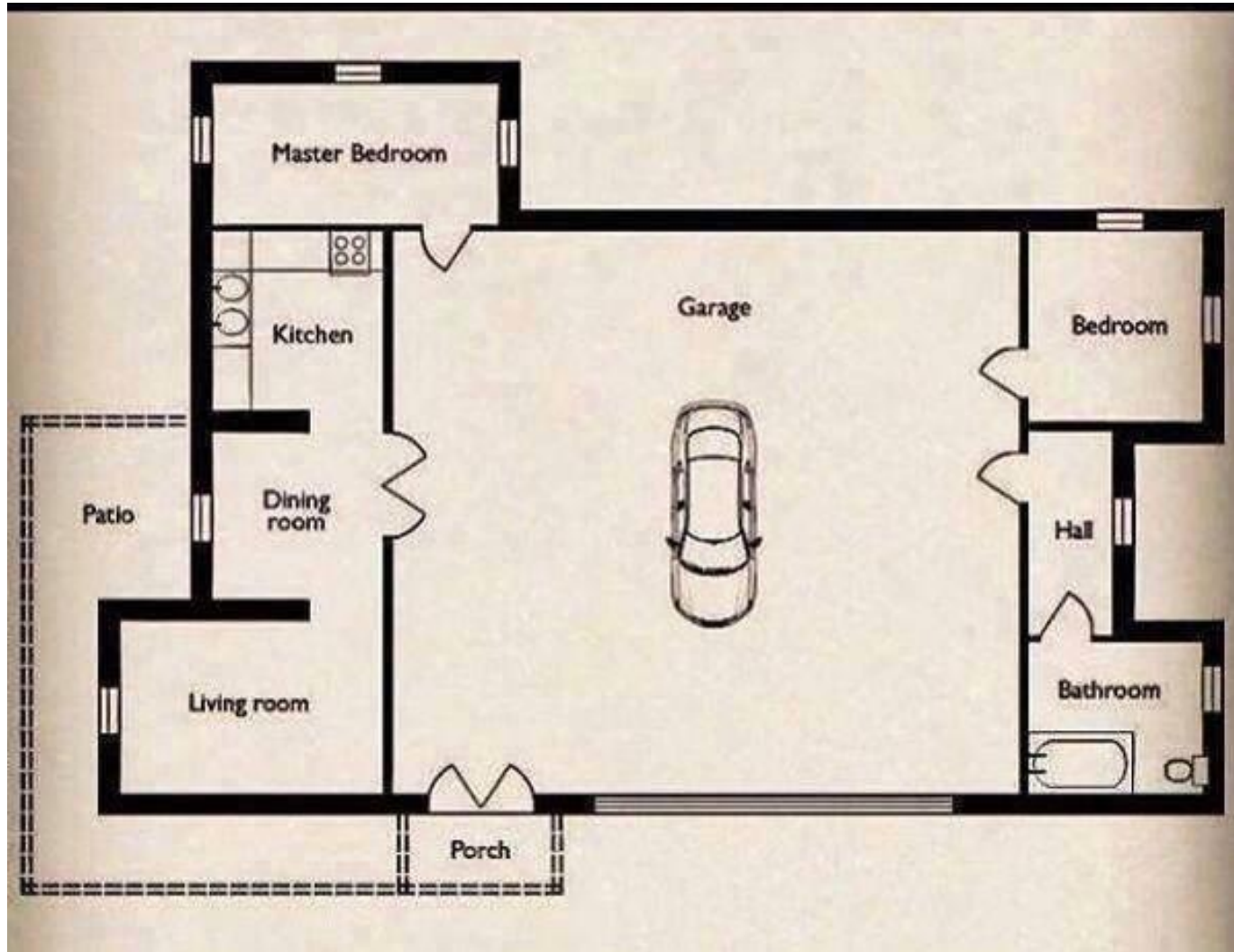
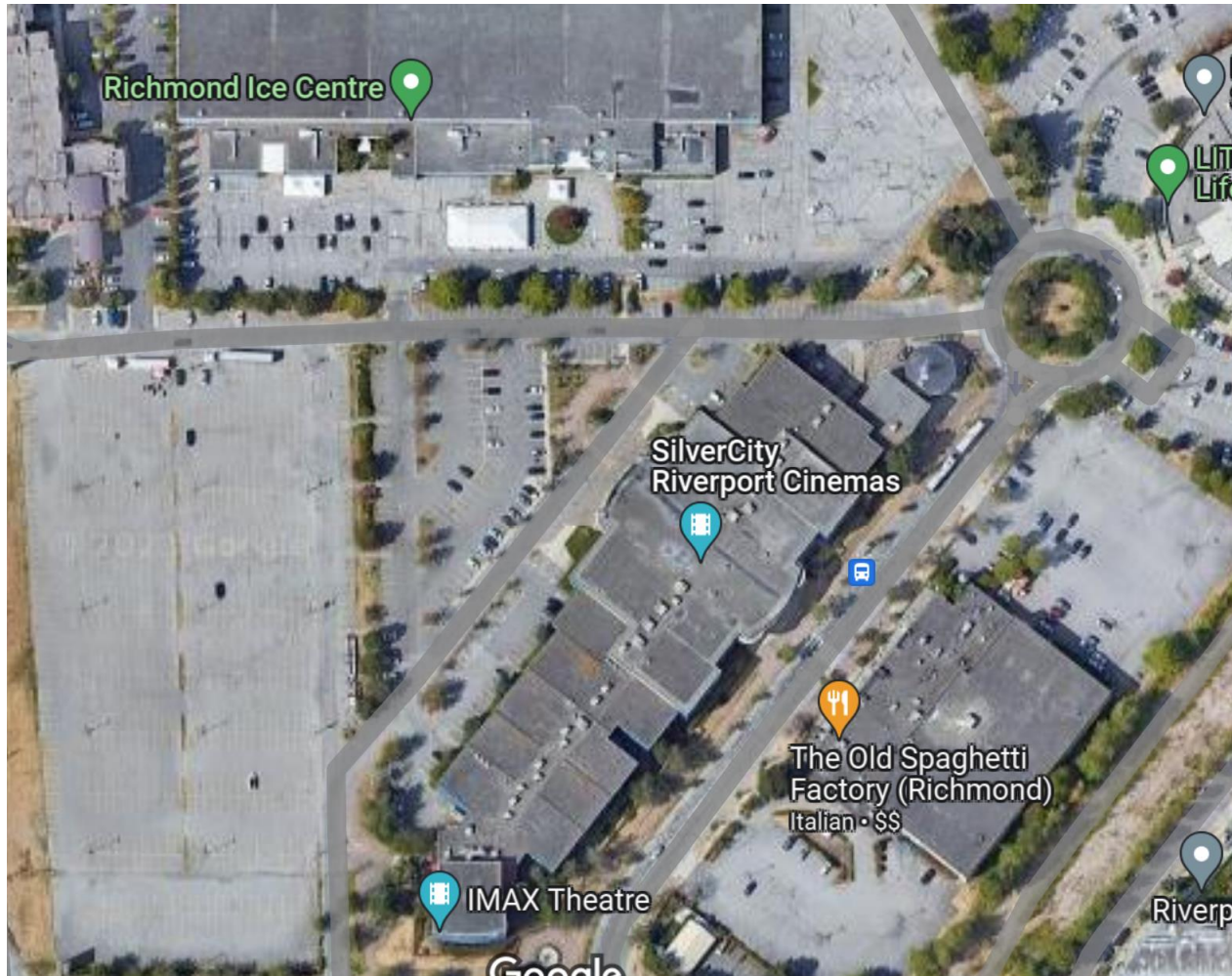GABRIELLE JAFFE   SEP 5 2013, 7:00 AM ET

*The* Atlantic

bicycling injury prevention in North America is like air pollution exposure prevention in China
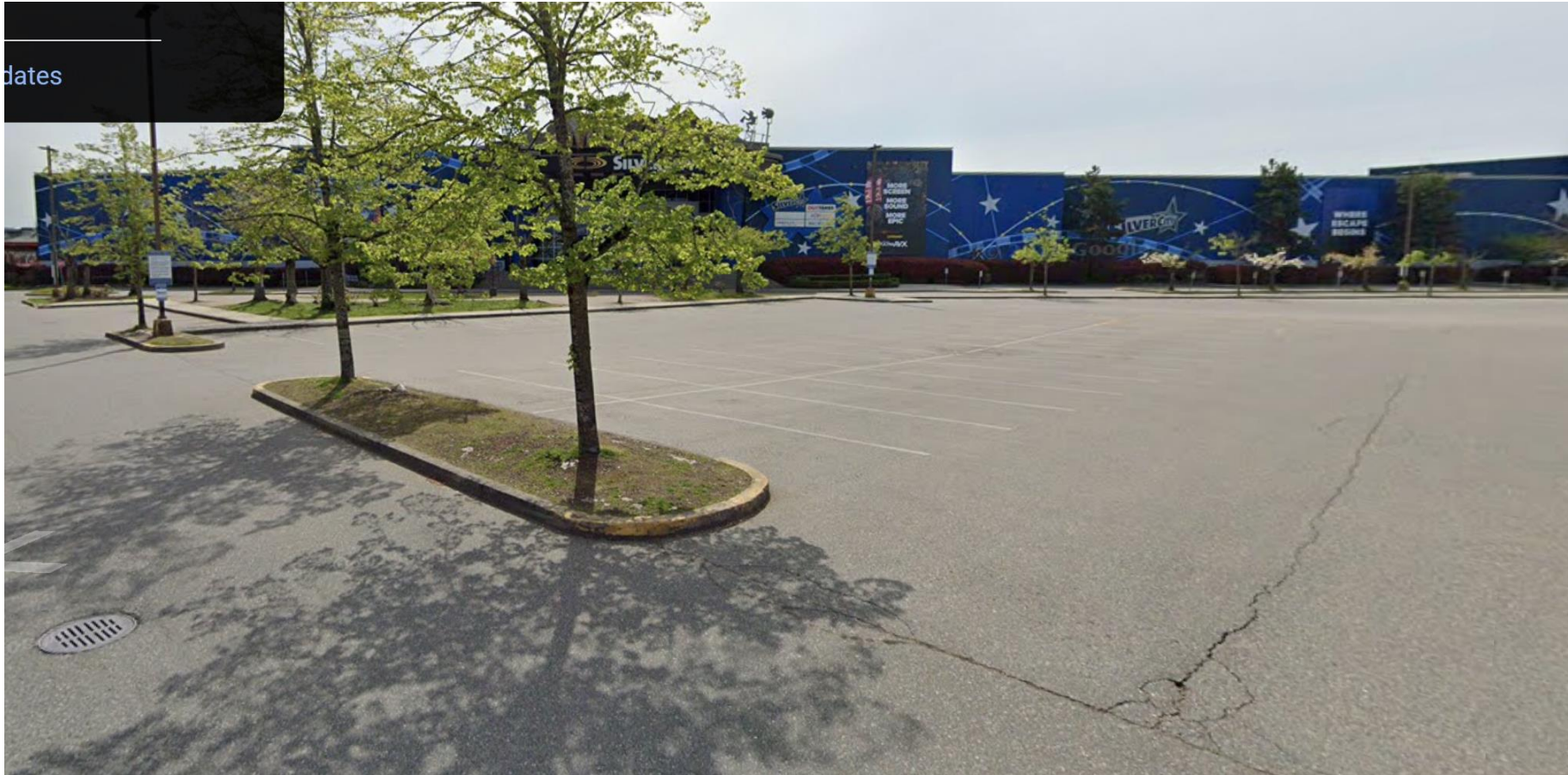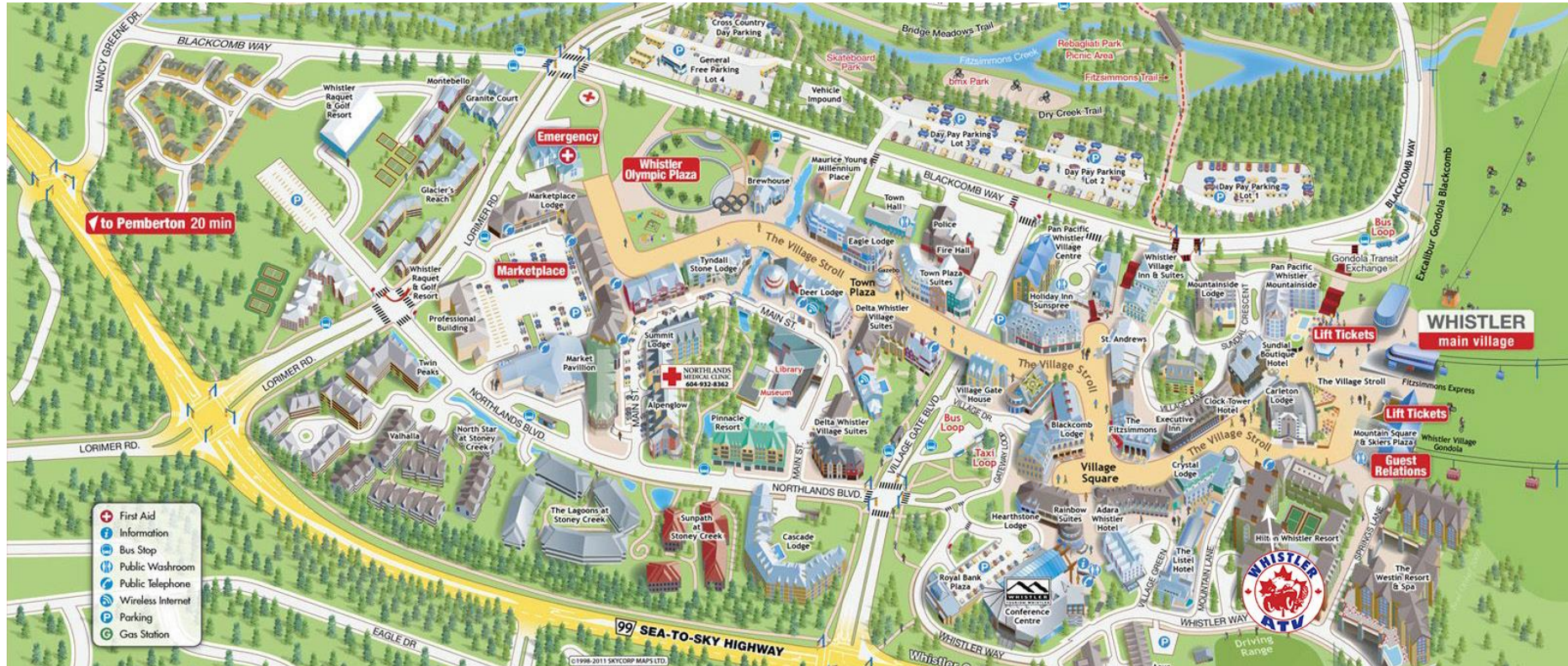
# "If we designed houses the way we design our cities."

# E.g. Riverport, Richmond, B.C.

# A parking "crater"

# But not Whistler!

# Whistler village

"Vancouver's building permit system is a bad thing.

Imagine a village where, if you start building a lovely spiral staircase inside your own house, you have to keep the shutters closed and move the lumber inside during the dead of night.

If you don't, a neighbour might see what you're doing, and report it to the village.  Before you know it a posse of village folk will come into your house and order you to tear it down, saying that it doesn't conform to their idea of how stairs should be.

They'll also empty the cash from your wallet as punishment. "

"Would you want to live in such a village of nosey, interfering busybodies?  Well, that's Vancouver.  If a City building inspector catches you building something like that, in your own house, that's not "up to code", then you will have to demolish it, as well as pay a hefty fine."

STAIR SAFETY
**A Review of the Literature and Data Concerning
Stair Geometry and Other Characteristics**

Prepared for

U.S. Department of Housing and Urban Development
Office of Policy Development and Research
Washington, D.C.  20410
Instrument No. DU100K000005897

by

NAHB Research Center
Upper Marlboro, MD  20772
November 30, 1992

"An in-depth review of the major works mentioned above found that the described research, considered either separately or together, fails to establish a consistent, statistically valid link between stair safety and stair geometry."

**5.**    Criticise the following arguments from analogy by finding the most relevant difference(s).

**Micki**:    Have you ever had sheep tripe soup?

**Darrell**:    Yes, once, but never again!  It was awful!

**Micki**:    You'd try a bowl of *my* tripe soup if I made some, wouldn't you?

**Darrell**:    That's like asking a man who's broken his right leg whether he'll allow you to break his left leg, so he can find out if it hurts as much as the first one!

**Felipe**: A person can't really understand political oppression unless they've experienced it personally, as I have. When have you ever been oppressed?

**Emma**: Oh come on. Biologists don't lay eggs, but they know more about the process than chickens do! And some great umpires have never played the game.

(ii)     When arteries are congested, expert surgeons insert stents to widen them, and increase the flow of blood.  In a similar way, when highways become congested, the only solution is to widen them as well.