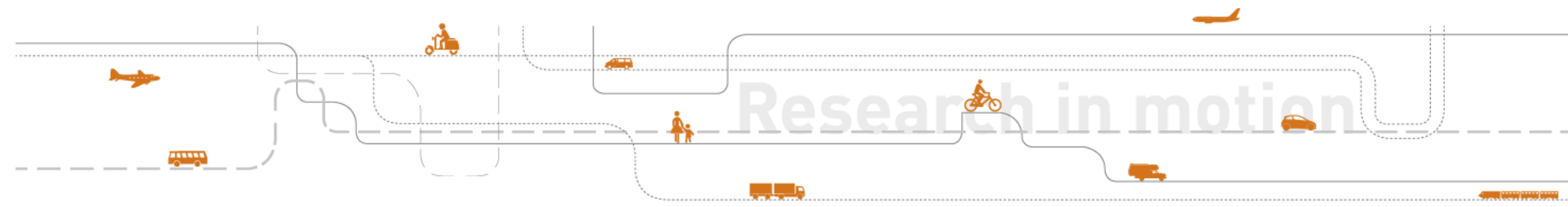


# Methods and common pitfalls to gaining valid knowledge

ICoRSI International Dialogues on Road Safety

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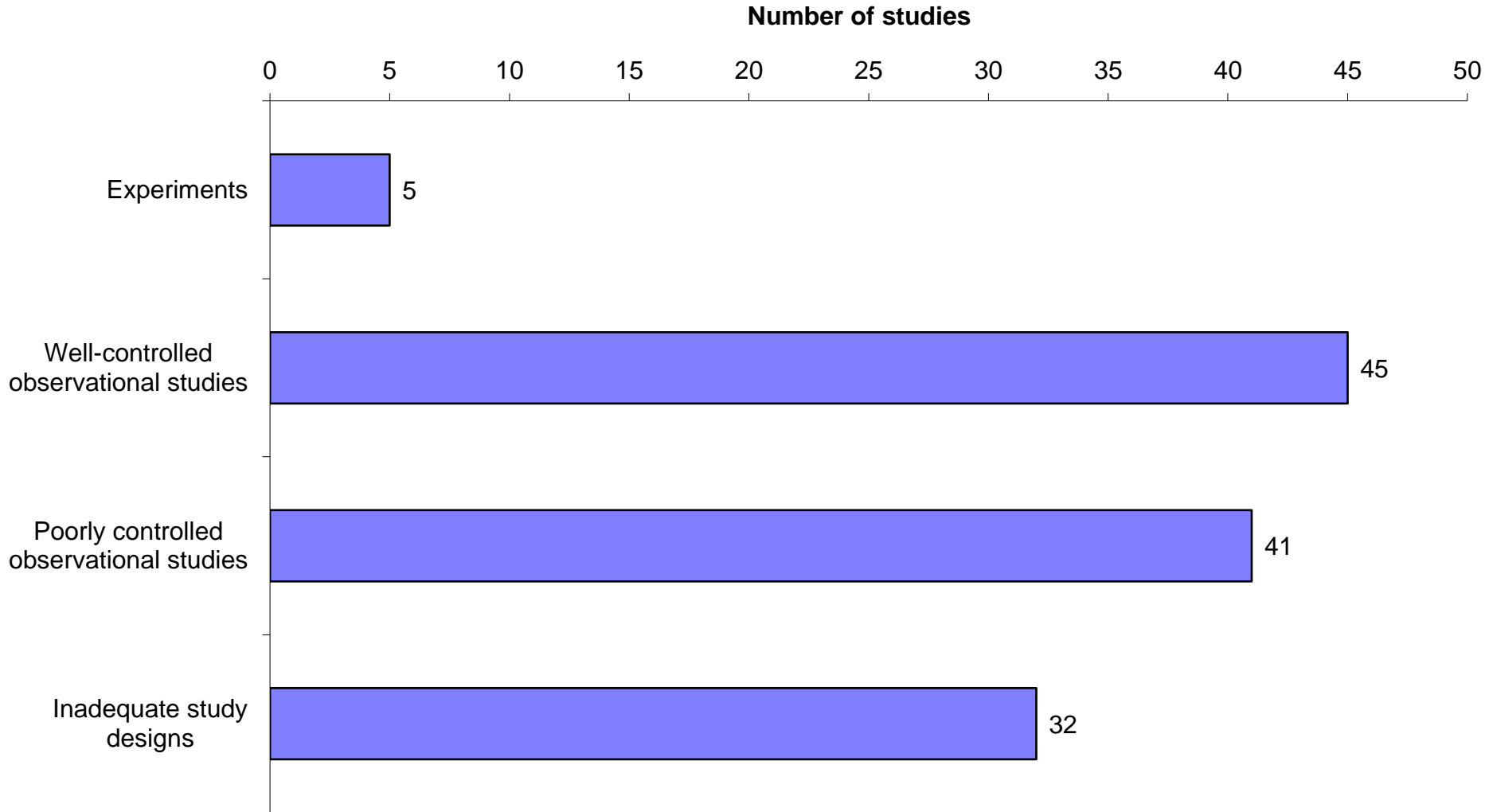
# What is valid knowledge?

- Knowledge is valid if we cannot give reasons for doubting its truth
- We cannot claim to know the truth
- We can only claim that we do not (for the moment) have reasons to believe that a study did not find the truth
- Knowledge is valid if it approximates the truth
- To judge validity, we need to specify what we mean by validity and what influences it

# The validity framework of Shadish, Cook and Campbell

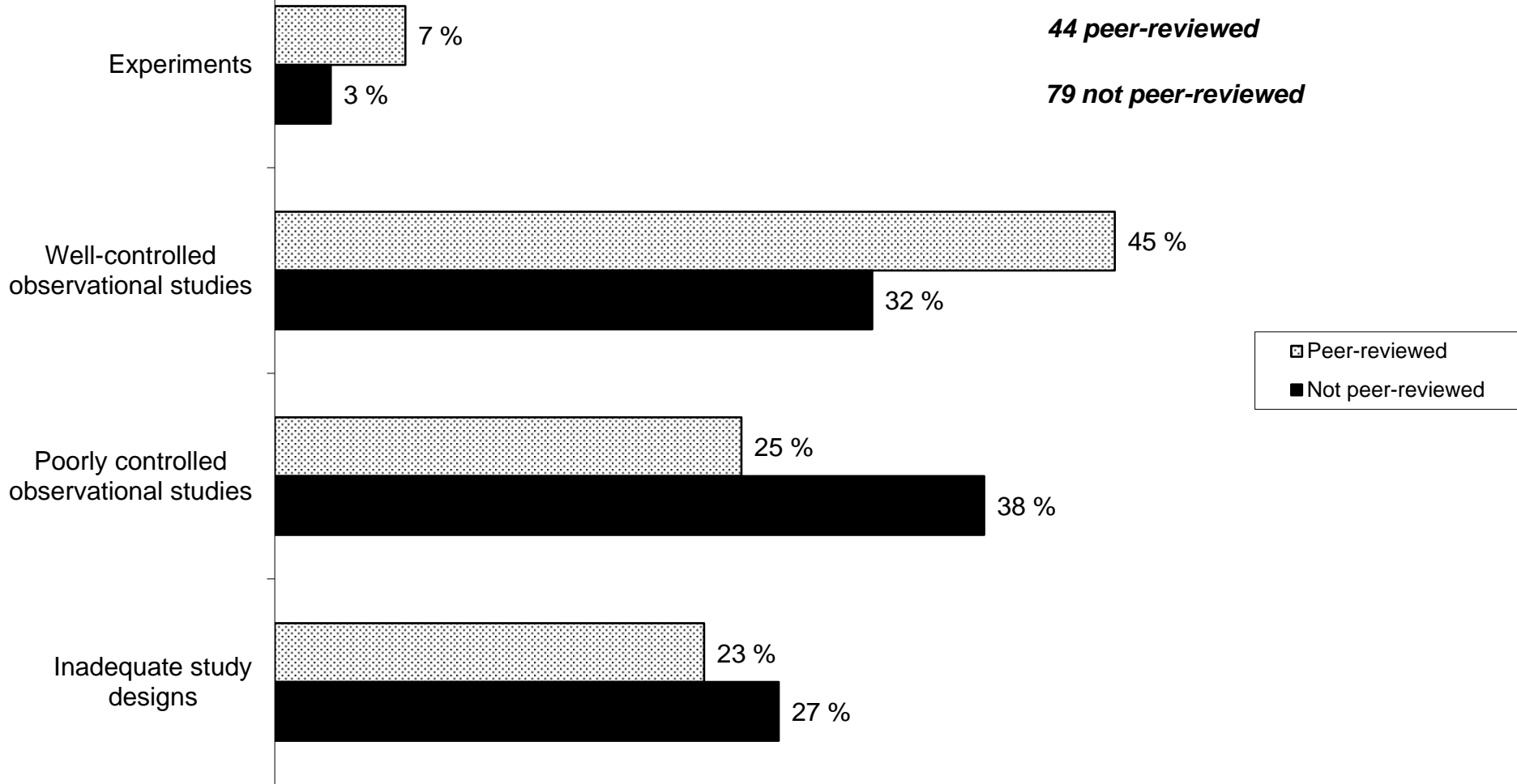
- Four types of validity:
  - *Statistical conclusion validity*
  - *Construct (theoretical) validity*
  - *Internal validity*
  - *External validity*
- This typology can be applied to road safety studies
- The most valid knowledge is gained from randomised, controlled trials (experiments) performed in large samples
- Any other method is considerably less valid

# 123 road safety evaluation studies according to design



# Percentage of evaluation studies

0 % 10 % 20 % 30 % 40 % 50 %



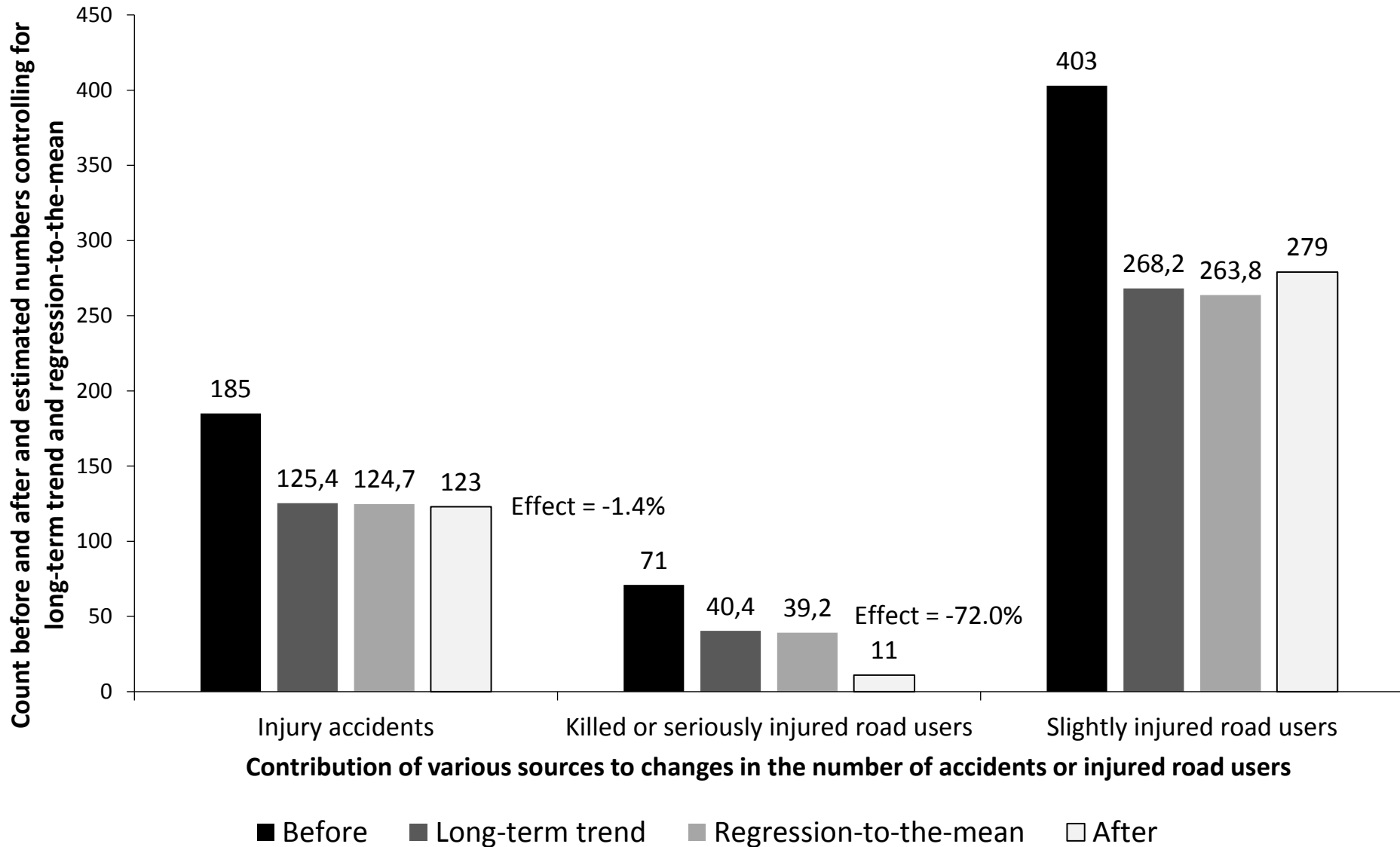
# Our dilemma in a nutshell

- What we tell policymakers:
- ***We strongly recommend that you base your policy on the best available scientific evidence***
- What we ought to add:
- ***But we must warn you that most of this evidence should not be trusted***

# Is there a way out of the dilemma?

- It will never be the case that all, or even most, road safety evaluation studies are experimental
- Observational studies will continue to dominate
- We should trust observational before-after studies that control for at least well-known confounding factors
- We should trust well-controlled case-control studies
- We should even trust a set of poorly controlled studies if their findings as a whole «make sense»
- A single poorly controlled study should not be trusted

# Factors contributing to changes in road safety - new motorway





# Making sense of poor studies – the case of road lighting

- The most common study design:

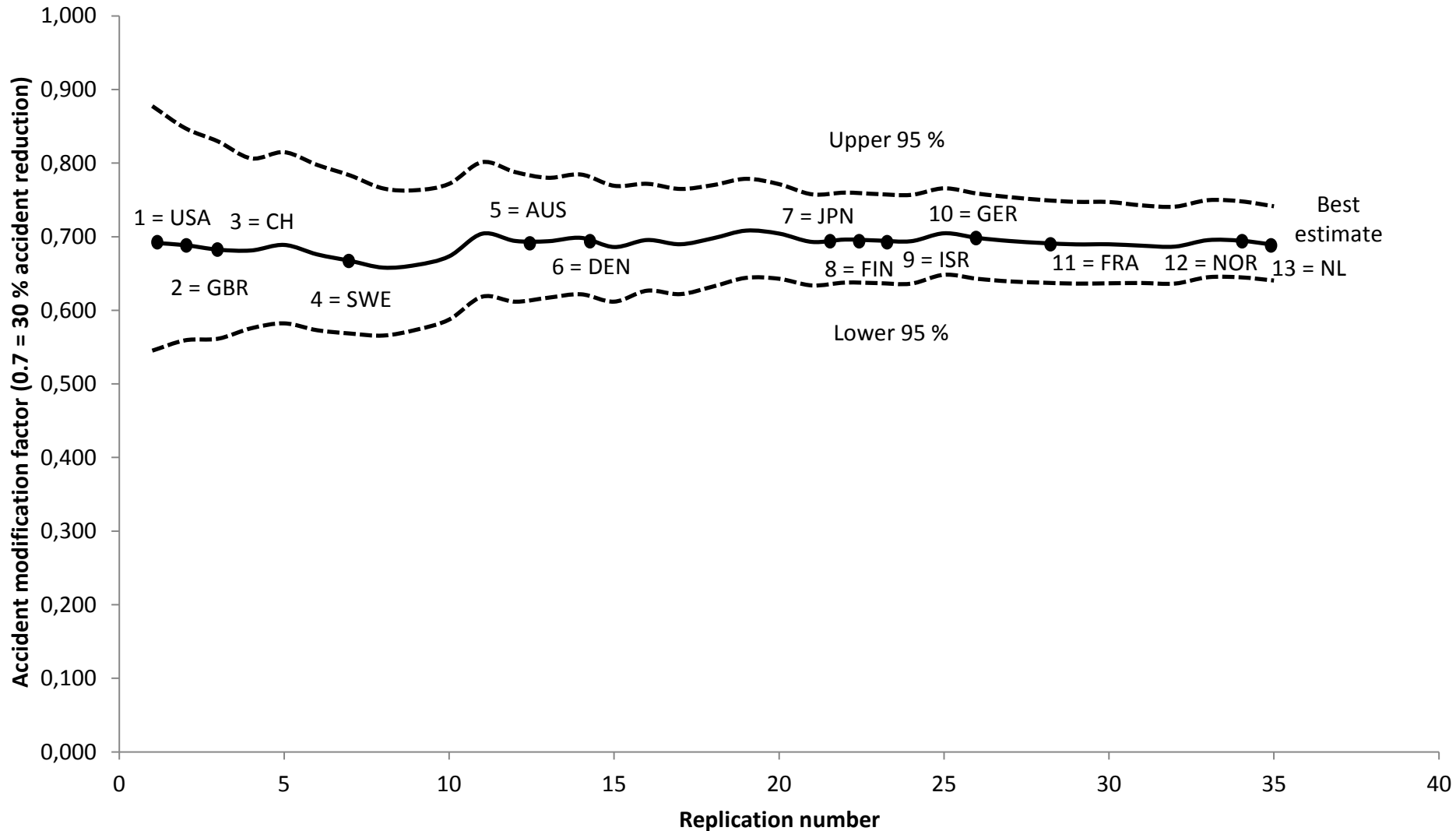
Condition	Before	After	Total
Darkness	40	25	65
Daylight	80	75	155
Total	120	100	220

- Odds ratio estimate of effect =  $(25/40)/(75/80) = 0.667$
- There is no control for:
  - *Long-term trends*
  - *Regression-to-the-mean*
  - *Changes in traffic volume*

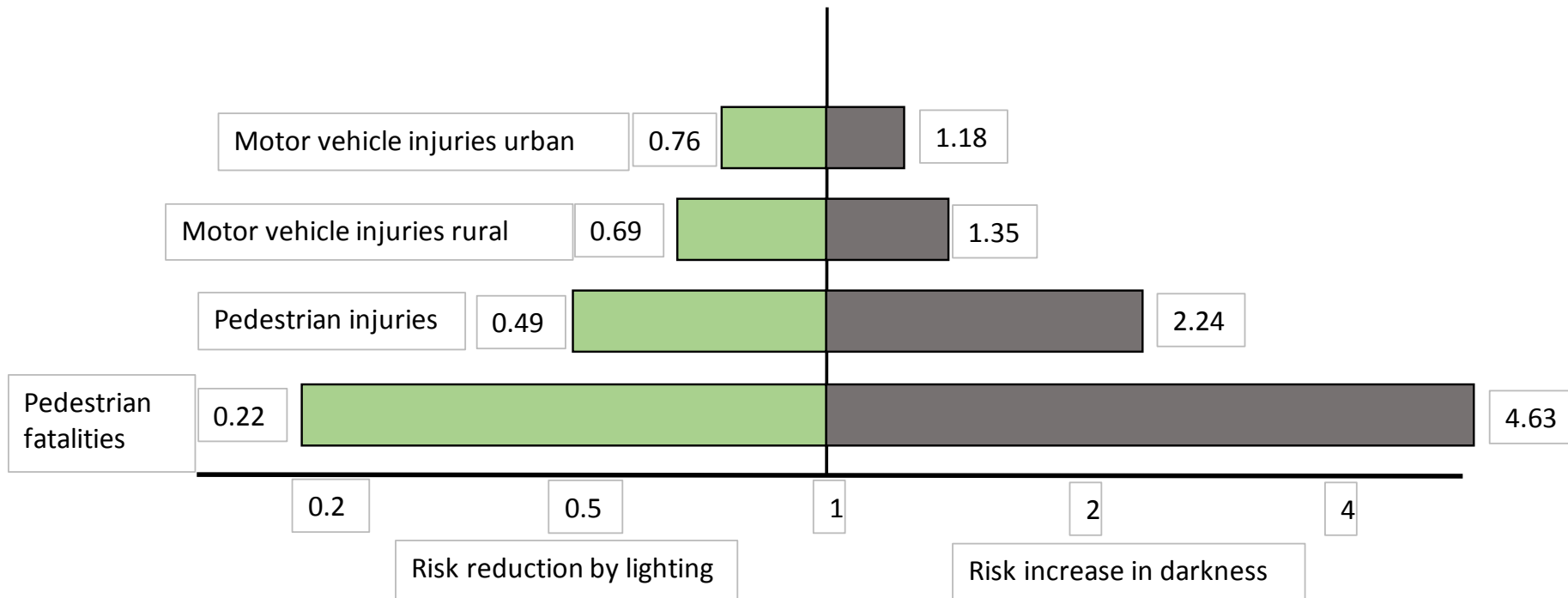
# The whole set of studies of road lighting makes sense

- Darkness is a universal risk factor; one would therefore expect the results of evaluation studies to be consistent over time and between countries
- One would expect a smaller effect in urban areas, where there are many sources of artificial lighting, than in the countryside
- One would expect a larger effect on fatal crashes than on less serious crashes
  
- Meta-analysis can be used to test these hypotheses

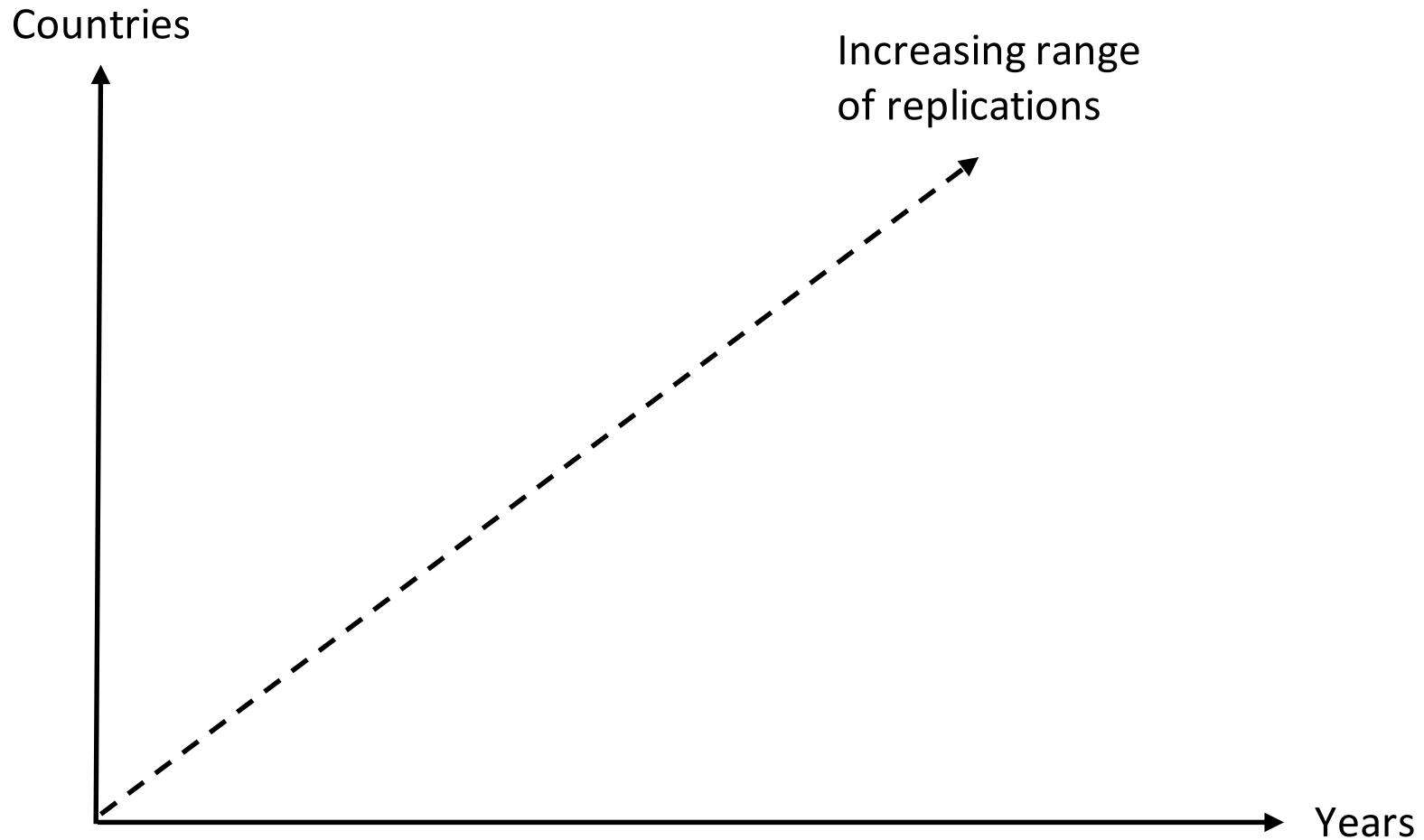
# The effects of road lighting are the same in all countries where they have been evaluated



# Relationship of effects to risks



# The range of replications



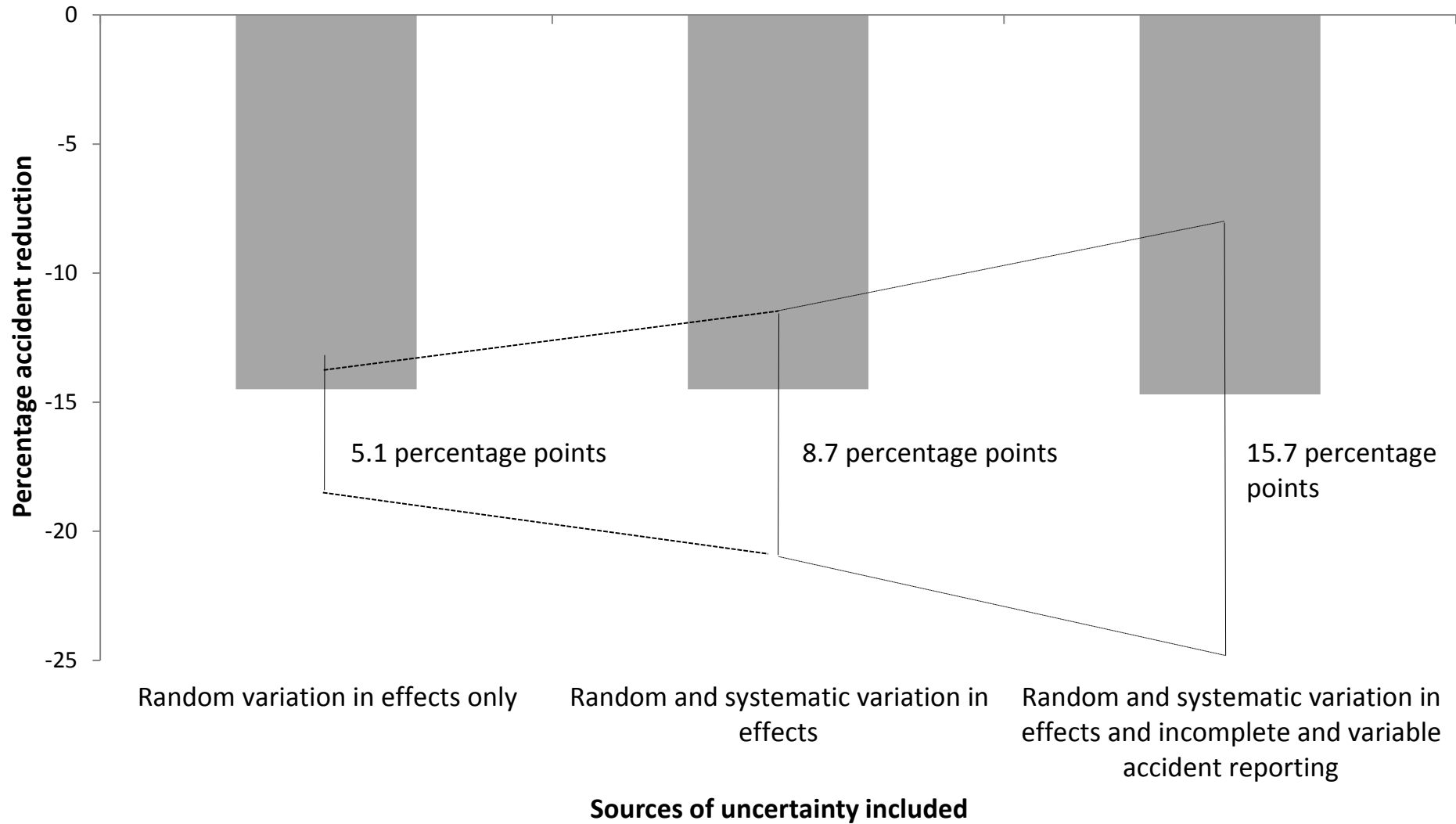
# Consistent and theoretically plausible evidence

- Is available for a number of important risk factors and road safety measures:
  - *Road lighting*
  - *Roundabouts*
  - *Guardrails*
  - *Seat belts*
  - *Motor cycle helmets*
  - *Speed and speed limits*
- In all these cases the effects are plausible by reference to the laws of physics
- How about road safety measures primarily targeting the human factor?

# Measures targeting human factors

- There are randomised controlled trials consistently showing that driver training is ineffective
- I believe this is a theoretically plausible finding
- The literature on campaigns is a mess – lots of poor studies
- Attempts to make sense of these studies have, I think, been unsuccessful
- Enforcement? It is probably effective in many cases

# Contribution of three sources of uncertainty to summary estimates of effect of traffic calming on injury accidents





# Can pitfalls be avoided?

- We can do before-after studies that control for long-term trends and regression-to-the-mean
- Case-control studies are notoriously prone to confounding, but should be trusted if their findings are theoretically plausible
- Incomplete reporting of crashes or injuries is a potentially important source of bias and imprecision which it is difficult to control for
- But that problem should have a technical solution that should be implemented