Yes, When Will We Ever Learn? Exemplars of Strategies for Causal Attribution in Evaluation

Evaluation Cafe
The Evaluation Center
University of Western Michigan
25 April 2007

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CIRCLE at RMIT University, Australia
Overview

1. The story so far - and why we need exemplars
2. Exemplars supporting the need for more rigorous impact evaluation
   - Carrots
   - Ambulances
3. Exemplars raising concerns about RCTs
   - Parachutes
   - Plants
   - Comprehensive Child Development Program
4. Exemplars outlining alternative strategies
   - John Snow
   - Lung cancer
   - Sudden Infant Death Syndrome
   - New York crime rate
5. Learning lessons from exemplars
One way of summarising the story so far...

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Exemplars supporting the need for more rigorous impact evaluation

- Carrots
- Ambulances
CARROTS

FACT: 95%* of people who die have recently eaten carrots

ERRONEOUS CONCLUSION: Carrots are fatally dangerous

CORRECT CONCLUSION: Most people have recently eaten carrots and they are rarely related to death

*(actually this is a made up statistic)*
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LESSON FOR EVALUATION: Need comparison with those not receiving intervention or not having that outcome

(* actually this is a made up statistic)
FACT: Patients who had travelled further in an ambulance were more likely to die

ERRONEOUS CONCLUSION: Lengthy transport is dangerous

CORRECT CONCLUSION: High-risk patients are more likely to be taken to centralised facilities not local ones
FACT: Patients who had travelled further in an ambulance were more likely to die.

ERRONEOUS CONCLUSION: Lengthy transport is dangerous.

CORRECT CONCLUSION: High-risk patients are more likely to be taken to centralised facilities not local ones.

LESSON FOR EVALUATION: Need to consider systematic differences between the two groups.
Exemplars raising issues about RCTs

- Parachutes
- Plants
- Comprehensive Child Development Program
FACT: A systematic review was unable to find any randomised controlled trials of parachute intervention.

ERRONEOUS CONCLUSION: Parachute use should be discontinued until evidence from RCTs supports their use.

Smith and Pell (2003)
SUGGESTED CONCLUSION:
“Advocates of evidence based medicine have criticised the adoption of interventions evaluated by using only observational data. We think that everyone might benefit if the most radical protagonists of evidence based medicine organised and participated in a double blind, randomised, placebo controlled, crossover trial of the parachute.”

LESSON FOR EVALUATION: Lack of RCT evidence does not constitute lack of credible evidence

Smith and Pell (2003)
FACT: If plants are randomly assigned to a treatment providing daily water, or to a control that receives none, and both groups are placed in a dark cupboard, the treatment group does not have better outcomes than the control.

ERRONEOUS CONCLUSION: Watering plants is ineffective in making them grow.

CORRECT CONCLUSION: Plants need water AND light.

LESSON FOR EVALUATION: Need to pay attention to the whole causal package needed to produce the outcomes.
FACT: Families in the program improved their level of functioning in terms of intermediate and final outcomes (following program theory)

SPURIOUS CONCLUSION: Program was effective

St Pierre et al 1996, St Pierre and Rossi 2006
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ANOTHER FACT: Families which were randomly assigned to the control group improved by an equivalent amount

CONCLUSION: No evidence that the program was effective

POSSIBLE LESSON: Only an RCT can provide evidence of causal attribution

St Pierre et al 1996, St Pierre and Rossi 2006
COMPREHENSIVE CHILD DEVELOPMENT PROGRAM

FACT: Families in the program improved their level of functioning in terms of intermediate and final outcomes (following program theory)

SPURIOUS CONCLUSION: Program was effective

ANOTHER FACT: Families which were randomly assigned to the control group improved by an equivalent amount

CONCLUSION: No evidence that the program was effective

POSSIBLE LESSON: Only an RCT can provide evidence of causal attribution

ANOTHER FACT: Many control group families were able to obtain services on their own (‘contamination’)

CONCLUSION: The evaluation was not effective

POSSIBLE LESSON: Need to randomly assign groups individuals

St Pierre et al 1996, St Pierre and Rossi 2006
FACT: “One of the 21 sites in the study had statistically significant and moderately large positive effects in several different outcome domains: children’s cognitive development; families’ employment, income, and use of federal benefits; and parenting attitude. No single factor can be pointed to as ‘the reason’ why CCDP was more effective on Site #2 than on other sites. The circumstances and context of Site #2 were probably unique, and certainly acted in concert to produce positive effects”.

CONCLUSION: No conclusion was possible

POSSIBLE LESSON: Success may not be due to a single factor. When something is working very well, we should try harder to learn from it

St Pierre et al 1996,
Limitations of RCTs

- False negatives - when an RCT evaluation wrongly concludes that an intervention doesn’t work.
- False positives - when an RCT evaluation wrongly concludes that an intervention does work.
- Negative impact of the evaluation process itself
False negatives in RCTs

- Concluding there is no credible evidence of effectiveness when RCTs are not possible.
- The intervention by itself may not be sufficient to cause the outcomes, but also need the contribution of other interventions and/or favourable circumstances.
- The intervention may not be the only way to achieve the outcome – meaning that when the outcomes for those receiving the intervention are compared to those who did nor receive it there is little evident difference.
- Failing to detect inadequacies in implementation which are by themselves enough to prevent the outcomes from being achieved.
- Failing to identify sub-groups or particular cases which have succeeded.
False positives in RCTs

- Corruption of evaluation findings because of self-interest
- Mis-interpretation of statistically significant findings
- Knowing that they are receiving the intervention changes the way participants, staff and others behave, leading to positive outcomes that will not be sustained when the research component is removed
- Lack of external validity - inability to reproduce the favorable implementation environment of the experimental trial
An alternative approach

- List of Possible Causes (LOPC)
- General Elimination Methodology

Scriven (2007)
Mayne’s Contribution Analysis: Addressing Attribution with Performance Measures

- Acknowledge the problem
- Present the logic of the program.
- Identify and document behavioural changes.
- Use discriminating indicators.
- Track performance over time.
- Discuss, and test alternative explanations.
- Gather additional relevant evidence.
- Gather multiple lines of evidence.
- When required, defer to the need for an evaluation.

Mayne (2001)
Exemplars demonstrating an alternative to RCTs

- John Snow
- Lung cancer
- SIDS (Sudden Infant Death Syndrome)
- New York crime
Exemplar 1: John Snow

- The problem
  Four cholera pandemics in London in the 1800s
  14,600 deaths in London (6.2 per 1,000)

- Alternative theories as to cause
  - Airborne spread of disease
  - Waterborne spread of disease

Koch (2004)
Analysis

Cholera deaths in Soho mapped

“It might be noticed that the deaths are most numerous near to the pump in Broad Street”. 
From Koch (2004)
Looking for exceptions

- Deaths in streets nearer to the Rupert Street pump
  - “some streets which are nearer to it on the map are in fact a good way removed on account of the circuitous road to it”.

Looking for exceptions

- Few deaths in the workhouse near the Broad Street pump:
  - Surrounded by houses with cholera deaths but only 5/535 inmates died from cholera
  - Had its own pump well on the premises and “the inmates never sent to Broad Street for water”
Looking for exceptions

- Few deaths among workers at the brewery near the epicentre of cholera deaths
  - No cholera among 70 workers
  - Had its own private deep well on-site
  - Workers never drank from the Broad Street pump
Looking for exceptions

- Deaths of 4 school children who did not live near the Broad Street pump
  - Drank from the pump on their way to school

- Deaths of 2 adults living further away
  - One temporarily living in Broad Street
  - One nursing a dying friend from Broad Street
Learning from the exemplar

- Search for exceptions and seek to explain them
Exemplar 2: Lung cancer

- The problem
  - From 1900 increase in numbers dying of lung cancer

- Methods
  - Retrospective studies
  - Prospective studies
  - Animal studies
Looking for exceptions

- Not everyone who gets lung cancer has smoked

Some of these have been affected by second-hand smoke – a different causal path caused by smoking
Looking for exceptions

- Not everyone who smokes gets lung cancer

Theory of cancer initiator and promoter – many things can initiate cancer but smoke is a major promoter.

If lung cancer has begun, smoking will promote it.
If lung cancer has not begun, smoking may not have an effect.

LESSON FOR EVALUATION: Pay attention to the causal package.
<table>
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<th>What the tobacco industry was saying publicly:</th>
<th>What the health authorities were saying:</th>
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<td>‘At the best, the probabilities are that some combination of constituents of smoke will be found conducive to the onset of cancer or to create an environment in which cancer is more likely to occur.’ 1963.</td>
<td>‘The smoking of tobacco continues to be one of the subjects requiring study in the lung cancer problem, as do many other agents and influences in modern living. Science does not yet know enough about any suspected factors to judge whether they may operate alone, whether they may operate in conjunction with others, or whether they may affect or be affected by factors of whose existence science is not yet aware.’ 1967.</td>
<td>Surgeon General: ‘Cigarette smoking is causally related to lung cancer in men: the magnitude of the effect of cigarette smoking far outweighs all other factors. The data for women, though less extensive point in the same direction.’ ‘Cigarette smoking is a significant factor in the causation of cancer of the larynx (and) an association exists between cigarette smoking and cancer of the urinary bladder in men.’ 1964.</td>
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<td>‘Carbon monoxide will become increasingly regarded as a serious health hazard for smokers . . . Additional evidence of smoke-dose related incidence of some diseases associated with smoking has been published. But generally this has long ceased to be an area for scientific controversy.’ 1978.</td>
<td>‘. . . we believe there is sound evidence to conclude that the statement ‘cigarettes cause cancer’ is not a statement of fact but merely an hypotheses.’ 1971.</td>
<td>Surgeon General: ‘Tobacco use is associated with increased risk of coronary heart disease; stroke; aortic aneurism; peripheral vascular disease; chronic obstructive broncho-pulmonary disease; cancers of the lung, lip, larynx, oral cavity, oesophagus, urinary bladder, and pancreas; and gastrointestinal disorders such as peptic ulcer disease . . . In addition, maternal smoking during pregnancy retards foetal growth.’ 1972.</td>
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<td>‘Cigarette smoking has not been scientifically established to be a cause of chronic diseases, such as cancer, cardiovascular disease, or emphysema. Nor has it been shown to affect pregnancy outcome adversely.’ 1983.</td>
<td>Surgeon General ‘Smoking is responsible for more than one of every six deaths in the United States. Smoking remains the single most important preventable cause of death in our society.’ 1989.</td>
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**LESSON FOR EVALUATION:** Pay attention to the incentives for discrediting evidence of impact
Exemplar 3: Sudden Infant Death Syndrome

- The problem
  Unexplained death of babies
  In the US and in Australia SIDS was the main cause of death among infants for most of the 1990s.

- Methods
  Review of epidemiological data
  Review of individual cases
  Development of alternative hypotheses
  Investigation of evidence
  Development of guidelines for practice in the light of incomplete evidence
At least 19 retrospective case-control studies demonstrated a higher risk of SIDS when infants slept prone, with odds ratios ranging from 1.2 to 14.1. Overall the studies showed a threefold or greater increased risk of SIDS when babies slept prone.

Public Health Association of Australia (1999/2005)
An increased risk of SIDS when babies are exposed to cigarette smoke has been found in over 30 case-control and cohort studies. This finding is consistent over time and place. Many studies have reported a dose-response relationship.
Guidelines for practice

- Avoid maternal smoking
- Lie the baby to sleep on its back
- Avoid over-heating
FACT: In Australia, rates were higher in winter.
POSSIBLE EXPLANATION: Linked to winter respiratory diseases.

ANOTHER FACT: Rates were not higher in winter in Sweden – which has colder winters

ANOTHER FACT: A review of cases found a large number who had been put to bed fully dressed or with additional bedding

POSSIBLE EXPLANATION: In under-heated houses, parents over-dressed their children. Over-heating seemed to be a risk factor.

RECOMMENDATION FOR PRACTICE: Avoid overheating: The infant should be lightly clothed for sleep, and the bedroom temperature should be kept comfortable for a lightly clothed adult. Overbundling should be avoided, and the infant should not feel hot to the touch.
SIDS rates in Australia

Rate per 100,000 live births

Note: ICD-9 code 798.0 (1991 to 1996) and ICD-10 code R95 (1997 to 2000).
Source: AIHW Mortality Database [Table A8.1].

Figure 8.1: SIDS rates for infants, 1991-00
SIDS rates in Sweden

Risk reducing campaign, spring 1992

Alm et al 2001
LESSONS FOR EVALUATION: Less than perfect information can be useful
Exemplar 4: New York crime rate

FACT: Crime rates fell

Homicide: Police-recorded crime rate per 1,000 population in New York City

Langdon and Durose 2004
### POSSIBLE EXPLANATIONS:

<table>
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<th>Expected Outcome</th>
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<td>New approach to policing – zero tolerance and CompStat</td>
<td>Would expect decline to follow implementation in 2004, and not be present in other cities</td>
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<td>Increased number of police</td>
<td>Would expect decline to follow increased police from 1991</td>
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<td>Ageing of the population – fewer young men</td>
<td>Would expect a gradual decline as population aged</td>
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<td>Improved access to community colleges</td>
<td>Would expect a decline linked to the time of introduction</td>
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<td>Wider access to abortions from 1973</td>
<td>Would expect decline to have started earlier in states which introduced this earlier, and to be greater in states with high abortion rates</td>
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“Over a five year period, New York experienced a precipitous drop in the burglary rate (53%) a 54% drop in reported robberies, and an incredible 67% drop in the murder rate. ... These extraordinary achievements were realized in large part due to the department’s innovative model of police management, known as CompStat.”

(O’Connell, 2001, p.8) (Quoted in Kusek and Rist, 2004, p. 141)
What we can learn from these exemplars
Strategies for impact evaluation of programs to address:

- Obesity and related diseases?
- Climate change?
- World poverty?
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Byard et al. SIDS rates and risk campaigns [electronic response to Goldwater PN; Sudden infant death syndrome: a critical review of approaches to research] archdischild 2004
http://adc.bmjournals.com/cgi/eletters/archdischild;88/12/1095#593


Levitt and Dubner (2005) Freakonomics.


St Pierre and Rossi 2006. Early Childhood Programs Randomize Groups, Not Individuals: A Strategy for Improving Early Childhood Programs Evaluation Review; 30; 656