

SCOTTISH GOVERNMENT SOCIAL RESEARCH GROUP

SOCIAL SCIENCE METHODS SERIES

Guide 3: Natural experiments

What are 'natural experiments'?

Natural experiments are observational studies which can be undertaken to assess the outcomes and impacts of policy interventions. They are often possible where there is a divergence in law, policy or practice between nations, regions or other political, jurisdictional or social units. It is commonly a situation which can be exploited by researchers to help answer a research question, rather than one which researchers have designed or influenced themselves.

So, unlike 'experiments' such as randomised controlled trials (RCTS), or quasi-experimental design studies, researchers do not have the ability to assign participants to 'treatment' and 'control' groups. Rather, divergences in law, policy or practice can offer the opportunity to analyse populations like they had been part of an experiment. In essence, one population has received an intervention, while the other hasn't. The validity of such studies depend on the premise that the assignment of subjects to the "treatment" and "control" groups is random or "as if" random.

In practice, of course, the situation is often complex and the researcher must seek to determine the degree of randomness which may be assumed and any factors that may introduce bias. As with other quasi-experimental designs, natural experiments will never *unequivocally* determine causation because the researcher cannot exert control over the situation. However, they provide a useful and important inferential tool and may provide help with a research question that may not be obtainable in any other way, perhaps due to practical or ethical considerations. They are most common, to date, in public health, behavioural economics and education. But there is scope to use natural experiments across many policy areas.

Natural experiments and devolved government

Devolved government within the UK potentially results in policy divergence across a wide range of policy areas. The Devolution in Practice work (led by ippr) does much to compare policy development and design across the constituents of the UK, and to encourage policy learning. Increasingly devolution may also offer increasing opportunities to use natural experiments to explore the effectiveness or outcomes of a range of policy interventions. In some cases there may be policy divergence, with no plans for further expansion or roll out across the UK; in other cases the introduction of policy interventions may be 'staggered' still allowing a window of opportunity for this type of study. There are also some longer standing divergences in policy across the UK which began well before devolution which may also be ripe for this kind of study.

Very simplistically, for example:

- In Scotland, the introduction of free personal social care and free tuition fees
- In England, an increase in the school leaving age to 17 (and fundamental differences in education provision)
- In Wales the introduction of free prescription charges
- In London, the congestion charge

Some argue that there should be scope to develop more 'experimentation' (including natural experiments) into policy development and implementation (see for example Lodge and Kalitowski 2007)

Guide 3: Natural experiments

What are the advantages and disadvantages of natural experiments?

The advantages

- They can be a pragmatic, cost-effective research design if data are already be available for analysis in national data sources.
- They can provide an opportunity to answer research questions that it may not be possible to address in any other way (particularly given the ethical and practical constraints of 'randomisation').
- They may identify effective interventions to improve social, educational and health equalities and provide a useful tool for policy evaluation

The disadvantages

- It is difficult to draw clear casual inferences. Natural experiments are observational studies, not true experiments; the researcher has little (if any) control over the social conditions of the experiment
- The process by which subjects are assigned to the "treatment" or "control" groups is rarely truly random and many extraneous factors may influence the selection. Subjects may even self-select in ways that are unobserved or unmeasured but are correlated with the outcome of interest
- There may be baseline differences in health, social or other prognostic factors between the two groups
- The "boundaries" of geographical and social populations may be difficult to define and may change and overlap in unpredictable ways

Examples of natural experiments

There are currently no published examples of natural experiments by the Scottish Government, but a good number from elsewhere in the UK, and internationally. Three examples are described below:

Example 1: The effects of daylight saving on road traffic accidents in the United States

A study of the effects of daylight saving on road traffic accidents was undertaken in the United States. The authors use 28 years (1976-2003) of road accident data involving a fatality, and exploited a *natural experiment* arising from a 1986 change in legislation. Daylight saving was known to be beneficial in terms of saving energy, but there was less evidence of its effects on accidents. In essence, this change in legislation changed the time when states switched to daylight saving. The authors were able to identify the short run and long run effects of daylight saving on automobile crashes. The findings suggest that daylight saving had no significant detrimental effect on crashes in the short run; and indeed it significantly reduced road traffic accidents in the long run.

Sood and Ghosh (2007). Daylight Saving Time and Fatal Automobile Crashes. B.E Journal of economic analysis and policy 7:1 www.bepress.com/bejeap/vol7/iss1/art11

Example 2: The effectiveness of needle-exchange programmes for prevention of HIV infection

The effectiveness of needle exchange programmes in preventing HIV infection was assessed by drawing on published and unpublished data of seroprevalence among injecting drug users across 81 cities in the United States in the late 80s and early 90s. In addition, further information on the implementation of needle exchange programmes were obtained in these cities. This clearly varied. The results showed that, on average, seroprevalence increased by 6% annually in the 52 cities *without* needle exchange programmes implemented, compared to a 6% decrease annually, on average, in cities with active needle exchange programmes. This study highlighted the potential importance of needle exchanges as a harm reduction measure – the authors describe this as 'plausible explanation' based on their results and the 'clear theoretical mechanisms', despite the possibility of confounding.

Hurley SF, Jolley DJ, Kaldor JM. The effectiveness of needle-exchange programmes for prevention of HIV infection. Lancet, 1997 Jun 21;349(9068):1797-800

<http://www.ncbi.nlm.nih.gov/pubmed/9269214?dopt=Abstract>

Guide 3: Natural experiments

Example 3: The effects of a local law banning smoking in public places on hospital admissions for acute myocardial infarction This study is based in Helena, Montana which is a geographically isolated community with one hospital serving a population of 68 140. The authors examined whether legislation that required no smoking in workplaces and public places was associated with a decline in hospital admissions for acute myocardial infarction. Helena was the 'intervention and areas outside Helena was the 'control' (further information in the paper). In essence, the number of admissions monthly for people living in Helena fell significantly in the 6 months the law was in force. This was a small scale study – but the authors do suggest that legislation to enforce smoke free public environments may be associated with an effect on morbidity from heart disease.

Sargent RP, Shepard RM, Glantz SA, Reduced incidence of admissions for myocardial infarction associated with public smoking ban: before and after study., British Medical Journal, volume 328 pp. 977-980, 2004
<http://www.bmj.com/cgi/content/full/328/7446/977?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&fulltext=Sargent&searchid=1&FIRSTINDEX=10&fdate=1/1/1994&tdate=8/31/2008&resourcetype=HWCIT>

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Thad Dunning, Department of Political Science, University of California, Berkeley. Improving Causal Inference: Strengths and Limitations of Natural Experiments, (2005)
http://www.allacademic.com//meta/p_mla_apa_research_citation/0/4/1/9/6/pages41968/p41968-1.php

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Emilia Del Bono, Fernando Galindo-Rueda (2006) The Long Term Impacts of Compulsory Schooling: Evidence from a Natural Experiment in School Leaving Dates. Institute for Social and Economic Research
<http://www.iser.essex.ac.uk/pubs/workpaps/pdf/2006-44.pdf>

Michael, J (2006) Using Natural Experiments to analyze the impact of state legislation on the incidence of abortion, <http://www.heritage.org/Research/Family/cda06-01.cfm>

Poverty and Child Mental Health: Natural Experiments and Social Causation (2003) Journal of the American Medical Association 2003 - 290 - 15 – 2063

Gill Wyness. The impact of student finance policy on higher education participation – natural experiments- Current Research?, DQSQ <http://doctoralschool.ioe.ac.uk/conference/viewabstract.php?id=166&cf=3>

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